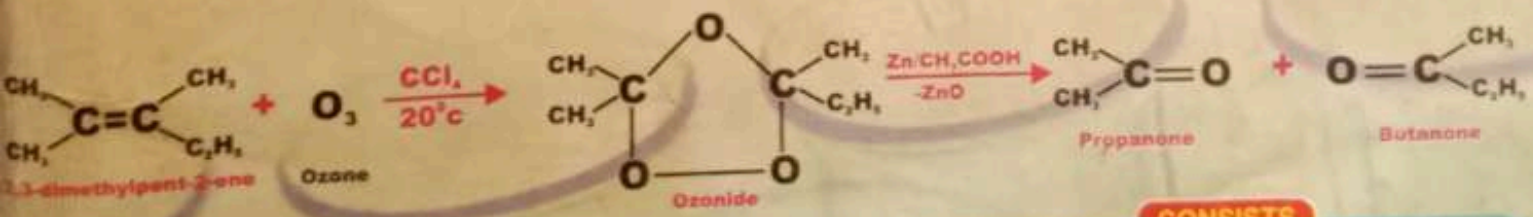
ONE TIME SUCCESS

in

OAU PRE-DEGREE PROGRAMME EXAMINATION

Organic Chemistry



SAMSON A. AKOMIRE

CONSISTS

- *Solution to Mid-Contact test 2003 - Till date*
- *Solution to Contact Exam 2003 - Till date*
- *Solution to Tutorial Organic Question Set 1-76*
- *Solution to Inorganic Tutorial Question 1-39*
- *Solution to OAU Part One Organic Question*
- *Solution to UME Organic Question 1978 - Till date*
- *Useful Hints to undeniable success*

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(i) One of our students move from 39F to 98A in further Mathematics in only one term of coaching. He became the best Chemistry student in Osun State Olepiad Chemistry competition and second best student in Nigeria. He also won the award for the best Chemistry and further mathematics student in his school.

(ii) 2005/2006 Pre-degree Session, we coached the overall best student

(iii) 2006/2007 Pre-degree Session, we coached the 2nd best student

(iv) 2009/2010 Pre-degree Session, we recorded 100% success etc

We are master of one thing: to bring out the genius in you; and we are known for one thing: to make you an excellent student. We are capable in bring out the genius in you, please give us a chance to help you realize your dreamed course in obafemi Awolowo University,Ile-Ife Osun State.

Our price is affordable because you mean so much to us. We are expecting you!

For more information; please call

Samson A. Akomire on 07063474749

TO MY DEAREST PREDITES

Beloved Predites, I understand all you are passing through-the stress, the study, financial constraints and the failure you have experienced in some of your subjects. I want you to know that all these are not enough to throw away your golden dream of becoming a Doctor, Engineer, Pharmacist etc. Your dream cannot be truncated by anybody except you. This is the reason I want you to stay focus with eagerness and enthusiasm to realize your dream. All will be fine with you, I believe with firmness.

I am grieved by the failure experienced by majority of you in the recent test or examination. This is not because something is wrong with your brain, but because you lacked basic information in your various subjects. This basic information is what I intended giving you in my series. "ONE TIME SUCCESS IN OAU PRE-DEGREE EXAMINATION." Beloved, I have toiled night and day to make this series available. It has caused me so much energy but what is that compared to the love I have for you all.

I do not really put much blame on you for the failure experienced in your recent test or examination but I hold you responsible for your future. It is because success and failure are both choices. It is what you choose, you experienced. But permit me to say this: you are experiencing failure because you despised knowledge. This is because you handle the volume one of the ONE TIME SUCCESS IN OAU PRE-DEGREE CHEMISTRY with loose hand, negligence and nonchalant attitude. Once bitten twice shy! To prevent affliction from rising the second time, you need to get a copy each of volume one and two of "One Time Success in OAU pre-degree Chemistry." Sit down with them and digest them. Then, your success will shine forth.

In the Pre-degree programme, you need to be exposed to a higher level of knowledge if you must shine. This is because at this level your ignorance will not be excused. It is believed at the O'Level, that acidified solution of Na_2CrO_7 or $KMnO_4$ oxidizes primary Alkanol to Alkanoic acid. Put in reality, while acidified solution of $KMnO_4$ oxidize primary Alkanol to Alkanoic acid, only warm acidified solution of Na_2CrO_7 will oxidize primary Alkanol to Alkanoic acid. But cold acidified solution of Na_2CrO_7 will oxidize primary Alkanol to Alkanal. This is the more reason you need to be guided, don't be presumptuous.

Dearest predates your success is of paramount concern to me. Hence, I implore you to handle this 2nd edition of **One Time Success** with high regard as it shows you with unusual clarity the high-way to excellence in your test or exam. The knock against most students is not the talent but the tools. Indeed, the talent and the tool must tally. Hence, I have provided you with the tools.

Beloved, you were not born to merely exist and become an object of circumstance but to live in your uniqueness. I know there is a plane you were born to fill in history and something you were born to do in which nobody can do. Therefore, put all excuses and reasons why you cannot realize your goal aside. Sit with determination and earnestness to take your place in your dream course at the Obafemi Awolowo University. I want you to know success is not in the University but in the students power is not in the library but in the individual. You have extraordinary potentials to emerge as an icon of excellence. I believe so much in you.

Your Friend,

Akomire, A. Samson

For counseling and advice call: 07063474749

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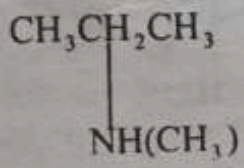
CHAPTER ONE

OBAFEMI AWOLOWO UNIVERSITY
2003/2004.PRE-DEGREPROGRAMME
Mid-Term Test Chemistry 1hr.

1a. Write down the IUPAC name for each of the following.

i. $CH_3C(CH_3)_2CH_3$

ii



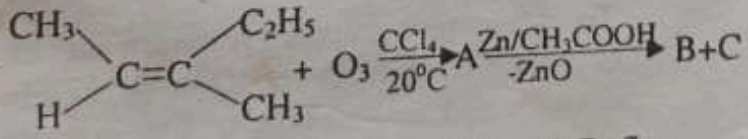
bi. Draw the graphic structure for the following compound. Show all the bond angles $CH_3CH = CH–C \equiv CH$

ii. How many pie (π) and sigma (σ) bonds are present in the molecule shown in (b) above

ci. Draw a well labeled, workable diagram for the laboratory preparation of fairly pure ethyne

ii. Give the necessary equation for the reaction.

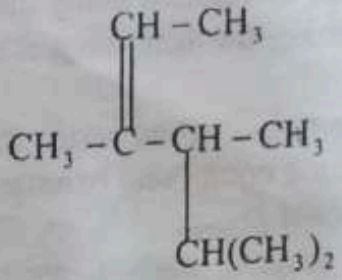
d. Identify the lettered compounds in the following reaction.



e. i. What is a basic oxide? (ii) Define a hard water (iii) List two advantages and two disadvantages of hard water.

2a. 2.50g of an organic compound containing carbon, hydrogen and oxygen yielded 4.79g of carbon (iv) oxide and 2.93g of steam when burnt in excess oxygen. Determine the empirical formula of the compound.

b. Give the IUPAC name for:



c. But-l-yne is bubbled into dilute H_2SO_4 in the presence of $HgSO_4$ at 60^0C write an equation for the reaction taking place.

d. Supply the structure of the lettered compounds

$$CH_3COCH_3 \xrightarrow[10\text{-}15^0C]{KCN/H_2SO_4} X$$

ei. Account for how the two types of hard water are come by in nature. Back up your answer with equation where necessary.

ii. List two methods, each of which will remove any form of hardness.

3a. What weight of bromine will saturate 5.2g of but-3-ene-l-yne
[C=12; O=16; H=1; Br=80]

b. Give the structures and names of all the possible dichloropropanes. Give the name of any of the isomers that (i) will give only one trichloro product (ii) is optically active. Draw the optical isomers.

c. Draw the structures of the following compounds and then criticize the names:
(i) 1,3,4-tribromobenzene (ii) 2-ethylbutane (iii) 7-bromo-5-chloro-3-methyloctane

d. Write equations for the steps involved in the industrial preparation of hydrogen by the action of steam on coke.

e. Of what uses are addition of (i) Alum (ii) Chlorine (iii) Fluorine and (iv) Iodine in the treatment of water for town-water supply.

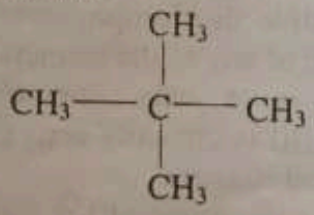
SOLUTION TO 2003/2004 MID-CONTACT TEST

1a. To name an organic compound using the IUPAC nomenclature, the following are the steps.

- Determine the homologous series in which the organic compound belongs using it functional group.
- Choose the longest carbon atom containing the functional group.
- Number the carbon atoms along the longest carbon chain containing the functional group such that the lowest numbering is given to each branch chain (for the Alkanes) or functional groups (for the other homologous series).
- The substituent or branch chain must be arranged in alphabetical order with comma separating numbers and a hyphen separating numbers and words.
- There must not be space between the name of the last branch chain or substituent group and the parent.

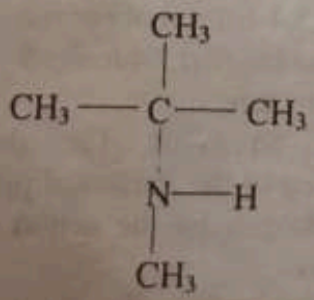
Note that a – CH_3 group in a bracket is a branch chain.

i.



2, 2-dimenthylpropane

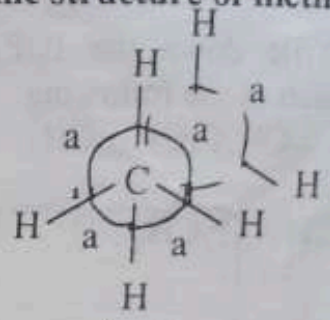
ii.



N-methyl-2-aminopropane

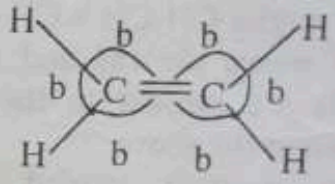
1b. (i) The graphic structure of an organic compound is a structures that shows the configuration or arrangement of atoms of the organic compound in space. Thus indicate the bond angles of the compounds. The graphic structure of methane, ethane and ethyne are shown below.

Graphic structure of methane



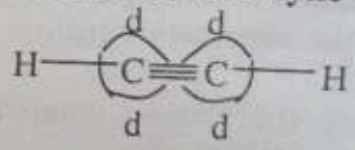
Bond angle (a) = $109^0\ 28^1$ or 109.47^0

Graphic structure of Ethene



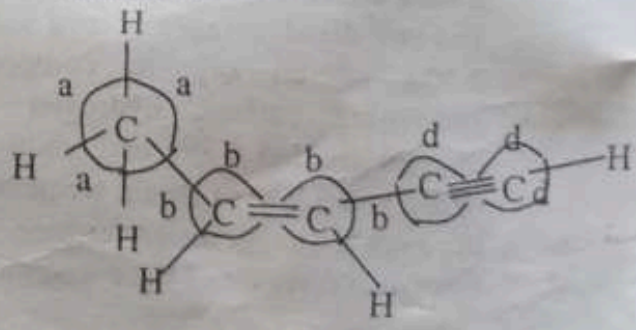
Bond angle (b) = 120^0

Graphic structure of Ethyne



Bond angle(d) = 180^0

To draw the graphic structure of an organic compound containing single double and triple bonds, the graphic structure of methane, ethane and ethyne are combined.



Bond angles (a) = $109^0\ 28^1$ or 109.47^0, (b) = 120^0, (d) = 180^0

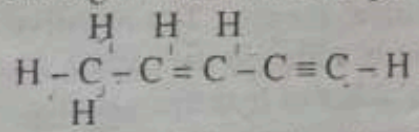
ii. **A sigma bond** is a bond that is involved in the formation of a new compound i.e.

it is not broken **during** the formation of a new compound. Sigma bonds are form by

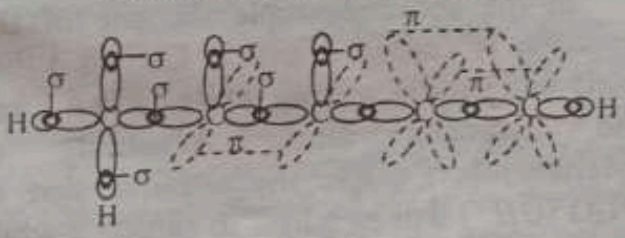
- Hybrid – Hybrid orbital
- Hybrid – S orbital
- Hybrid – P orbital
- P – P orbital linearly oriented

A pie bond is a bond that is not involving in the formation of a new compound i.e. it is broken during the formation of a new compound. Pie bonds are form by P-P orbitals that are laterally oriented.

Generally, all single bonds are sigma bond. But in a multiple bond (i.e. double or triple) only one of the bond is a sigma while the remaining are pie bond, i.e. in a double bond, there is one sigma and one pie bond. But in a triple bond, there is one sigma bond and two pie bonds.



Number of sigma bonds = 10
Number of pie bonds = 3
These bonds are show below.



σ→ Sigma bonds
π→ Pie bonds

Note that sigma bond is stronger than pie bond.

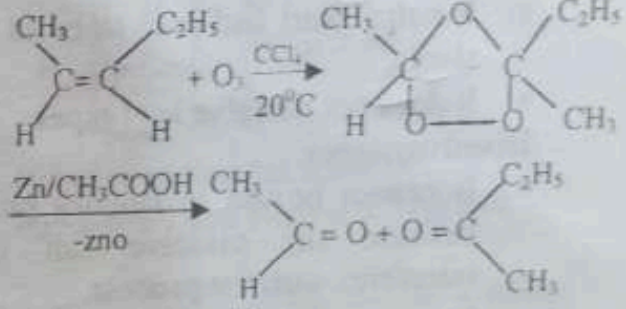
C(i)Please refer to any readable Chemistry textbook for the diagram of preparation of fairly pure ethyne

ii. The necessary equation for the laboratory preparation of ethyne is:

$CaC_2 + 2H_2O \rightarrow Ca(OH)_2 + C_2H_{2(g)}$

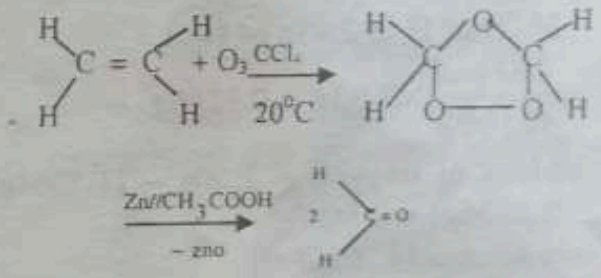
The impurity, phosphine (PH_3) is absorbed by washing the product with acidified $CuSO_4$ solution.

d. **Ozonolysis** is the addition of ozone followed by hydrolysis. In a three letter words Ozonolysis is defined as ozonization and hydrolysis.



A is ozonide
B is ethanal
C is butanone

If Ozonolysis gives only one product it means that the alkene is symmetry i.e. it can be divided into two equal halves or it is cyclic containing only one double bond. Examples are green below



Note that the presence of the Zn prevents the formation of hydrogen peroxide (H_2O_2) which may initial the polymeriza tion of the Alkanal or Alkanone formed.

e(i) Basic oxides are oxide of metal which reacts with an acid to produce salt and water only; if it is soluble in water it forms an alkaline solution e.g.

$CaO_{(s)} + 2HCl_{(aq)} \rightarrow CaCl_{2(aq)} + H_2O_{(l)}$
$CaO_{(s)} + H_2O_{(l)} \rightarrow Ca(OH)_{2(aq)}$

ii. **Hard water** is water which will not readily form later with soap.

iii. **Advantage of hard water**

- It taste better due to the dissolve minerals in it
- It helps animal to build strong bone due to the calcium it contain.
- It helps snail and crab to build their shells.
- It does not dissolve lead pipes

Disadvantages

- It cannot be use in laundry process because the dissolve salt in it interferes with the process.
- It causes furrowing of kettle.
- It waste soap when use in watching.

2a. Mass of organic compound (analyte) = 2.50g

Mass of Co_2 formed = 4.79g

Mass of H_2O formed = 2.93g

Mass of C in 4.79g of CO_2=

$$\frac{12g/mol}{44glmol} \times 4.79g = 1.3064g$$

Mass of H in 2.93g of H_2O =

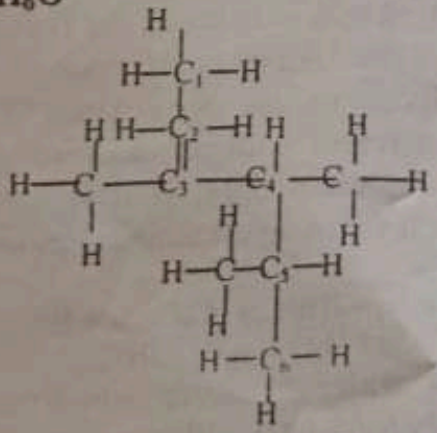
$$\frac{2g/mol}{18glmol} \times 2.93g = 0.3256g$$

Mass of oxygen = 2.50g – (1.3064g + 0.3256g) = 0.8680g

C	H	O
1.3064	0.3256	0.8680
12	1	16
0.1089	0.3256	0.0543
2.0075	5.9963	1

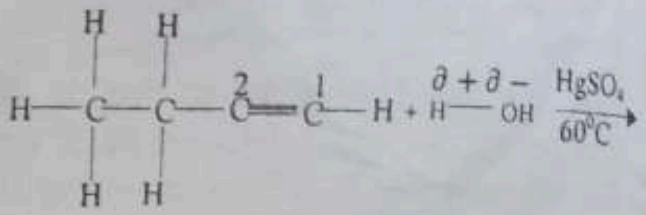
Empirical formula of compound = C_2H_6O

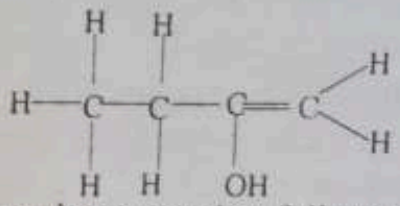
2b.



3, 4, 5-trimethylhex-2-ene

c. When Alkynes is made to react with dilute H_2SO_4 in the presence of $HgSO_4$ as a catalyst at 60^0C, an enol is formed. Enol is an organic compound which contain a double dond and –OH group as functional groups.



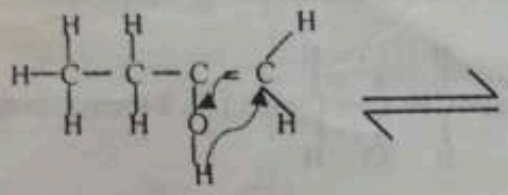


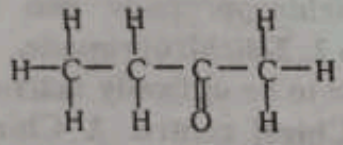
The above reaction follows Markownikoff's rule. **Markownikoff's rule** state that in an addition reaction between unsymmetrical unsaturated organic compound and unsymmetrical reagent. The negative part of the reagent is added to the carbon atom with the least number of hydrogen atoms.

An unsymmetrical molecule is a molecule that cannot be divided into two equal parts.

In the above example the site of the reaction is carbon 1 and 2. Carbon 1 has only one hydrogen atom while carbon 2 has no hydrogen atom. According to Markownikoff's rule the negative part of H_2O (OH^-) will be added to carbon 2 while the positive part of H_2O (H^+) will be added to carbon 1 to form a compound called **ENOL. Enols** are classes of organic compounds which **contain the –OH group and the double bond as their functional group.**

Enols are unstable compounds, they re-arrange to form carbonyl compound (i.e. Alkanal or Alkanone). The rule is that the hydrogen in the –OH group moves away to the next carbon atom bearing the double bond and the double moves to the oxygen atom.

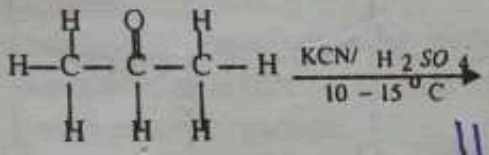


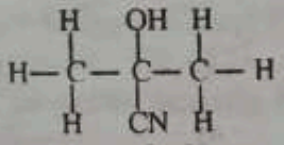


butanone

Generally, if the **–OH group** is attached to the first carbon atom then **Alkanal** will be the final product but if not, **Alkanone** will be the final product.

d.





2-cyanopropan-2-oL

$X \rightarrow$ 2-cyanopropan – 2 – oL

e(i) Water acquires temporary hardness when it dissolves **limestone [$CaCO_3$]** from the soil over which it flows. Limestone is sparingly soluble in water. However **dissolved CO_2** in the water reacts with **$CaCO_3$** to form **soluble $Ca(HCO_3)_2$** as show below;

$CaCO_3 + CO_2 + H_2O \rightarrow Ca(HCO_3)_2$

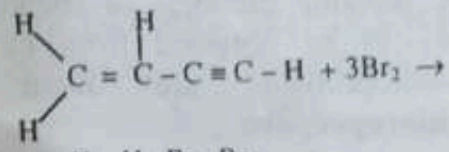
$Ca(HCO_3)_2$ is the main causes of temporary hardness.

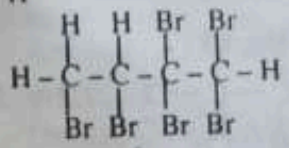
Water acquires **permanent hardness** when it dissolved gypsum **$CaSO_4.2H_2O$** or **$MgSO_4$** from the soil over which it flows.

(ii)

- ion – exchange resin
- addition of Na_2CO_3
- Distillation

3a.





Relative molecular mass of but-3-ene-l yne [C_4H_4] = 52g/mol

$$\cap C_4H_4 = \frac{\text{Reacting mass}}{\text{molar mass}} = \frac{5.2g}{52g/mol} = 0.1\,mol$$

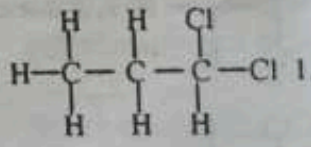
$$\cap Br_2 = \frac{3\,\text{mole of Bromine}}{1\,\text{mole of but - 3 - ene - lyne}} \times$$

0.1 mol of but - 3 - ene - l - yne = 0.3mol

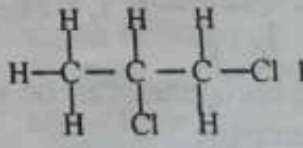
$$\cap Br_2 = \frac{\text{Reacting mass } [MBr_2]}{\text{molar mass (M)}}$$

$mBr_2 = \cap Br_2 \times M = 0.3mol \times 160g/mol = 48g$

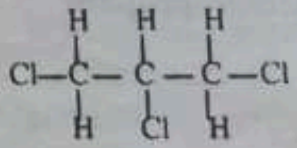
3b.(i) The possible structures of dichloropropanes are shown below:



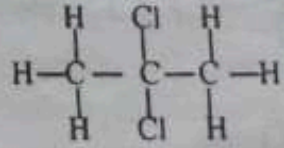
1, 1-dichloropropane



1, 2-dichloropropane

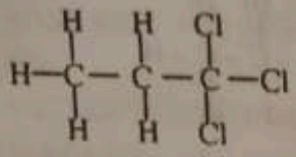


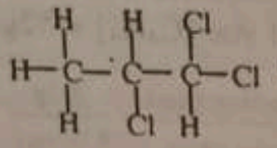
1, 3-dichloropropane

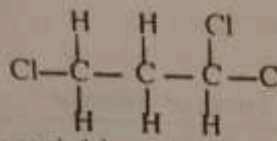


2, 2-dichloropropane

The possible numbers of trichloropropane that can be obtained from each of the dichloropropane are **from 1, 1-dichloropropane**

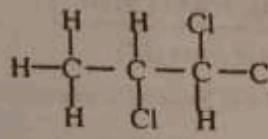

1, 1, 1-trichloropropane

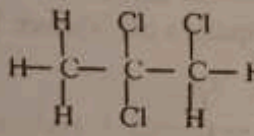

1, 1, 2-trichloropropane

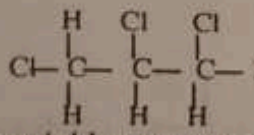

1, 1, 3-trichloropropane

Three trichloropropanes can be obtain from 1,1-dichloropropane.

From 1,2-dichloropropane

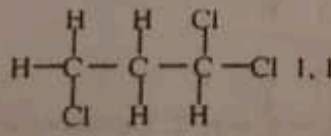

1, 1, 2-trichloropropane

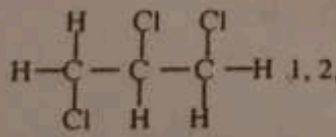

1, 2, 2-trichloropropane


1, 2, 3-trichloropropane

Three trichloropropanes can be obtain from 1,2-dichloropropane

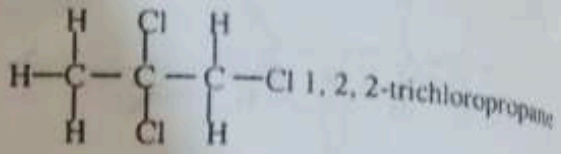
From 1, 3-dichloropropane


1, 1, 3-trichloropropane


1, 2, 3-trichloropropane

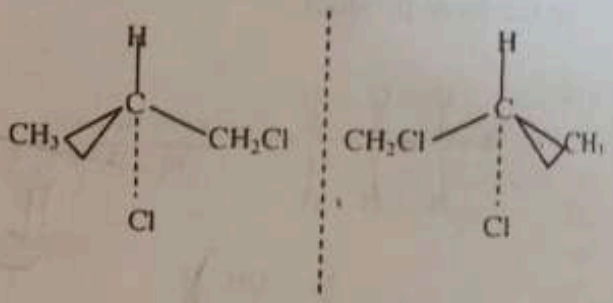
Only two trichloropropane can be obtained from 1,3-dichlropropane

From 2, 2-dichloropropane

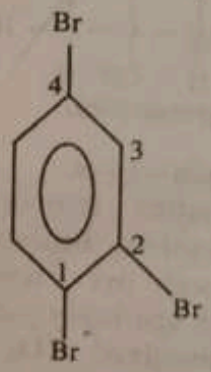

1, 2, 2-trichloropropane

Only one trichloropropane can be obtained from 2, 2-dichlropropane.

(ii). For a molecule to be optically active it must have a **Chiral centre. A Chiral centre is a carbon atom with four different group attach to it** e.g. 1,2-dichloropropane.



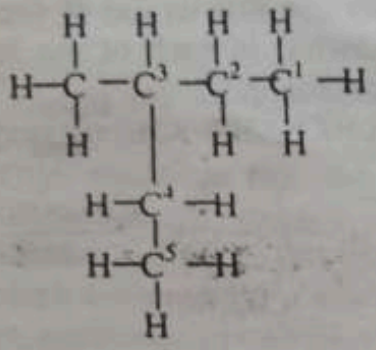
3c.



The correct name should be 1,2,4-tribromobenzene.

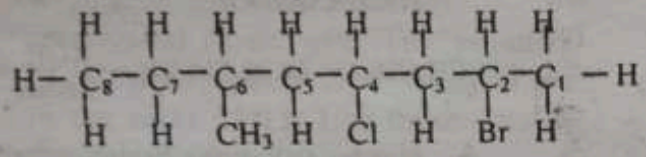
This is because the carbon chain should be number such that the **lowest numbering is give to the side chain.**

ii.



The correct name is: **3-methylpentane**

iii.



The correct name is: **2-bromo-4-chloro-6-methylactane.**

3d. The industrial preparation of hydrogen by the action of steam on coke is known as Bosch process/reaction.

$$H_2O_{(g)} + C_{(s)} \rightarrow CO_{(g)} + H_{2(g)}$$

$$H_2O_{(g)} + CO_{(s)} \rightarrow CO_{2(g)} + H_{2(g)}$$

Under pressure the CO_2 formed is dissolved in water leaving behind pure hydrogen gas.

Note that a mixture of $CO_{(g)}$ and $H_{2(g)}$ is known as water gas.Therefore water gas is gas that contain CO and H_2 in the ratio of 1:1.Water gas is often confuse with synthesis gas.The reason is that both water gas and synthesis gas are made of CO and H_2.Synthesis gas is a gas that is made up of CO and H_2 in the ratio of 1:3

3e

(i.) Alum is used as a coagulant to coagulate flocs in water treatment.

(ii) Chlorine is use as a germicide to kill bacteria in water treatment

(iii) Fluorine is added to water to prevent tooth decay in water treatment

(iv) Iodine is added to water to prevent goitre in water treatment.

OBAFEMI AWOLOWO UNIVERSITY
PRE-DEGREE PROGRAMME
2003/2004 Second Term Examination
CHM 002

Instructions

a. Answer ALL the questions for 70 marks.

b. Do not OVER ANSWER a particular question at the expense of others. Write your full names with surname written first and underlined.

c. Write your exam. Number anywhere on the front cover of the exam booklet and underline it

d. Remember to start each questions on a fresh page. When you have finished answering a particular question, any unused portion of the page should be cancelled out.

e. On no account must you write your Entrance Exam Number.

Question

1a. A condenser has specific usages in the organic laboratory. With aid of diagrams involving condensers only distinguish between the different usages.

b. Write equation(s) for reactions which produce(s) hydrocarbon(s) by the action of water on metals carbides.

c. (i). Organic reactions are slow, why are they slow? (ii) Organic compounds are volatile, why are they volatile? (iii) What are the respective consequences of (i) and (ii) to the conduct of experiments involving organic compounds?

d. (i) Define hybridization as applied to carbon (ii) Draw a big structure for methylbenzene and show all bonds and atoms label the different sigma bonds as σ_a, σ_b etc. Distinguish the different types by identifying them as, for example, three σ_a – p orbital on C/s orbital on C.

e. An unknown organic compound gives steam white fumes with PCl_5 and also gives a positive Iodoform test. What functionality in the compound is responsible for the behaviours?

f. Draw the structure(s) of all tertiary amine(s) with molecular formula $C_4H_{11}N$ and name each by the IUPAC system.

g. Your mother asked you to fetch a bucket of water from the tap. You discovered that is was cloudily. You filtered but the cloudiness was not removed. What operation(s) would you perform to aid the production of clear water? Give the function of the operation performed.

h. The flow chart below represents the stages involved in the manufacture of H_2SO_4

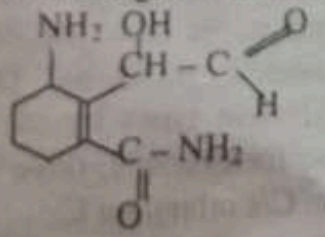
$$S + O_2 \xrightarrow[\text{stage I}]{} SO_2 \xrightarrow[\text{stage II}]{+X} SO_3 \xrightarrow[\text{stage III}]{+ c.H_2SO_4} Y \xrightarrow[\text{stage IV}]{+ H_2O} H_2SO_4$$

(i) Name the process represented by the chart (ii) Name reactant X and product Y (iii) Which stage requires catalyst and state the catalyst used. (iv) Give the reason why the SO_3 produced in stage II is not directly dissolved in water to form acid. What happens if it is done?

i. Write an equation for the reaction between hydrogen sulphide and sulphur (iv) oxide.

j. To a clear solution is added aqueous barium trioxonitrate (v) to produce a white precipitate. What do you conclude from this observation?

2a. Name any FOUR functional groups present in the given molecule



b. Draw the structure(s) of the organic product(s) in each of the following reactions:

i. $CH_3CH_2CH(Br)CH_3 \xrightarrow[\text{heat}]{\text{alcoholic KOH}}$

ii. $CH_3CH_2-C(OH)(CH_2CHCH_3)-CHO \xrightarrow[\text{heat}]{K_2Cr_2O_7/H_2SO_4}$

iii. $(CH_3CH_2COO)_2Ca \xrightarrow[400^oC]{\text{Dry distill}}$

iv. $CH_3CH_2OOCCH_2CH_2CH_3 \xrightarrow[\text{Reflux}]{KOH}$

ci. A given organic hydrocarbon L decolorizes bromine in CCl_4. what does this tell you about?

ii. One mole of L is saturated by one mode of hydrogen. What further deduction can you make concerning L?

iii. Ozonolysis of L produces propanal and 3-methylpentan-2-one. Deduce the structure of L.

iv. Give the IUPAC name for L.

di. Draw a clearly, well labeled diagram for the laboratory preparation of dry, pure sample of Chlorine.

ii. Write equation(s) to show the reaction of chlorine with cold dilute NaOH and hot concentrated NaOH.

iii. Write equation(s)/ representation(s) to show the bleaching action of chlorine.

3a.i Draw the structure of the simplest amino acid and name it by the IUPAC system.

ii. Deduce the formation of a dipeptide from two molecules of the amino acid in (a) and indicate what you consider as the peptide linkage.

b.i. With the aid of equation, show how ethanol can be obtained from starch indicating all the necessary conditions.

ii. Mention, the process by which purer ethanol can be obtained from (b) (i) above.

iii. How can you obtain absolute ethanol form (b) (ii).

c. Write equations for the complete combustion in oxygen of (i) an Alkanes and (ii) an Alkynes, each of which contains "X" carbon atoms in its molecule. (ii) equal volumes of the two hydrocarbons in (i) and (ii) were separately completely combusted in oxygen. The volumes of oxygen respectively consumed are in the ratio 13:11. Use these data to determine the value of x.

Note: All volumes were determined at the same temperature and pressure.

d. List TWO ways by which water pollution may take place.

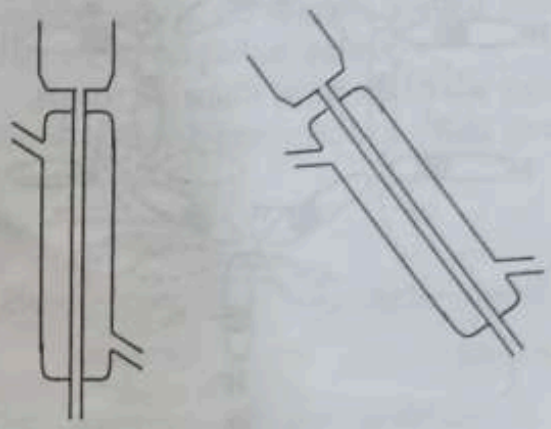
e. With the aid of balanced or unbalanced equations ONLY, indicate the processes of ozone layer depletion.

Note: You can write full discussions if you so wish, but it will waste your time.

f. List the products of destructive distillation of coal.

SOLUTION
2003/2004 EXAMS

1. Condensers are only used for the purpose of condensation. **However in organic chemistry the position of the condenser defines its use and classifies them into groups**. But the major positions of condensers are either **vertical** (for reflux, that is condenser in vertical position) or **slant** (lebig condenser for cooling vapour to liquid)



Reflux condenser Labig condenser used for cooling

1b. $CaC_2 + 2H_2O \rightarrow Ca(OH)_2 + C_2H_2$
Ethyne

$AL_4C_3 + 12H_2O \rightarrow 4AL(OH)_3 + 3CH_4$
methane

1c.i. It is because of the **reluctance in breaking carbon to carboncovalent bond.**

ii. It is because of the separate molecules of organic compounds are **joined together by weak intermolecular force such as van der waal forces.**

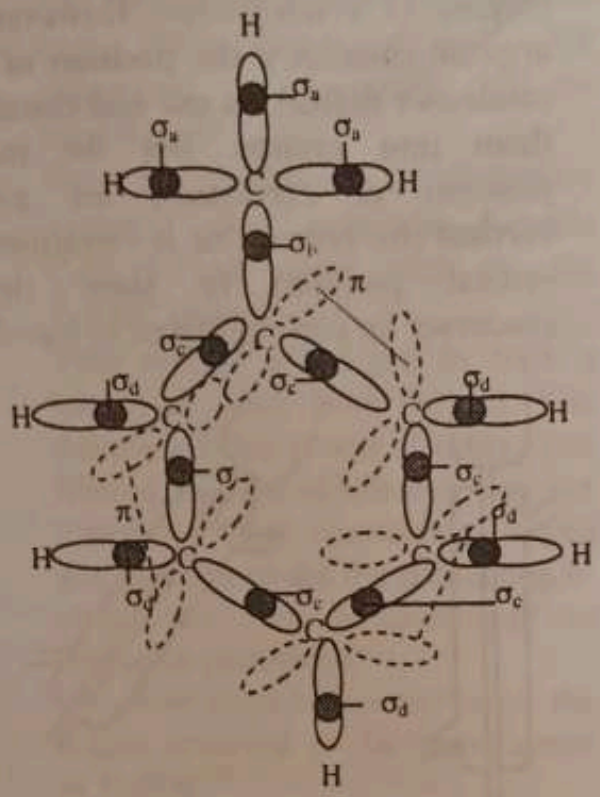
Implications

iiia

- Organic reactions are carried out under high temperature or reflux in the presence of catalyst.
- Organic compounds have low boiling points.

1d. Hybridization, as applied to carbon is the blending or mixing of the 2s and

2p-orbitals of carbon to form new sets of orbitals known as the hybrid orbitals or equivalent orbitals.



$\sigma_a \rightarrow$ sigma bond form between sp^3-s orbitals

$\sigma_b \rightarrow$ sigma bond formed between sp^3-sp^2 orbitals

$\sigma_c \rightarrow$ sigma bond formed between sp^2-sp^2 orbitals

$\sigma_d \rightarrow$ sigma bond formed between sp^2-s orbitals

$\pi \rightarrow$ pie bonds.

1e. An organic compounds that give a steaming white fumes with **PCl_5 is either an Alkanol or Alkanoic acid**

$CH_3CH_2OH + PCl_5 \rightarrow CH_3CH_2Cl + POCl_3 + HCl$

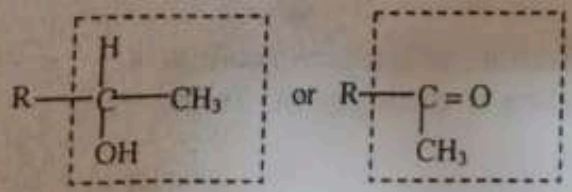
Steamy white fume

$CH_3COOH + PCl_5 \rightarrow CH_3COCl + POCl_3 + HCl$

Steamy white fume

The steamy white fume (SWF) is due to the **HCl liberated**

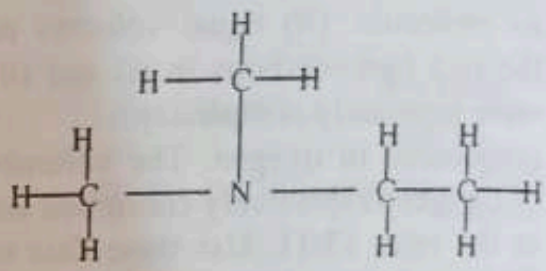
An organic compound that gives **a positive Iodoform test** contains the functionality.



Where R is an Hydrogen atom, Alkyl group(C_nH_{2n+1}) or Aryl group (Aromatic ring)

Therefore the organic compound in question is an **Alkanol and the functionality in the compound is –OH**.

1f.



N, N-dimethylammoethene

1g. The cloudiness of the water shows that it contain suspended particles and ions. Addition of alum will cause coagulation of the suspended particle which then settles done. However passing the water through an ion-exchanging resin will remove any suspensions of ions form.

The process employ in removing the cloudiness form the water is **coagulation followed by passing the water through the ion exchanging resin**.

h(i). **Contact process**

(ii). **$X \rightarrow O_2$ (oxygen)**

$Y \rightarrow H_2S_2O_7$ (Oleum)

(iii). Stage II. The catalyst used is V_2O_5

(iv). The reaction between SO_3 and H_2O is highly exothermic as a result when SO_3 is added to water, the heat evolve causes the H_2SO_4 formed to evaporate and form tiny droplet all over the factory, leading to pollution and acid rain which are harmful to plants and animals.

i. $2H_2S + SO_2 \rightarrow 2H_2O_{(L)} + 3S$

Note that both SO_2 and H_2S are reducing agent(also known as Reductant) but **H_2S is a stronger reducing agent than SO_2**.In the presence of a stronger reducing agant like H_2S,SO_2 will act as

an oxidizing agent(also known as Oxidant). Hence **SO_2 can act as a reducing agent as well as oxidizing agent.**

j. ions that form white precipitate with Ba^{2+} are CO_3^{2-}, SO_3^{2-}, SO_4^{2-} and S^{2-}. Hence the clear solution contains any of the following ions, CO_3^{2-}, SO_3^{2-}, SO_4^{2-} and S^{2-}.

To comfirm each of the ion, **HCl is added to the white precipitate form:**

(i) The liberation of CO_2, comfirm the presence of CO_3^{2-}

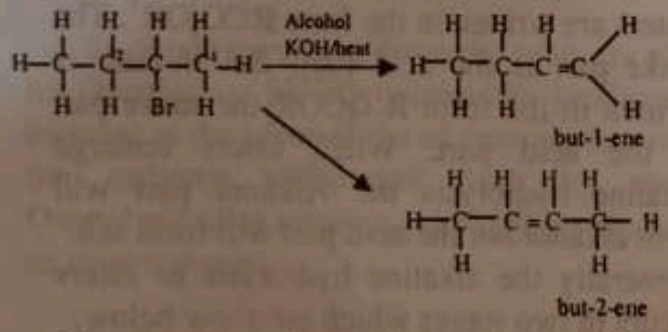
(ii) The liberation of SO_2, confirm the presence of SO_3^{2-}.

(iii) If no gas is liberated or no reaction occur, than SO_4^{2-} is present

(iv) The liberation of H_2S which smells like a rotten egg, comfirm the presence of S^{2-}

2a. i. Amine group (NH_2)
ii. Alkanal group (-CHO)
iii. Amide group (-$CONH_2$)
iv. Alkanol group (-OH)
v. Double bond
vi. Cyclic ring.

2b. (i)



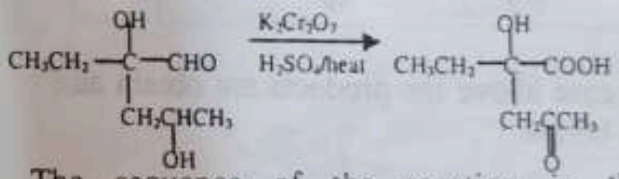
The reaction above gives two possible products. One major question to be answered is that which of the productsis the main product. This question is answered by **Saytzeff's empirical rule**. Before stating the rule, a brief illustration of the reaction will put lots of confusion to rest.

The above reaction involves the remove of **an halide (HBr, HCl, HI)** from an **alkyl halide.** The hydrogen atom in the HX (X = Br, I, Cl) can be loss in carbon 1 and carbon 2. If it loss in carbon 1, then the product will be but-1-ene but if it is loss in carbon 2 the product will be but-2-ene. Carbon 2 have the least number of hydrogen compare to carbon 1, hence it is called the **most alkylated carbon atom.**

Saytzeff's rule: State that if two or more alkene can be formed from the dehydrohalogenation of an alkyl halide or dehydration of alcohol, the alkenes that predominate is the alkene formed from the most alkylated carbon atom.

Hence the **main product in the example above is but-2-ene** while the side product **is but-1-ene.**

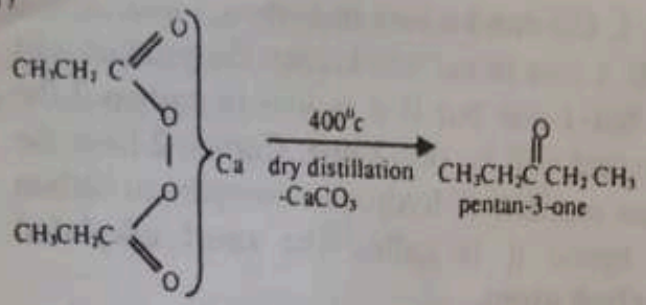
(ii)



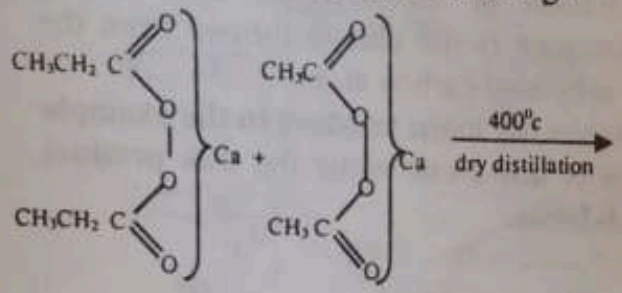
The sequence of the reaction is **that primary Alcohol and Alkanal are oxidized to Alkanoic acid, secondary alcohol are oxidized to Alkanone while tertiary alcohol are no affected** (i.e. does not react).

Note that: The two common oxidizing agents used in organic Chemistry are **$K_2Cr_2O_7/H_2SO_4$** and **$KMnO_4$** (either in acid or alkaline). **$K_2Cr_2O_7/H_2SO_4$ is a weak oxidizing agent, its oxidizes primary alkanol to Alkanal and have no effecton Alkanal and secondary Alkanol.** But **$K_2Cr_2O_7/H_2SO_4$ in the presence of heat** will oxidize primary Alkanol and Alkanal to Alkanoic acid and secondary Alkanol to Alkanone. However cold excess $K_2Cr_2O_7/H_2SO_4$ will oxidize primary Alkanol and Alkanal to Alkanoic acid and secondary Alkanol to Alkanone. **$KMnO_4$ on the other hand is a strong reducing agent**, it will oxidize primary Alkanol and Alkanal to Alkanoic acid and secondary Alkanol to Alkanone either in the **cold, hot, excess or limited form.**

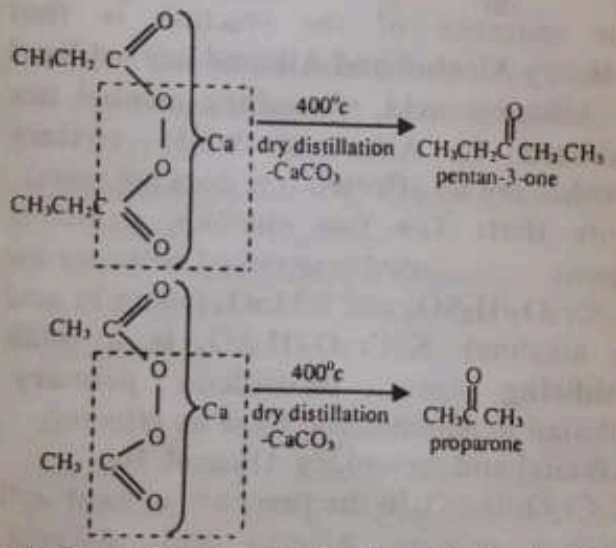
(iii)



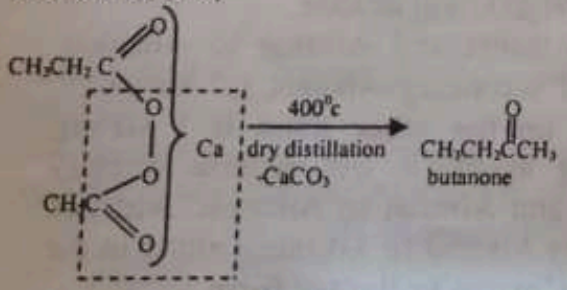
Note that dry distillation of organic salt of calcium can sometime give more than one product if there is two or more salts e.g.

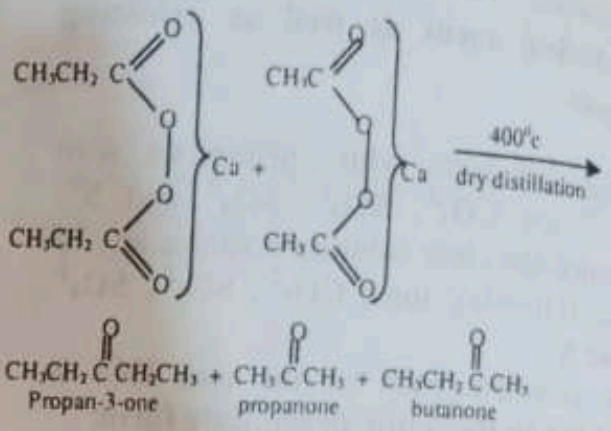


In the case above the products are obtain as shown below.



The third product is obtained by joining half of each of the organic salt of calcium to form the salt below;

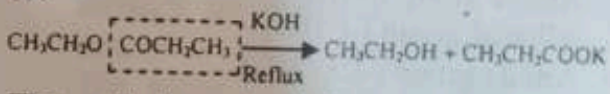




In essence, the dry distillation of organic salt of calcium gives carbonyl compound (i.e. Alkanal or Alkanone or both). When an organic salt of calcium is dry distil it loses one mole of $CaCO_3$ to form either Alkanal or Alkanone.

One mole of organic salt of calcium gives only one product on dry distillation. But if two, three products will be form.

iv.



The alkaline hydrolysis of Ester or Alkanoate gives Alkanol and an organic salt. Esters are made up of two parts which are the acid part and the Alkanol part. When Esters are written in the form RCO_2OR^1. The make part is the acid part. But if ester is written in the form R^1OCOR the make part is the acid part. When esters undergo alkaline hydrolysis the Alkanol part will form alkanol but the acid part will form salt. Generally the alkaline hydrolysis of esters occurs in two stages which are show below;

$RCO.OR^1 + H-OH \rightarrow RCOOH + R^1OH$ ..... Rnx 1

$RCOOH + KOH \rightarrow RCOOK + H\text{-}OH$ ..... Rnx 2

$RCOOR^1 + KOH \rightarrow R^1OH + RCOOK$ Overall rnx

If Ester undergoes acid hydrolysis, the Alkanol part will form Alkanol while the Acid part will form Acid.

$$RCOOR^1 \xrightarrow{H_2O/H^+} R^1OH + RCOOH$$

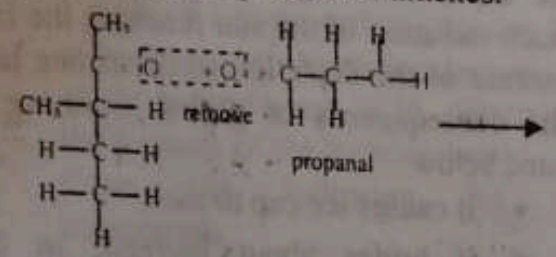
$$CH_3COOCH_3 \xrightarrow{H_2O/H^+} CH_3COOH + CH_3OH$$

c(i) An organic compound which decolorize bromine in CCL_4 is unsaturated that is it contain double or triple bonds.

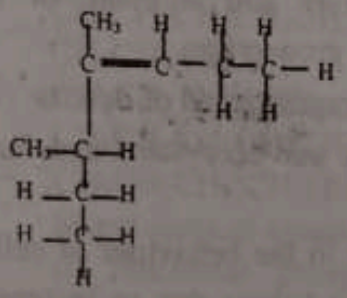
ii. An unsaturated compound which takes one mole of a reagent to be saturated contains one double bonds (while unsaturated compound which takes two mole of any reagent to be saturated contain one triple bond or two double bonds).

The further deduction shows that the hydrocarbon in question is alkenes.

iii.



3-methylpentan-2-one



4, 5-dimethylhep-3-ene

To obtain on alkene from the products of its Ozonolysis, simply joined the products together at the point of the oxygen contain in the carbonyl compound form by the Ozonolysis after removing the oxygen atoms as shown above.

(iv) 4, 5-dimethylhept-3-ene

d(i) Check any O' Level Chemistry textbook for the diagram

(ii) $Cl_2 + 2NaOH \rightarrow NaCl + NaOCl + N_2O$

Cold diluted

$3Cl_2 + 6NaOH \rightarrow 5NaCl + NaClO_3 + 3H_2O$

Hot conc

(iii) $Cl_2 + H_2O \rightarrow HCl + HOCl$

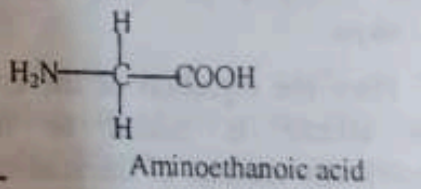
$HOCl + dye \rightarrow HCl + [dye + O]$

Coloured colourless

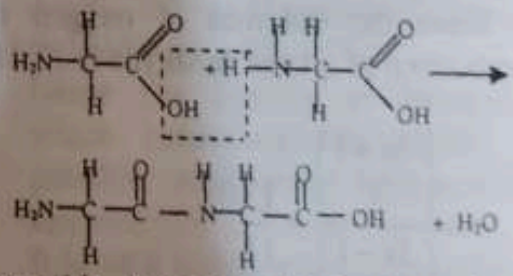
Chlorine bleaches by oxidation and in the process produce HCl. This implies that chlorine cannot be used to bleach acid sensitive material. The differences between the beaching action of chlorine and sulphur iv oxide are given in the table below

S/N	Chlorine	Sulphur IV Oxide
1.	It bleaches by oxidation	It bleaches by reduction
2.	It can be used for acid sensitive material	It cannot be use for acid sensitive material
3.	It bleaching action is lasting	It bleaches action is not lasting

3a.



Aminoethanoic acid



The peptide bond is obtained as shown above. The reaction above show that for every peptide linkage one water molecules is loss:

3b. $2(C_6H_{10}O_5)_{n(s)} + nH_2O \xrightarrow[\text{Hydrolysis}]{\text{diastase}} n\,C_{12}H_{22}O_{11(aq)}$ maltose

$C_{12}H_{22}O_{11(aq)} + H_2O \xrightarrow[\text{Hydrolysis}]{\text{maltase}} 2C_6H_{12}O_{6(aq)}$ Glucose

$C_6H_{12}O_{6(aq)} \xrightarrow[\text{Decomposition}]{\text{zymase}} 2C_2H_5OH(aq) + 2CO_2$ Ethanol

Note that the hydrolysis of starch to glucose can also be catalyst by the enzyme **AMYLASE**. Also note that the fermentation of starch occur in three stages.

(i)**Hydrolysis** of starch to form **Maltose**
(ii)**Hydrolysis** of maltose to form **Glucose**
(iii)**Decomposition** of glucose to form **Ethanol**

Hence the sequence of the reactions that take place in the fermentation of starch is:

Hydrolysis → Hydrolysis → Decomposition

(ii) Fractional distillation

(iii)Purification of rectified spirit over quicklime.

$$C_xH_{2x+2} + \left(\frac{3x+1}{2}\right)O_2 \rightarrow xCO_2 + (x+1)H_2O$$

Alkane

$$C_xH_{2x} + \left(\frac{3x}{2}\right)O^2 \rightarrow xCO_2 + xH_2O$$

Alkene

$$C_xH_{2x-1} + \left(\frac{3x-1}{2}\right)O^2 \rightarrow xCO_2 + (x-1)H_2O$$

c. Alkyne

Here the equation of the combustion of the alkene is added to increase the knowledge toolbox of the student.

Since the volumes of oxygen in the combustion of alkene &Alkyne is 13:11

$$\Rightarrow \frac{\left(\frac{3x+1}{2}\right)}{\left(\frac{3x-1}{2}\right)} = \frac{13}{11}$$

$$\Rightarrow \frac{3x+1}{3x-1} = \frac{18}{11}$$

$$11(3x+1) = 13(3x-1)$$

$$33x + 11 = 39x - 13$$

$$11 + 13 = 39x - 33x$$

$$24 = 6x$$

$$\Rightarrow x = \frac{24}{6} = 4$$

Hence the Alkane = $C_xH_{2x+2} = C_4H_{10}$

The Alkyne = $C_xH_{2x-2} = C_4H_6$

d.(i) **crude oil spillage**

(ii) **Dumping of refuse on river**

e.

$$CF_2Cl_2 \xrightarrow{uv} CF_2Cl + Cl$$

Chloroflorocarbon

$$O_3 + Cl \rightarrow ClO + O_2$$

$$ClO \xrightarrow{uv} Cl + O$$

The release Chlorine radical will attack another ozone layer making the process a continuouse one. Depletion of ozone layer leads to global warming. Global warming is the phenomenon whereby the temperature of the Earth rises above normal due to too much radiation of the sun reaching the Earth because of the depletion of the ozone layer. The consequences of global warming are listed below

- It causes ice cap to melt
- It brings about increase in land temperature and shortage of fresh water to grow crops
- It encourages spread of deserts
- It upsets our ecosystem and human lives
- Changes in the behaviour of cells in the living tissues due to increase in ultraviolet radiation

f. i.**coke**
bii. **Ammoniacal liquor**
iii. **Coal tar** and
iv **coal gas**

CHAPTER TWO

OBAFEMIAWOLOWOUNIVERSITY
PRE-DEGREE PROGRAMME
2004/2005 Mid-Contact Period Examination

CHEMISTRY

Instructions

(a) Answer ALL the questions. Indicate the venue for the Examination, your Serial No, your Surname (in CAPITAL) plus other Names. Start each question on a fresh page.

1.a 1 mole of a hydrocarbon contains 8g of hydrogen. If the molecular weight of the hydrocarbon is 56, determine the formula of the hydrocarbon.

(b) From the following list of compounds

$CH_3CH_2CH=CH_2$;
$CH_3CH_2CH_2CH_2OH$;
$CH_3CH=CHCH_3$;
$CH_3CH_2\ OCH_2CH_3$;
$CH_3CH_2CH(OH)CH_3$
$CH_3CH(CH_3)CH_2OH$

Select pairs of compounds that exhibit (i) functional group isomerism, (ii) chain isomerism, (iii) position isomerism.

(c) Write equation(s) to show how and under what conditions 1-bromopropane will react with sodium hydroxide.

(d) Apart from the use of ion exchange resin, give the equation(s) for a common method that removes both temporary and permanent hardness in water.

(e) Straw hats bleached with SO_2 usually go back to the original colour upon exposure to air. Explain why this is so.

(f) Oxygen is better prepared by the thermal decomposition of sodium. trioxonitrate (V) than by thermal decomposition of lead (II) trioxonitrate (V). Why is this so?

2(a) Draw the structure of the predominant product in each of the following reactions.

(i) $CH_3C(CH_3)=CHCH_3 + HCl \xrightarrow{\text{in a polar solvent}}$

(ii) $CH_3CH(CH_3)-C \equiv CH + H_2O \xrightarrow[HgSO_4,\ 60^0C]{\text{dil. } H_2SO_4}$

(b) Classify each of the following as Nucleophiles or Electrophiles. Give a reason in each case (i) NH_3 (ii) Br_2

(c) Deduce the IUPAC name for the given structure. $CF_3CH(Br)(Cl)$

(d) By means of equation(s) only, show the bleaching action of chlorine.

(e) In the Contact Process of making tetraoxosuiphate (VI) acid, sulphur (VI) oxide is not dissolved directly in water to give the required acid. Why?

(f) Give the function of each of the following chemicals in the treatment of water for town water supply (i) Alum. (ii) a Fluorine.(iii)Chlorine (iv) Iodine.

3 (a) Name the type(s) of isomerism which butan-2-ol can exhibit. If possible, structurally represent the isomers.

(b) 0.5g of a hydrocarbon is completely burned in oxygen. The weights of CO_2 and H_2O obtained are 1.6923g and0.34615g respectively. Calculate the percentages of carbon and hydrogen in the compound.

(c) Consider the reactions:

(i) $CH_3CH_2OH\text{-}H_2O \xrightarrow[180^0C]{\text{Conc. } H_2SO_4} CH_2=CH_2$

(ii) $CH_3CH_2Br\text{-}HBr \xrightarrow[\text{Heat}]{\text{Alcohol/KOH}} CH_2=CH_2$

(I) Give a name for (i), (II).Give a name for (i) and (ii).

(d) (i) Give equation of the reaction that occurs when Cl_2 is bubbled into a solution of sulphur (IV) oxide in water. (ii) How can you qualitatively

identify any of the products formed in (i)

(e) What is observed when H_2S is passed into concentrated H_2SO_4? Write an equation for any reaction taking place.

SOLUTION

2004/2005 MID-CONTACT PERIOD

1a. Mass of hydrogen in hydrocarbon = 8g

No of mole of hydrogen =

$$\frac{Reacting\ mass}{Molar\ mass} = \frac{8g}{1g/mol} = 8mol$$

The general formulae of hydrocarbon is

$C_xH_y \Rightarrow y = 8$

R.m.m of $C_xH_y = 56$

$12x + y = 56$

$12x + 8 = 56$

$12x = 56-8 = 48$

$x = 48/12 = 4$

$C_xH_y = C_4H_8$

1b. **Functional isomers** are isomers that have the same molecular formula but different functional group. The following pairs always form functional isomer.

- Alkanol / Ether
- Alkanal/Alkanone
- Alkanoic acid/Esters

From the list of compound given, the following are functional isomers.

(i) $CH_3CH_2OCH_2CH_3$ & $CH_3CH_2CH(OH)CH_3$

(ii) $CH_3CH_2OCH_2CH_3$ & $CH_3CH(CH_3)CH_2OH$

In functional isomer the chemical and physical properties differ because the isomer belong to different homologous series

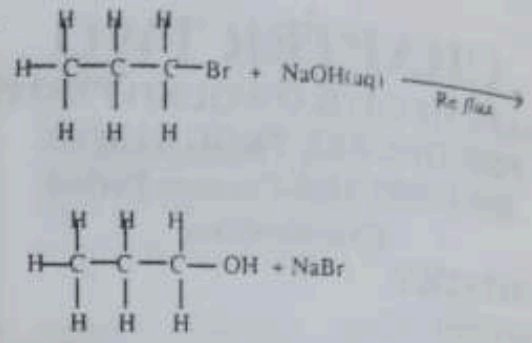
(ii) In chain isomers the position of the functional group remain the same but the longest carbon chain is rearranged e.g.

$CH_3CH_2CH_2CH_2OH$ & $CH_3CH(CH_3)CH_2OH$

(iii) In position isomers, the isomers have the same carbon chain but the position occupy by their functional group differs.

- $CH_3CH_2CH=CH_2$ & $CH_3CH=CHCH_2$
- $CH_3CH_2CH_2CH_2OH$ & $CH_3CH_2CH(CH)CH_3$

1c.



In the above reaction, if aqueous NaOH is use Alcohol will be form but if Alcoholic NaOH is use Alkene will be form

1d. Temporary and permanent hardness in water can be removed by

- ion exchange resin
- Na_2CO_3
- Distillation

The cause of temporary and permanent hardness in water is **$Ca(HCO_3)_2$** and **$CaSO_4$ or $MgSO_4$** respectively. i.e. the hardness is cause by Ca^{2+} or Mg^{2+} in the form of soluble salts. To remove the hardness means removing the ions.

$$Na_2CO_3 + Ca(HCO_3)_2 \rightarrow 2NaHCO_3 + CaCO_3$$ ppt

$$Na_2CO_3 + CaSO_4 \rightarrow Na_2SO_4 + CaCO_3$$ ppt

$$Na_2CO_3 + MgSO_4 \rightarrow Na_2SO_4 + MgCO_3$$ ppt

e. **SO_2 bleaches by reduction.** As a result the straw hat will return to its original colour due to oxidation by atmospheric oxygen

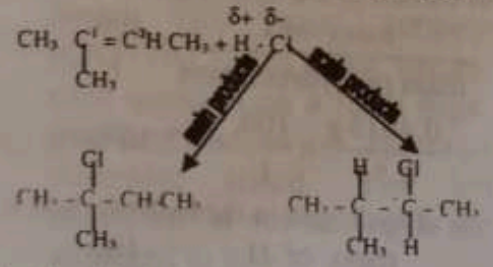
f. $NaNO_3 \rightarrow NaNO_{2(s)} + O_2$

$2Pb(NO_3)_2 \rightarrow 2PbO_{(3)} + 4NO_{2(g)} + 2O_{2(g)}$

In reaction one, the products are solid ($NaNO_2$) and gas (O_2). Hence the gas formed can be easily separated from the solid give rise to pure oxygen.

In reaction two, the products contain two gases (NO_2 & O_2) which mixed together So that oxygen obtain is usually contaminated by NO_2 i.e. it is impure.

2. **Markownikoff's rule** state that if an unsymmetrical reagent (e.g. HX) act across the double or triple bond of an unsymmetrical unsaturated organic compound the main or predominant product is that form when the negative part of the reagent is added to the carbon with the least number of hydrogen.



In the above reaction, the site of reaction is carbon 1 and 2. Carbon 1 does not have any hydrogen while carbon 2 has one hydrogen atom. In accordance to Markownikoff's rule, to form the main product the chlorine will be attached to carbon 1 because it has the least number of hydrogen when compare to carbon 2. The reverse is the case for the formation of the side products. It means that to apply markownikoff's rule,one must know the negative and positive part of the unsymmetry reagent

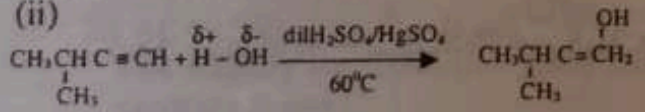
(a) Hydrogen Halide $\overset{\delta+}{H}-\overset{\delta-}{Cl}$, $\overset{\delta+}{H}-\overset{\delta-}{Br}$, $\overset{\delta+}{H}-\overset{\delta-}{I}$

(b)Bromine water $\overset{\delta+}{Br}-\overset{\delta-}{OH}$

(c) Water. $\overset{\delta+}{H}-\overset{\delta-}{OH}$

(d) Chlorine water $\overset{\delta+}{HO}-\overset{\delta-}{Cl}$

(ii)



Note that the above reaction also follow markownikoff's rule.The compound form contains the –OH group and double bonds such compounds are called <u>enol</u>. Enol are unstable, they rearrange themselves to form either Alkanal or Alkanone.

In the rearrangement of enol, the hydrogen attach to the –OH group in carbon 2 moves to carbon 1 and the double bond move to the oxygen atom.

b. **Nucleophiles** are reagents which attack electron deficient centre. They are also known as nucleophilic reagent. The following are Nucleophiles.

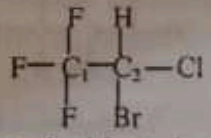
- All election – rich molecules (i.e. molecules in which the centre atom has a lone pair of electron) e.g. H_2O, NH_3, PH_3, BrF_5, XeF_4 etc
- All anions NO_3^-, Cl^-, F^- e.g.
- All Lewis base.

Electrophiles are reagents which attacks electron deficient centre. They are also known as electrophilic reagent. The following are Electrophiles.

- All electron-deficient molecules e.g. $AlCl_3$, BF_3, $BeCl_2$ etc.
- All cation e.g. Ca^{2+}, Mg^{2+}, NH_4^+ etc.
- All Lewis acids
- All molecules that are easily polarized and attack election – rich centre with their positive poles e.g. Br_2

Therefore NH_3 is Nucleophiles while Br_2 is Electrophiles.

c.



2-bromo-2-chloro-1, 1, 1-trifloroethane. **The naming starts from left to right** because the carbon atom 1 have three substituent groups while the carbon atom 2 have two substituent groups.

d. $Cl_2 + H_2O \longrightarrow HCl + HOCl$

$HOCl \longrightarrow HCl + [O]$

$Dye + [O] \longrightarrow [Dye + O]$

e. It is because the reaction between water and SO_3 is highly exothermic. The heat

liberated is high enough to cause the H_2SO_4 form to boils. The result is that the H_2SO_4 form evaporate and form tiny droplet all over the factory leading to air pollution and acid rain which are harmful to animal and plants.

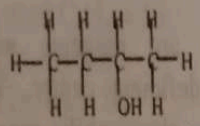
f.i. Alum is use to coagulate flocs together to form heavy particles which settles down in the sedimentation tank.

ii. Fluorine is added to water to prevent tooth decay.

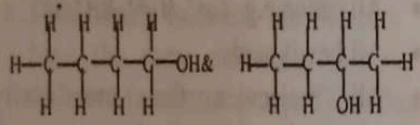
iii. Chlorine is added to water to kill germs.

iv. Iodine is added to water to prevent goiter.

3a. The structure of butan-2-ol is

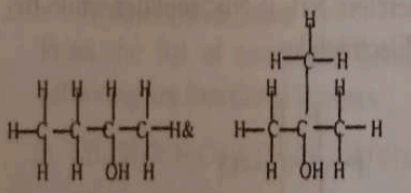


It can undergoes chain, position and functional isomerism.example of positional isomer of Butan-2-ol isomerism



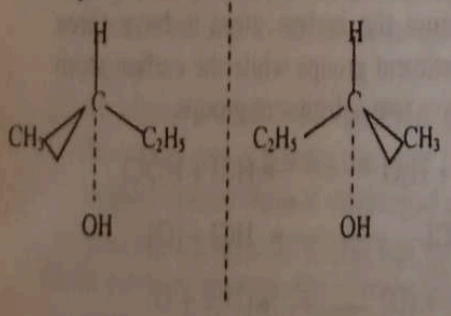
Butan-1-oL Butan-2-oL

Chain isomers of butan-2-oL



Butan-2-oL 2-methylpropan-2-oL

Optical isomer of Butan-2-ol



b. Mass of hydrocarbon = 0.5g

Mass of CO_2 formed = 1.6923g

Mass of H_2O formed = 0.34615g

Mass of C in 1.6923g of CO_2 =

$$\frac{12 g/mol}{44 g/mol} \times 1.6923 g = 0.4615 g$$

Mass of H in 0.34615g of H_2O =

$$\frac{2 g/mol}{18 g/mol} \times 0.34615 g = 0.0385 g$$

% of carbon in the hydrocarbon =

$$\frac{\text{mass of C}}{\text{mass of hydrocarbon}} \times \frac{100}{1}$$

$$= \frac{0.4615 g}{0.5 g} \times \frac{100}{1} = 92.30\%$$

% of hydrogen in the hydrocarbon =

$$\frac{\text{mass of H}}{\text{mass of hydrocarbon}} \times \frac{100}{1}$$

$$= \frac{0.0385 g}{0.5 g} \times \frac{100}{1} = 7.70\%$$

I. Dehydration

II. Dehydrobromination

III. Elimination

d. $Cl_{2(g)} + SO_{2(g)} + 2H_2O_{(l)} \rightarrow SO_4^{2-} + Cl^- + 4H^+$

The two ions in the reaction are SO_4^{2-} and Cl^-. SO_4^{2-} gives a while precipitate with $BaCl_2$

$$SO_4^{2-} + Ba^{2+} \longrightarrow \underset{\text{ppt}}{BaSO_4}$$

Cl^- gives a while precipitate with $AgNO_3$

$$Cl^- + Ag^+ \longrightarrow \underset{\text{ppt}}{AgCl}$$

e. $H_2S_{(g)} + H_2SO_{4(aq)} \rightarrow 4H_2O_{(L)} + 4S_{(s)}$

OBAFEMI AWOLOWO UNIVERSITY
PRE-DEGREE PROGRAMME
2004/2005 Contact Period Examination
CHEMISTRY

Instructions

a. Answer ALL the questions. Indicate the venue for the examination, your Serial No, your surname in (CAPITAL) plus other names. Start each question on a fresh page. Each question carries 4 marks except otherwise stated. You will be penalized for not staying in the room allocated to you.

1a(i) The Ozonolysis of an alkene yielded propanone as the only product. Deduce the structure of the alkene and name it by the IUPAC system.

(ii) Give the structures of D and E in the following equation in –

$$CH_3CH_2OCOCH_2CH_3 \xrightarrow[\text{Reflux}]{\text{Dil HCl}} D+E$$

b. Propose a scheme for the conversion of propanal to ethanol. Your answer should take the form

$$CH_3CH_2CHO \xrightarrow[\text{Condition}]{\text{Reagent}} X \xrightarrow[\text{Condition}]{\text{Reagent}} \text{etc}$$

ci. What do you observe when a mixture to solid NaC1, solid MnO_2 and conc H_2SO_4 is heated.

ii. Give the equation(s) leading to the observation.

di. $2H-C\equiv C-H + 2Na \xrightarrow{A} H_2 + B \xrightarrow{CH_3I} C$
Just identify the Condition A and the products B and C

ii. Write an equation for the reaction that takes place when ethyne is passed into an acidified solution of $KMnO_4$.

ei. Write an equation to show how and under what conditions propanone will react with hydrogen cyanide.

ii. What compound is formed when the product in (i) above is refluxed with conc HCl

iii. In what, form is carbohydrate stored in (I) Cassava and (11) wood?

f. Write down the stepwise process that leads to Ozone layer depletion in the upper atmospheric. You may wish to express your answers in the form of equations.

g. You have introduced into a packed column, a mixture to be separated. Explain in one sentence, what you understand by the term 'elution".

2a(i) "Isomerism is the existence of two or more compounds with the same molecular formula but different physical and/or chemical properties. Select a pair of isomeric compounds that will justify the use of each of (I) **and** (II) **or** in the above definition.

ii. Which dichloropropane is optically active? Draw the optical isomers.

b. One mole of an organic compound containing carbon. Hydrogen and oxygen has 10g of hydrogen and 48g of carbon. If the relative molecular mass of the compound is 74, determine the molecular formula of the compound. (H = 1, C =12; 0 = 16).

c.(i) Write a balanced equation for the combustion of a compound with molecular formula $C_nH_{2n+2}O$

ii. Write equation for the conversion of CH_3COOH into (I) CH_3COCl and (II) $CH_2ClCOOH$.

(d)(i) What do you understand by the statement that methane is tetrahedral?

(ii) Given two samples to be $CH_3CH_2CONH_2$ and $CH_3CH_2NH_2$ describe one test, together with observation that will identify one of them.

(iii) How can one show that two samples given you are carbohydrates?

(e) When sodium is exposed to the air, give the sequential equations for the reactions that take place.

(f)(i) Why is a salt moistened with conc HCl prior to flame test for metal ion.

(ii) With the aid of equations explain how Cl_2 gas turns clamp starch iodide paper blue-black.

(g)(i) Give any one characteristic property of a transition metal.

(ii) Why is zinc not regarded as a transition metal.

3(a)(i) List two organic compounds that will react to form $HCOOC_2H_5$

(ii) Write the structure to an isomer of $HCOOC_2H_5$ that will react with $NaHCO_3$ and one isomer that will not react with $NaHCO_3$

(iii) Write a balanced equation for the reaction of the isomer in (ii) and sodium hydrogen trioxocarbonate (IV) and state your observation.

(b)(i) Write the equation for the preparation of soapy detergent from any glyceride

(ii) How is the soap produced separated from the mixture obtained at the end of the reaction.

(c) Write equation for the reactions obtained when CH_3COONH_4 is treated with:

(i). dil HCl (ii) warm aqueous NaOH

(d) I. $X + \frac{11}{2}O_2 \rightarrow 4CO_2 + 3H_2O$

II $X + \frac{11}{2}O_2 \xrightarrow{Pd} Y \xrightarrow{KMnO_4/H^+} Z$

III. X react with copper (I) chloride in ammonia solution.

(i) Write the structures of X,Y and Z

(ii) Name Z.

(c) Starting with ammonia, write in logical sequence the balanced equations that describe the industrial preparation of trioxonitrate (V) acid.

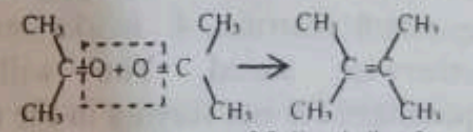
(f)(i) Write equation(s) for the reaction(s) taking place when magnesium is burnt in air

(ii) Write balanced equation(s) for any reaction(s) taking place (including any observations) when water is added to the product(s) in (i)

(g) State what is observed when NH_3 solution is drop wisely added to copper (II) chloride solution?

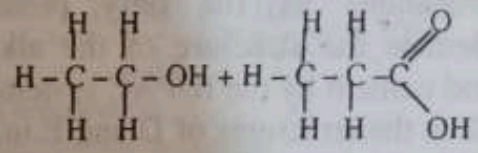
SOLUTIONS
2004/2005 CONTACT PERIOD EXAM

1a.i.



2,3-dimethylbut-2-ene

ii. $CH_3CH_2OCOCH_2CH_3 + H_2O \xrightarrow[\text{Relux}]{\text{dil HCl}}$



ethanol propanoic acid

1b.

$CH_3CH_2CHO \xrightarrow{LiALH_4} CH_3CH_2CH_2OH$

$\xrightarrow{KMnO_4/H^+} CH_3CH_2COOH \xrightarrow{NH_3}$

$CH_3CH_2CONH_2 \xrightarrow{Br_2/KOH}$

$CH_3CH_2NH_2 \xrightarrow[0\text{-}5^0C]{NaNO_2/HCl} CH_3CH_2OH$

The process involve in the conversion of propanal to ethanol are listed below

(i)Reduction (ii)Oxidation

(iii)Amonolysis (iv)Hofmann Degradation

(v)Reaction with HNO_2

1c.i Chlorine gas is liberated

ii. $2NaCl + MnO_2 + 2H_2SO_4 \rightarrow Na_2SO_4 + MnSO_4 + 2H_2O + Cl_2$

Hence chlorine gas is liberated when a mixture of NaCl, MnO_2& H_2SO_4 is heated.

1d. $2H-C\equiv C-H + 2Na \xrightarrow{Liq\ NH_3}$

$2H-C\equiv C-Na + H_2 \xrightarrow{2CH_3I}$

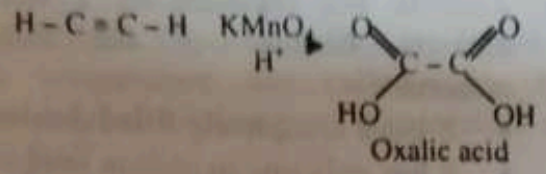
$2H\text{-}C\equiv C-CH_3 + 2NaI$

i. The condition of A is that the sodium metal must be in liquid ammonia.

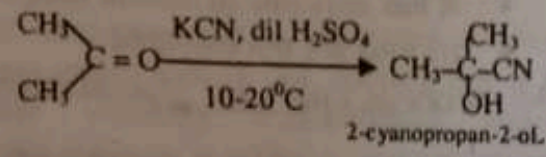
$B \rightarrow H-C\equiv C-Na$

$C \rightarrow H-C\equiv C-CH_3$

ii.

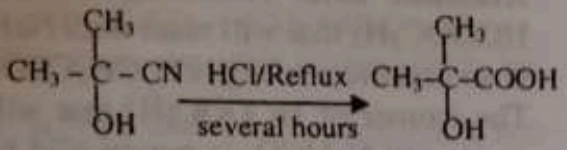


e(i)



Note that the above reaction is actually Between carbonyl compound and HCN.But HCN is a very poisonous gas, hence it is prepare by the reaction of KCN and dilute H_2SO_4

ii.



2-hydroxy-2-methylpropanoic acid

The compound form when 2-cyanopropan-2-o1 is reflux with conc. HCl is 2-hydroxy-2-methylpropanoic acid.

iii. Carbohydrates stored in cassava as starch and in wood as cellulose.

f. The depletion of ozone layer in the atmosphere is due to either burning of chlorinated material such as PVC, chloroethene or the use of volatile chlorine compound such as chlorofloro carbons (CFCs) e.g. CF_2Cl_2.
The chlorine radical formed causes the depletion of ozone layer rapidly.

$$CF_2Cl_2 \xrightarrow{uv} CF_2Cl + Cl$$

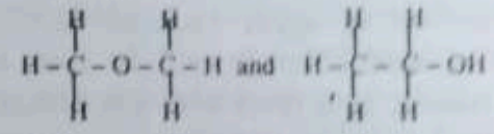
Chloroflorocarbon

$$O_3 + Cl \rightarrow ClO + O_2$$

$$ClO \xrightarrow{uv} Cl + O$$

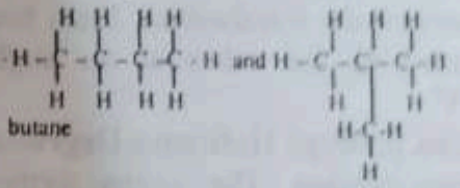
1g. Elution is the process whereby the mixture to be separate is transported through the adsorbent medium by the solvent in column chromatography.
Elution and chromatographic tank are associated with column chromatography. Both stationary phase and mobile phase are associated to both paper and column chromatography

2a. Isomers with different physical and chemical properties are in different homologous series e.g.



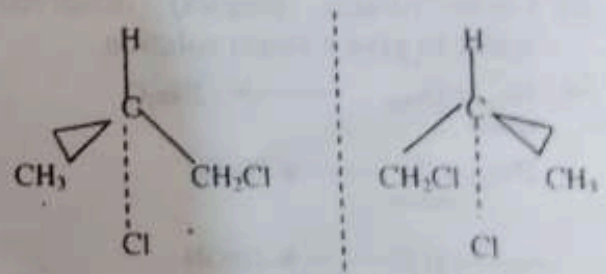
Methoxymethene ethanol

b. Isomers with different physical or chemical properties and in the same homologous series e.g.



butane 2-methylpropene

ii. 1,2-dichloropropane is optically active because it contain a Chiral centre.



2b. $\cap_H = \frac{\text{Reacting mass}}{\text{molar mass}} = \frac{10g}{1g/mol} = 10mol$

$$\cap_C = \frac{48g}{12g/mol} = 4mol$$

Let the compound be represent by $C_xH_yO_z$ where x = 4 & y = 10

$\Rightarrow C_xH_yO_z = C_4H_{10}O_2$

R.m.m of $C_4H_{10}O_2$ = 74g/mol

[4(12) + 10(1) + Z(16)]g/mol = 74g/mol

48 + 10 + 16z = 74

58 + 16z = 74

16z = 74 – 58

16z = 16

z = 16/16 = 1

The molecular formula of the compound is $C_4H_{10}O$

2ci. $C_nH_{2n+2}O + (3n/2)O_2 \rightarrow nCO_2 + (n+1)H_2O$

ii. $CH_3COOH + SOCl_2 \rightarrow CH_3COCl + SO_2 + HCl$

iii. $CH_3COOH + Cl_2 \xrightarrow{\text{Reflux}} CH_2ClCOOH + HCl$

Whenever Alkanoic acid react with chlorinating agent such as $SOCl_2$ and PCl_5, acid chloride will be form.But if Alkanoic acid react with Cl_2, chlorinated Alkanoic acid will be form

2di.CH_4 is tetrahedral means that the central atom (carbon) is situated in the central of a regular tetrahedron and the four bonds point out from the centre towards the corners of the tetrahedron. Each bond is included to the other at an angle of 109.5^0

ii. Amides undergo **Hofmann Degradation** to give amines. The amine formed is noticed by its fishy smell.But Amines do not undergo Hofmann Degradation.

$CH_3CH_2CONH_2 \xrightarrow{Br_2/KOH} CH_3CH_2NH_2 + K_2CO_3 + 2H_2$

iii. Carbohydrates (sugars) dissolved in water to give a sweet solution.

2e. $Na_{(g)} + O_{2(g)} \xrightarrow[\text{limited}]{} 2Na_2O$

$2Na_{(g)} + O_2 \xrightarrow[\text{excess}]{} Na_2O_2$

$Na_2O + H_2O \xrightarrow[\text{Moisture}]{} NaOH$

$2NaOH + CO_2 \longrightarrow Na_2CO_3 + H_2O$

F(i).To prevent the precipitation of unwanted ions.

ii. Starch iodine paper contain iodide ion (I^-), since chlorine is more reactive that iodine. It liberates iodine from starch iodine paper.

$2I^- + Cl_2 \longrightarrow 2Cl^- + I_2$ (blue black)

g(i).Properties of transition elements

- They exhibit variable oxidation state.
- Their ions are coloured
- They formed complex ions
- They are excellent catalyst due to a vacant d-orbital available for the adsorption gases.

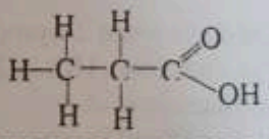
h. Zinc is not regarded as a transition element because of the following reasons.

- It has a completely filled d-orbitals.
- It has only one oxidation state.
- Its ions are not coloured.

3a.i. $HCOOC_2H_5 + H_2O \xrightarrow{H^+} C_2H_5OH + HCOOH$

Hence the organic compounds that formed $HCOOC_2H_5$ are ethanol (C_2H_5OH) and Methanoic acid (HCOOH).

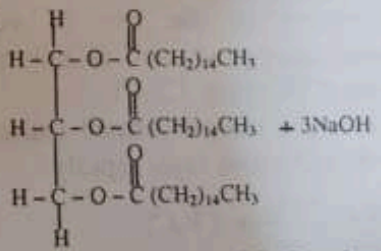
ii. **Estes are functional isomers of Alkanoic acid**. Hence the isomers of $HCOOC_2H_5$ that will react with $NaHCO_3$ is an organic acid e.g. CH_3CH_2COOH. The isomer of $HCOOC_2H_5$ that will not react with $NaHCO_3$ is not an acid but an ester e.g. CH_3COOCH_3



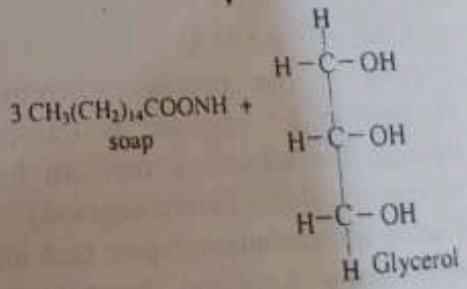
iv. $CH_3CH_2COOH + NaHCO_3 \rightarrow CH_3CH_2COONa + CO_2 + H_2O$

The liberation of CO_2 causes effervescence to occur.

3bi.



Triglyceride (propane-1,2,3-trihexadecanoate)



Generally, fata and oils are called GLYCRIDES. Glycerides that are liquid at room temperature are called OIL but glycerides that solid at room temperature are called FAT

ii.The soap prepared is separated out by a process called salting out. Salting out is the process whereby concentrated sodium chloride solution is added to soap mixture to decrease its solubility, so that it separates out as a hard cake on the surface on cooling.

ci. $CH_3COOHNH_4 + dil\ HCl \rightarrow CH_3COOH + NH_4Cl$

ii. $CH_3COONH_4NaOH_{(s)} \xrightarrow[warm]{} CH_3COONa + NH_3 + H_2O$

d(i). $X + 11/2\ O_2 \rightarrow 4CO_2 + 3H_2O$

The above equation is also satisfy by

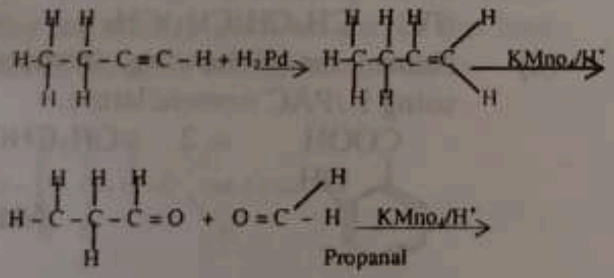
$$C_nH_{2n-2} + \left(\frac{3n-1}{2}\right)O_2 \rightarrow nCO_2 + (n-1)\ H_2O$$

Comparing the equation shows that n = 4

$C_4H_6 + 11/2\ O_2 \rightarrow 4CO_2 + 3H_2O$

Hence X is butyne. But butyne is of two types which are but-1-yne and but-2-yne. Since X react with ammonical solution of copper I chloride, it implies that X is a terminal Alkynes. Hence X is but-1-yne

(ii)



$\Rightarrow$ Y $\rightarrow$ but-1-ene

X $\rightarrow$ but-1-yne

ii. Z $\rightarrow$ propanoic acid & methanoic acid

e. $4NH_3 + 5O_2 \rightarrow 4NO + 6N_2O$

$2NO + O_2 \rightarrow 2NO_2$

$4NO_2 + H_2O + O_2 \rightarrow 4HNO_3$

fi. $Mg + Air \rightarrow MgO + Mg_3N_2$

ii. $MgO + Mg_3N_2 + 6H_2O \rightarrow 3Mg(OH)_2 + MgO + 2NH_3$

the observation is that a gas is liberated when water is added to the product. The gas is ammonia.

g. $Cu^{2+} + 2NH_3 + 2H_2O \rightarrow 2NH_4^+ + Cu(OH)_2$
pale blue ppt

$Cu(OH)_2 + 4NH_4OH \rightarrow Cu(NH_3)(OH)_2 + H_2O$
deep blue sol

Cu^{2+} gives a pale blue solution when ammonia solution is added in drop wise if the addition of ammonia is continuous the pale blue solution turns deep blue due to the formation of tetraamine copper II hydroxide.

CHAPTER THREE

OBAFEMI AWOLOWO UNIVERSITY, ILE-IFE, NIGERIA

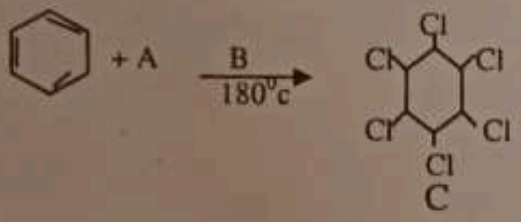
Pre-Degree Programme 2005/2006 Session

CHM 002 Second Mid term Test

1a. (i)What are Electrophiles and nucleophiles?(ii)With reasons, classify NH_3, H_3O^+, BF_3 and H_2O as either a Nucleophiles or an Electrophiles

b. Compound Q is an hydrocarbon with molecular formula C_4H_8

(i) Write down the structures and names of all the possible isomers of Q. (ii) Which of the isomers in (bi) above can exhibit geometrical isomerism? (iii) Clearly draw the graphical representation of such geometric isomers. (iv)Identify A and B in the following reaction:



C

(ii) Give the name and use of product "C" in this reaction above.

(i) With the aid of balanced appropriate chemical equations only, describe two methods each for removing (i) permanent hardness and (ii) temporary hardness of water (iii) Which of the isotopes of hydrogen is not naturally occurring and why?

2(a) (i) Consider the compound C_3H_7N which is an alkyl amine. How many double bond equivalents are there in this molecule?

(ii) Write down the structures of the following organic compounds:- (i). 3-ethyl-2, 5-dimethylhex-2-ene

(ii) 2-bromo-4-chloro-6-methyloctane

(iii) Hex-5-ene-1-yne

(iv) 4-chlorohexan-3-one

(v)3-amino-5,5, 6-trimehylheptan-2-ol

(b) Copy and complete the following equations identifying all the letters

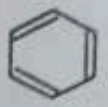
i. $HC \equiv CH + 2Na \xrightarrow{\text{Liqd } NH_3} A + H_2 \xrightarrow{B} CH_3CCH_2Na$

ii. $CH_3 - CH = CH_2 + HCl \rightarrow C$

(iii)

$CH_3CH = C(C_2H_5)_2 + O_3 \xrightarrow{CCl_4} D + H_2O$

$\xrightarrow[CH_3COOH]{Zn/} E + F$

iv.  $\xrightarrow[C.HNO_3]{C.H_2SO_4} \underline{G}$

(v) $CH_3CH_2OH + PCl_5 \rightarrow \underline{W} + HCl + POCl_3$

(c)(i) With the aid of a workable labeled diagram only describe the laboratory preparation of oxygen from potassium trioxochlorate (V)

(i) Write down a balanced equation for the expected reaction in (Ci) above:

3(a) (i) Arrange the following in order of increasing volatility. Explain how you arrive at your answer:

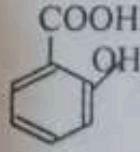
(I) $CH_3CH_2C(CH_3)_2CH_2CH_3$

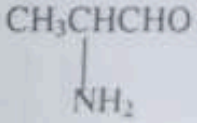
(II) $CH_3(CH_2)_2CH_3$

(III) $CH_3CH(CH_3)C(CH_3)_2CH_3$

(IV) $CH_3CH(CH_3)CH_3$

(ii) Name the following compounds using IUPAC nomenclature.

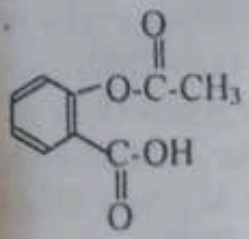


2 

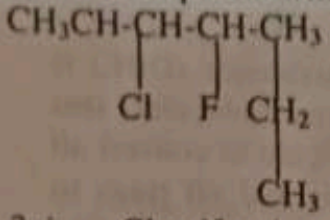
3b(i) Draw the graphical representation of the following molecule, showing all bonds and all bond angles:

$CH_3CH{=}CH{-}C{\equiv}CH$

Identify the functional group(s) in the molecule below:



3b(ii) Give the IUPAC name of the compound with the structure below.



3ci. Classify the following oxides and give equations to support your classification where possible.
(i) Sulphur (VI) oxide (ii) Dinitrogen(I) oxide (iii) Zinc (II) oxide (iv) Nitrogen (II) oxide

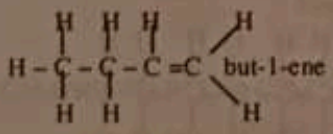
3cii. Mention 2 advantages of soft water over hard water.

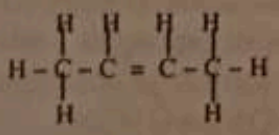
SOLUTION
2005/2006 MID-TERM TEST

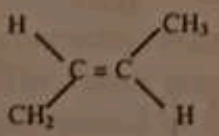
1a. **Electrophiles** (Electrophilic reagent) are **substance that attack electron-rich centre** e.g. H_3O^+, BF_3, Br_2 etc.
A **Nucleophiles** (Nucleophilic reagent) **are substance that attach election deficient centre** e.g. NH_3, H_2O, PH_3 etc.

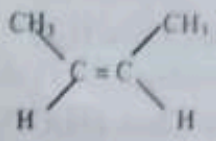
ii. H_3O^+ & BF_3 are Electrophiles. This is because all electron deficient molecule or ions will attack electron rich centre.
H_2O and NH_2 are Nucleophiles because they are rich in electron due to the lone pair of electron in their centre atom.

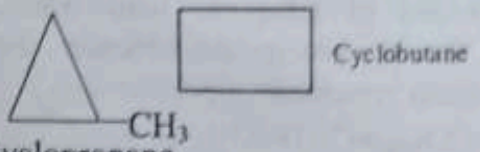
b.


but-1-ene


but-2-ene


Trans-But-2-ene


Cis-but-2-ene

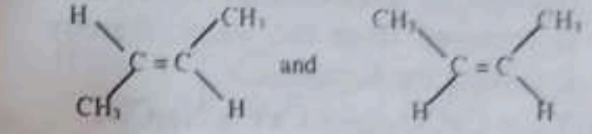

Cyclobutane

Cyclopropane

ii. **But-2-ene**

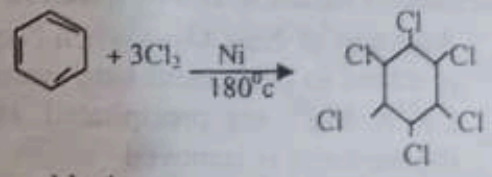
iii.

Trans-but-2-ene


Cis-but-2-ene

Note that the properties of Cis-trans isomers are determine by Auwers-Skita rule
Auwer-skita rule states that in a pair of geometric isomers, the CIS has the higher boiling point, density and retentive index but the TRANS has the higher stability. Note that the stability refer is in the difficulty of converting TRANS into CIS not probably on heating.

iv.



A → chlorine gas
B → Ni catalyst

ii. **The name of the product is cyclochlorohexane**. Cyclochlorohexane is also known as Benzenehexachloride (BHC). BHC is used as insecticide in poultry, cattle or sheep. It is sold as Gammenxame.

ci. **Temporary hardness of water** is caused by $CaCO_3$ in the form of $Ca(HCO_3)_2$. Any method that will precipitate the $CaCO_3$ will removed temporary hardness of water.

- Boiling → on boiling of temporary hard water the $Ca(HCO_3)_2$

decomposed to form $CaCO_3$ which precipitate out

$$Ca(HCO_3)_2 \rightarrow CaCO_3 + CO_2 + H_2O$$

ppt

- Addition of $Na_2CO_3 \rightarrow$ when Na_2CO_3 is added to temporal hard water, $CaCO_3$ is precipitate. Hence the hardness removed.

$$Na_2CO_{3(aq)} + Ca(HCO_3)_{2(aq)} \rightarrow 2NaHCO_{3(aq)} + CaCO_{3(g)}$$

- The use of ion-exchange resin $\rightarrow$ when temporary hard water is pass through an ion-exchange resin, Ca^{2+} is removed from the water, thereby removing the hardness.

$$Na_2Y_{(s)} + CaCO_{3(aq)} \rightarrow CaY + Na_2CO_3$$

ion-exchange ppt

- Addition of calculated amount of $Ca(OH)_2$

$$Ca(OH)_{2(aq)} + Ca(HCO_3)_{2(aq)} \rightarrow 2H_2O + 2CaCO_{3(g)}$$

- Distillation

ii. Permanent hardness of water is cause by Ca^{2+} & Mg^{2+} in the form of $CaSO_4 \cdot 2H_2O$ and $MgSO_4$ respectively permanent hardness can be removed by.

- Addition of $Na_2CO_3 \rightarrow$ when Na_2CO_3 is added to permanent hard water the Ca^{2+} & Mg^{2+} are precipitated. Hence the hardness is removed.

$$Na_2CO_{3(aq)} + CaSO_{4(aq)} \rightarrow CaCO_{3(s)} + Na_2SO_{4(aq)}$$

ppt

$$Na_2CO_{3(aq)} + MgSO_{4(aq)} \rightarrow MgCO_{3(s)} + Na_2SO_4$$

ppt

- The use of ion-exchange resin $\rightarrow$ when permanent hard water is passed through ion-exchange the Ca^{2+} & Mg^{2+} are precipitated. Hence the hardness is removed.

$$Na_2Y_{(s)} + CaSO_{4(aq)} \rightarrow CaY_{(s)} + Na_2SO_{4(aq)}$$

ion-exchanger ppt

$$Na_2Y_{(s)} + MgSO_{4(aq)} \rightarrow MgY_{(s)} + Na_2SO_{4(aq)}$$

ion-exchanger ppt

- Distillation

iii. Tritium (^3_1H) It is produced by radioactive decay.

$$^6_3Li + {}^1_0n \rightarrow {}^4_2He + {}^3_1H$$

2ai. Double Bond Equivalence (DBE) is the number of hydrogen molecules that would be added to a molecule to convert all pie bonds to single bonds and all rings to acyclic structures. One DBE means one ring structure or one double bond.Two DBE means two rings structure, two double bonds, one triple bonds or one ring plus one pie bond.Double Bond Equivalent(DBE) is also known as **unsaturation number**

$$DBE = \frac{2N_C - N_H - N_x + N_N + 2}{2}$$

N_C = Number of carbon atom

N_H = Number of hydrogen atom

N_x = Number of halogen atom

N_N = Number of nitrogen atom

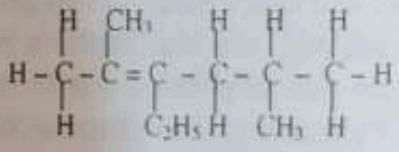
For example the DBE of C_3H_7N is obtain as shown

$$DBE = \frac{2(3) - 7 - 0 + 1 + 2}{2}$$

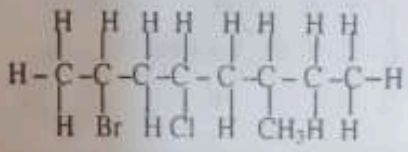
$$= \frac{6 - 7 + 1 + 2}{2} = \frac{9 - 7}{2} = \frac{2}{2} = 1$$

2a(ii)

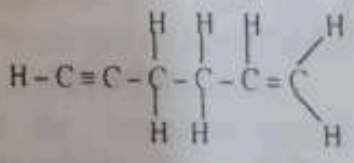
I.



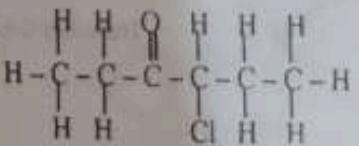
II.



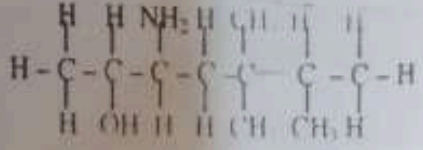
III.



IV.



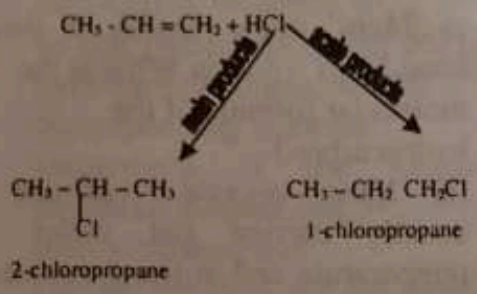
V.



bi. $2H-C\equiv C-H + 2Na \xrightarrow{liqNH_3} 2H-C\equiv C-Na + H_2$

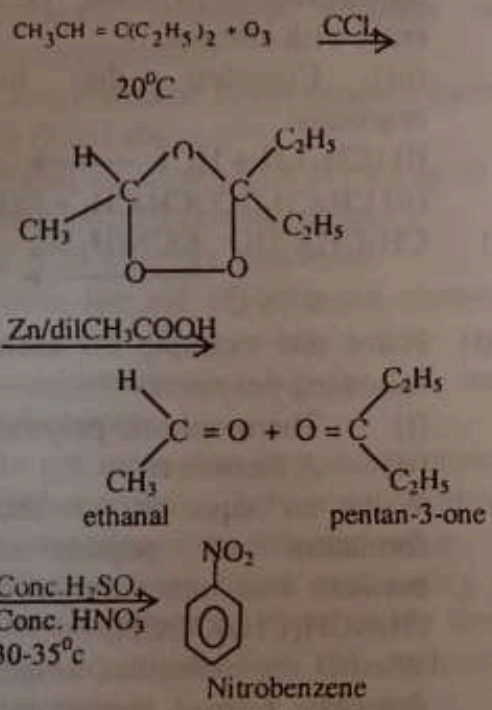
$2H-C\equiv C-Na \xrightarrow{CH_3I} 2H-C\equiv C-CH_3 + NaI$

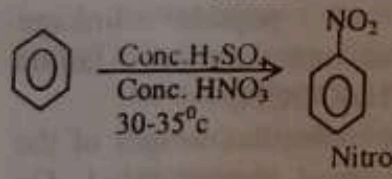
ii.



Note that the above reaction follow Markownikoff's rule.

iii.





v. $CH_3CH_2OH + PCl_5 \rightarrow CH_3CH_2Cl + POCl_3 + HCl$

chloroethene

2c. Oxygen is prepared in the laboratory by the decomposition of $KClO_3$. The equation of the reaction is shown below;

$2KClO_3 \rightarrow 2KCl + 3O_2$

Please refer to any readable chemistry textbook for the diagram

3a. The factor required to classified organic compound in terms of boiling point and volatility had already been dealt with in one of the question. Hence we do not state the factor again but just classified the compound.

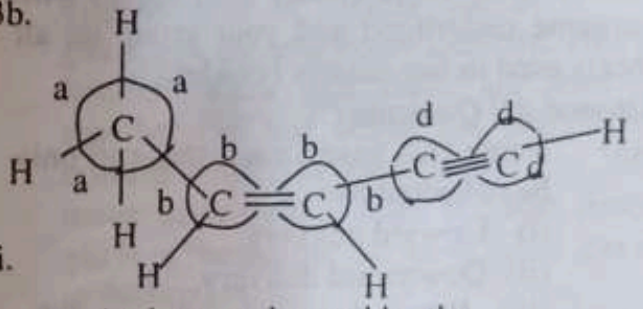
I< III< II < IV

(ii) (1) 2- hydroxybenzoic acid (o-hydroxybenzoic acid).

Note that o-hydroxy means ortho-hydroxy.

(2) 2-aminopropanal

3b.



ii.

- Aryl group denoted by the benzene ring ( )
- Alkanoic acid group (-COOH)
- The ketone group (– C(=O) –)
- The ether group (– O –)

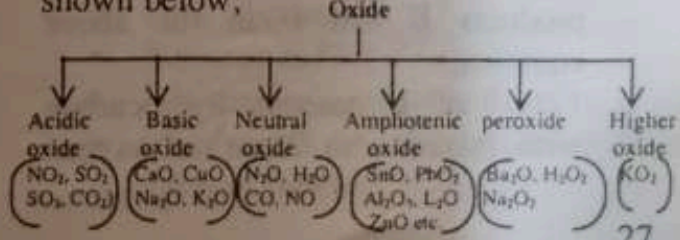
3b. $^{1}CH_3 - {}^{2}CH(Cl) - {}^{3}CH(F) - {}^{4}CH(^{5}CH_2{}^{6}CH_3) - CH_3$

i. The longest carbon chain contains 6 carbon atoms. Hence the parent alkene is hexane.

ii. There is a chlorine, fluorine and methyl group in carbon 2, 3 and 4 respectively. Hence the substituent name is 2-chloro-3-floro-4-methyl.

iii. The IUPAC nomenclature is 2-chloro-3-floro-4-methylhexane.

3c. Oxides are binary compounds of oxygen. The classifications of oxides are shown below;



3d. Advantage of soft water over hard water.
i. It does not waste soap
ii. It does not cause furring of kettle and blockage of pipes and boilers.

OBAFEMIA WOLOWO UNIVERSITY, ILE IFE, NIGERIA
CHM 002 Second Contact Period Examination

Instructions: Write clearly your names with Surname underlined and your group on all sheets used in our answer booklet.

Attempt All Questions

1(a) Name two gases, each that can only be collected by:
(i) Upward delivery
(ii) Downward delivery
(iii) What do you understand by destructive distillation of coal? Give two products of destructive distillation of coal and one corresponding use of each named product.

(b) (i) When Fehling's solution is added to two isomeric carbonyl compounds X and Y with molecular formula $C_5H_{10}O$, compound X produces Cu_2O while Y does not react. Y gave positive Iodoform test .when reacted with warm I_2/NaOH to give CHI_3. Write the possible structures and names of X and Y.
(ii) Which of the following compounds will react with warm I_2/NaOH to produce CHI_3? A. CH_3CHO B. $CH_3CH(OH)CH_3$ C. CH_3COOH D. CH_3COOCH_3 [Use letters A,B,C, or D for your answer]
(ii) Give a one word reason for your answer to b(ii) above (iv) $RCOOCOR^1 + NH_3 \longrightarrow E+F$
Write down the formulae of the products E and F in the above equation.

c. $12cm^3$ of a gaseous hydrocarbon were mixed with $72cm^3$ of oxygen and ignited. Upon cooling, $60cm^3$ of the residual gaseous mixture was obtained This mixture was reduced to $24cm^3$ upon passing it through conc.KOH solution What is the molecular formula of the hydrocarbon?

2(a) (i) Most organic reactions are usually carried out under high temperature and in the presence of a catalyst Why?
(ii) Write equations to show how and under what conditions:
(i) NaOH will react with 1-bromopropane (ii) Conc. H_2SO_4 will react with ethanol
(iii) Complete the following reactions:
(i) $(CH_3)_3N + HCl \longrightarrow$
(ii) $CH_3CH_2OCOCH_2CH_3 + KOH \longrightarrow$
(iii) $CH_3CH_2CHO \xrightarrow[0\text{-}15^\circ C]{KCN/H_2SO_4}$

(b)(i) Name one example for each of the following polymers:
(i) Thermoplastic polymer
(ii) A thermoset

(ii) Write an equation to show the formation of peptide linkage between two molecules of Alanine ($H_2NCH(CH_3)COOH$)
What is the molecular weight of the dipeptide formed above? (H=1, C= 12, N= 14, 0= 16)

(C) What is the difference between the bleaching action of chlorine gas and that of sulphur (1V) oxide? Use equations to support your answer.

3(a) (i) An organic compound Q has the molecular formula $C_5H_{12}O$, whatfamily/families of compound can Q belong?
(ii) If Q gives steaming white fumes upon treatment with PCl_5what does this observation tell you about the functional group present in Q?

(b) A given organic hydrocarbon decolorizes bromine CCl_4 and adds on one moleof hydrogen per mole of hydrocarbon to produce the corresponding Alkanes.
Ozonolysis of the hydrocarbon produced Ethanal and 3-methylbutan-2-one.

(i) Deduce the structure and name of the hydrocarbon

(ii) State the homologous series to which the compoundin(bi) belongs

(iii) Write an equation for the reaction between hydrogen chloride and thehydrocarbon

(iv) Give the name to the product formed in (b.iii) above

(c)(i) Name an appropriate drying agent of each ofthe following gases
(i) Chlorine (ii) Ammonia

(ii) With the aid of balanced chemical equation only show how you wouldobtain $NH_3(g)$ inthe laboratory.

(iv) In not more than two shortsentences differentiate between addition andcondensation polymerization.

4(a)(i) Starting from starch and stating all the conditions involved, write down the equations for the industrial preparation of ethanol by fermentation process."

(ii) In a tabular form only, classify the following either monosaccharide or disaccharides: maltose, fructose lactose, sucrose, and glucose

(b)(i) What is Oleum'?

(ii) With the aid of balanced equations only and stating the necessaryconditions show the chemistry of the industrial process for the preparationof H_2S0_4

(iii) Give one reason why all glass apparatus must be used during the laboratory preparation of HNO_3

(c)(i) In not more than one sentence distinguish between soaps and soapless detergents.

(ii) Give two consequences of the 'green house' affect.

SOLUTION
2005/2006 EXAMS

1a. **Upward Delivery** (downward displacement of air) is use to collect gases that are less dense than air. This is because when two gases are mixture together the less dense gas will move upward while the more dense gas will move downward. Hence the less dense gas is at the top but the more dense gas is at the bottom.

The major problem many student encounters, in gas delivery is that how would they know gases that are less dense than air or denser than air. This problem is easily solved by the fact that the relating molecular mass of air is 29g/mol. Therefore gases with relative molecular mass greater than 29g/mol (e.g. H_2S, SO_2, SO_3, CO_2 Cl_2 etc) are denser than air while gases with relative molecular mass lesser than 29g/mol (e.g. H_2 N_2, CO etc) are less dense than air.
Hence gases that are collected by upward delivery are: NH_3, N_2, H_2

ii. **Downward delivery** (upward displacement of air) is use to collect gases that are denser than air e.g. Cl_2, CO_2 HCl, H_2S, SO_2, N_2O etc.

iii. **Destructive distillation** of coal is the process of heating coal to a very high temperature in the absence of air in order for all the volatile components to distill over coal → coke + ammoniacal liquor + coal'tar + coal gas.

⇒ Uses of coke

- It is uses as fuel
- It is used as a reducing agent
- It is used in the production of gaseous fuel.

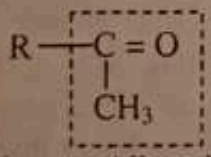
- It is use in the production of graphite, calcium carbide, silicon carbide. Aluminium carbide, carbon IV sulphide etc.

  ⇒ Uses of Ammoniacal liquor
- It used as a source of ammonia for the production of $(NH_4)_2SO_4$ which is used as a fertilizer.

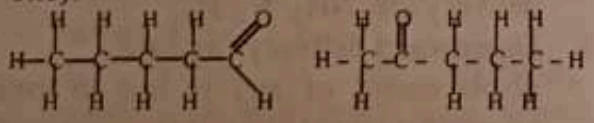
  ⇒ Uses of coal tar
- The distillation of coal tar yields products like benzene, toluene, phenol etc used in the synthesis of dye paints insecticides, drugs, plastics and explosives

  ⇒ Uses of coal gas
- It is uses as a fuel

1b. Carbonyl compound are Alkanal and Alkanone. Alkanal give a brick red colour to Fehling solution A & B. while Alkanone does not react with Fehling solution A & B. carbonyl compound that give a positive Iodoform test contain the functionality.

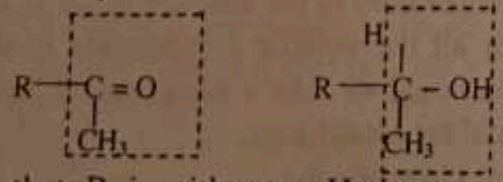


Hence X is an Alkanal i.e. Pentanal while Y is an Alkanone (i.e. propan-2-one).



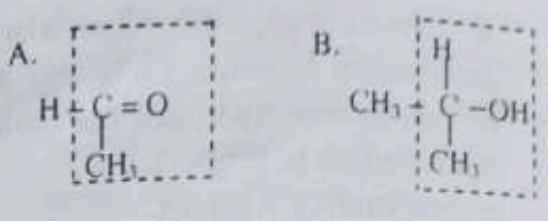
Propanal Propan-2-oL

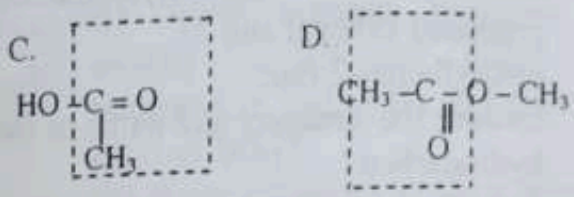
ii. For a compound to give a positive Iodoform test, it must contain the functionality.



Note that R is either an Hydrogen atom, Alkyl group or aryl group(C_6H_5 or substituted phenyl)

The structures of the give compound are shown below;

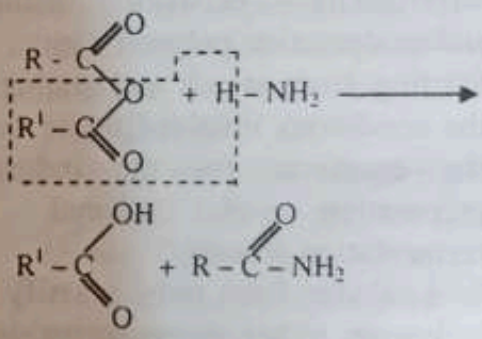




The required functionality is shown in the marked line. Note that ethanoic acid has a false carbonyl group because of resonance, hence it will not undergo Iodoform test. Also compound D will not give a positive Iodoform test because it R-group is neither an Hydrogen atom, Alkyl group nor an Aryl group. In other word only Alkanol and carbonyl compound(Alkanal and Alkanone) under Iodoform test. Hence the compound that will give a positive Iodoform test are A and B

iii. Iodoform - test

iv.



E F

1c. $C_xH_y + (x + y/4)\ O_2 \rightarrow xCO_2 + y/2\ H_2O$

VBR	$12cm^3$	$72cm^3$	-	-
VOR	$12cm^3$	$48cm^3$	$36cm^3$	-
VAR	-	$24cm^3$	$36cm^3$	-

⇒ from the reaction

$$\frac{1}{12} = \frac{x}{36}$$

$$x = \frac{36}{12} = 3$$

$$\Rightarrow \frac{x + y/4}{48} = \frac{x}{36}$$

But $x = 3$

$$\frac{3 + y/4}{48} = \frac{3}{36}$$

$$3 + y/4 = \frac{3}{36} \times \frac{48}{1}$$

$$3 + y/4 = 4$$

$$y/4 = 4 - 3 = 1$$

$$y = 4$$

$C_xH_y = C_3H_4$

Hence the hydrocarbon is propyne (C_3H_4).

2ai. This is because of the reluctance in breaking of carbon to carbon covalent bonds in organic compounds.

ii. $NaOH + CH_3CH_2CH_2Br \xrightarrow{\text{Reflux}} CH_3CH_2CH_2OH + NaBr$

$$CH_3CH_2OH \xrightarrow[180^0C]{\text{conc } H_2SO_4} CH_2 = CH_2$$

iii. $(CH_3)_3N + HCl \rightarrow [(CH_3)_3NH]^+Cl^-$

$$CH_3CH_2O\overset{\text{Alkanol part}}{\overbrace{}}\overset{\text{Acid part}}{\overbrace{CO\,CH_2\,CH_3}} + KOH \rightarrow$$

$$CH_3CH_2COOK + CH_3CH_2OH$$

Note that when alkaline hydrolysis is carried out the acid part will form salt while the Alkanol part will form Alkanol.

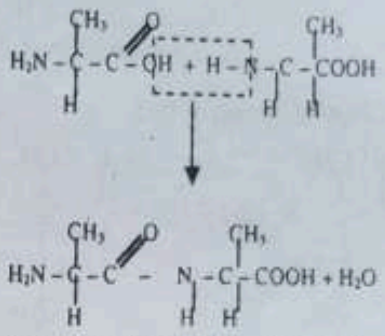
$$CH_3CH_2CHO \xrightarrow[0-15^0C]{KCN/H_2SO_4} CH_3CH_2-\underset{CN}{\overset{H}{C}}-OH$$

1-cyanopropan-1-01.

bi. I. Thermoplastic polymers are polymers which can be softened repeatedly by heat and remoulded e.g.Polythene, polypropene, Polystyrene, PVC, Nylon, Terylene perspex etc.

II. Thermosets polymers are polymers which cannot be softened or melted by heat and remoulded once they are formed or set.e.g.Phenolic material, Aminomethanal, material, Bakelite, Urea-Methanal

ii.



For every peptide bond form a water molecules is loss.

R.m.m of dipeptide =

12(1g/mol) + 6(12g/mol) + 2(14g/mol) + 3(16g/mol)

= 160g/mol

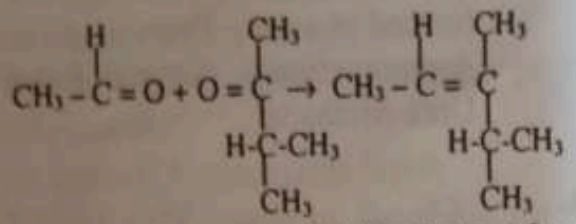
c.

Bleaching action of Cl_2	Bleaching action of SO_2
It bleaches by oxidation	It bleaches by reduction
It bleaching action is permanent	It bleaching action is temporal
$Cl_2+H_2O \rightarrow HOCl + HCl$ Dye + $HOCl \rightarrow HCl$ + [O+Dye]	$SO_2+H_2O \rightarrow H_2SO_3$ H_2SO_3 + Dye $\rightarrow H_2SO_4$ + colourless dye

3a. The $C_5H_{12}O$ satisfies the general formula $C_nH_{2n+1}OH$. Hence the compound is an Alkanal or ether since both are functional isomers.

ii. **Organic compound that give a steamy white fume with PCl_5 is either an Alkanol or Alkanoic acid**. Hence $C_5H_{12}O$ is an Alkanol. Therefore the functional group present in Q is –OH.

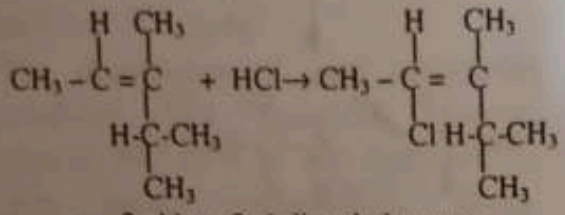
bi.



3,4-dimethylpent-2-ene

ii. Alkenes homologous series

iii.



2-chloro-3, 4-dimethylpentane

ci. Conc. H_2SO_4

ii. Silica gel, CaO

iii. $NH_4Cl + NaOH \rightarrow NaCl + NH_3 + H_2O$

iv. In addition polymerization there is no loss of small molecules like water, which does not, occurs in condensation polymerization.

4ai. $2(C_6H_{10}O_5) + nH_2O \xrightarrow[\text{Hydrolysis}]{\text{Amylase/Diastase}} nC_{12}H_{12}O_{11}$
maltose

$C_{12}H_{22}O_{11} + H_2O \xrightarrow[\text{Hydrolysis}]{\text{maltase}} 2C_6H_{12}O_6$
maltose glucose

$C_6H_{12}O_6 \xrightarrow[\text{Decomposition}]{\text{zymase}} 2C_2H_5OH + 2CO_2$
glucose ethanol

ii.

Monosaccharide	Disaccharides
Glucose	Lactose
Fructose	Maltose
Galactose	Sucrose

4bi. Oleum is a thick oily liquid obtained when SO_3 is dissolved in H_2SO_4

$SO_3 + H_2SO_4 \rightarrow H_2S_2O_7$
Oleum

ii. $S + O_2 \rightarrow SO_2$

$2SO_2 + O_2 \xrightarrow{V_2O_5} 2SO_3$

$SO_3 + H_2SO_4 \rightarrow H_2S_2O_7$

$H_2S_2O_7 + H_2O \rightarrow 2H_2SO_4$

iii. This is because HNO_3 attacks rubber and cock.

ci. Soapy detergents form scum with hard water as a result waste soap. While soapless detergents do not form scum with hard water as a result it does not waste soap

ii. **A green house** is a house made up of glass in which plant are nurse, such house allowed radiation from the sun to enter in but trap down the radiation so that it cannot return again into the atmosphere. The earth behaves like green house when there are much CO_2 in the atmosphere. The CO_2 allow radiation to travel through it to the earth but prevent it from returning back into the atmosphere.

The phenomenon whereby the earth traps radiation and prevent it from return back into the atmosphere as a result of the much CO_2 in the atmosphere is called **Green House Effect**. The radiation trap on the earth surface causes the temperature of the earth to rise above normal. The phenomenon whereby the temperature of the earth rises above normal due to the trap radiation on it is known as **GLOBAL WARMING. Hence the consequences of green houses effect is Global warming**. The consequence of global warming are listed below:

- It causes ice cap to melt
- It brings about increase in land temperature and shortage of freshwater to grow crops
- It encourages spread of deserts
- It upsets our ecosystem and human lives
- Changes in the behaviour of cells in the living tissues due to increase in ultraviolet radiation

CHAPTER FOUR

OBAFEMI AWOLOWO UNIVERSITY, ILE-IFE, NIGERIA

Pre-degree Programme 2006/ 2007 Session

CHMOO2 Second Mid - Contact Period Test

Answer All Questions

1.(a) (i) List the three important steps involved in the industrial manufacture of oxygen.

(ii) On what principle is the separation of nitrogen from oxygen in the process in (i) above based?

(iii) In the laboratory preparation of chlorine, why is collection of chlorine over brine preferred to over water?

(b) Use chemical equation to distinguish between But-2-yne and Pent-1-yne. State what is observed in each case?

(c) A compound with molecular formula C_7H_8 is a liquid at room temperature and burns in air with a luminous sooty flame.

(i) Determine the double bond equivalence in the compound

(ii) What is the possible structure for the compound?

(d) Write a balanced equation for the reaction between soda lime and sodium butanoate.

2.(a) Consider the following metallic oxides; CaO, MgO, PbO, CuO and HgO

(i) Which of the oxides is / are prone to reduction by H_2?

(ii) Which of the oxides can be used to produce oxygen?

(iii) Write a balanced equation to show the acidic property of one of the oxides.

(b) $2FeCl_2 + Cl_2 \rightarrow 2B + 6KOH \rightarrow 2C + 6KCl$

(i) What are B and C?

(ii) What is visually observed as $FeCl_2$ in the reaction passes to B, and B to C?

(c) State what is observed (with a one line reason) when each of the following liquids is put in turn on the path of a plane polarized light;

(i) 2-methylpropanoic acid (ii) 2-aminopropanoic acid

(d) Ozonolysis of an alkene produced propanone and 3-methylbutan-2-one.

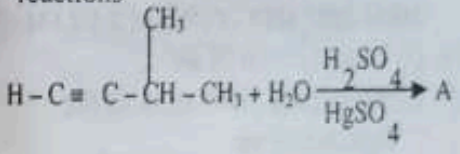
(i) Write the structure of the ozonide produced, and deduces the structure of the alkene.

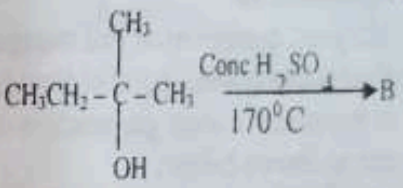
(ii) Name the alkene.

3(a) Explain why 2-ethylheptane is not a standard IUPAC name. Give the correct name for the compound.

(b) How many structural isomers are possible for $C_2H_4Cl_2$? Draw and give their names

(c) Give the structure of the lettered compounds in each of the following reactions





What are the organic products obtainable from the chain termination step in the monochlorination of ethane?

(d) An alkanol has the molecular formula $C_5H_{12}O$. Write the structure and name of an isomer corresponding to (1) primary (ii) secondary and (iii) tertiary alkanol

(e) Write a balanced equation for the complete combustion of any one of the isomers in (3d) above.

4. (a) (i) It is coloured

(ii) It has empty d-orbital

(iii) It is a halogen

(iv) It readily sublimes

(v) It is very reactive

Which of the above properties would you select as being responsible for the use of iodine in detecting the spots of colourless compounds on thin layer chromatograph

Use roman figure(s) for your answer.

(b) (i) is bromine an electrophile or a nucleophile?
(ii) Explain your choice with the aid of structures only
(c) deduce the IUPAC name for $CF_3CH(Cl)(Br)$
(d) Write an equation for the reaction taking place when chlorine water is exposed to sunlight
(e) (i) Which chemical (formula), when added to water removes both temporary and permanent hardness in the water?
(ii) Using the chemical in (i) above, give equation for the reaction that removes temporary and permanent hardness respectively.

SOLUTION

2006/ 2007 MID - CONTACT EXAM

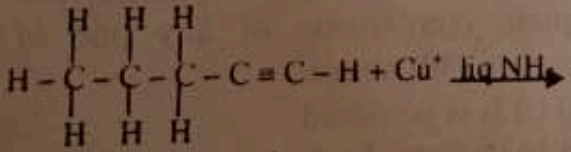
1a. (i) Liquefaction of air
(ii)Fractional distillation of the liquidified air.
(iii)Drying, compression and storage

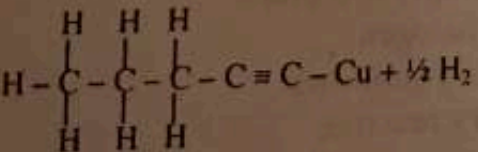
ii. Difference in boiling point of liquids.

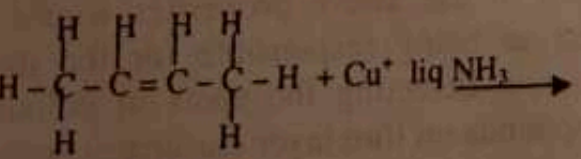
iii. It is because chlorine gas reacts with water as shown below;

$$Cl_2 + H_2O \rightarrow HOCl + HCl$$

b. Pent-1-yne is a terminal Alkyne while but-2-yne is not a terminal Alkyne. Terminal Alkyne react with Ammoniacal solution of copper I chloride or silver nitrate but non-terminal Alkyne does not







No reaction

ci. **Double Bond Equivalence (DBE)** is the number of hydrogen molecules that would be added to a molecule to convert all pie bonds to single bonds and all rings to acyclic structures. One DBE means one ring structure or one double bond. Two DBE means two rings structure, two double bonds, one triple bond or one ring plus one pie bond. Double Bond Equivalent (DBE) is also known as **unsaturation number**

$$DBE = \frac{2N_C - N_H - N_x + N_N + 2}{2}$$

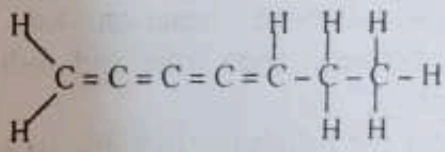
N_C = Number of carbon atom
N_H = Number of hydrogen atom
N_x = Number of halogen atom
N_N= Number of nitrogen atom

For example the DBE of C_7H_8 is obtain as shown

$$DBE = \frac{2(7) - 8 - 0 + 0 + 2}{2}$$

$$= \frac{14 - 8 + 0 + 2}{2} = \frac{16 - 8}{2} = \frac{8}{2} = 4$$

Hence the double bond equivalent is 4.



d. $NaCH_3CH_2CH_2COO + NaOH \longrightarrow$ (from sodaline)

$Na_2CO_3 + CH_3CH_2CH_3$

propane

2a. Oxides that are reduced by hydrogen contain metals that are lower than hydrogen in the activities series e.g. Cu, Hg, Ag & Au. Hence CuO and HgO are reduced by hydrogen gas.

$$CuO + H_2 \rightarrow Cu + H_2O$$
$$HgO + H_2 \rightarrow Hg + H_2O$$

ii. Oxygen can be produced by the thermal decomposition of oxide lower than Hydrogen in the electrochemical series e.g. Ag_2O, HgO, CuO etc.

$$4CuO \rightarrow 2Cu_2O + O_2$$
$$2HgO \rightarrow 2Hg + O_2$$

iii. Lead II oxide is amphoteric hence it will react with both acid and base.

$PbO + 2HCl \rightarrow PbCl_2 + H_2O$

2b. When HCl and Cl_2 combine/react with metal that can form more than one chloride HCl always form lower chloride while Cl_2 for always form the higher chloride i.e.

$2Fe + 2Cl_2 \rightarrow 2FeCl_3$

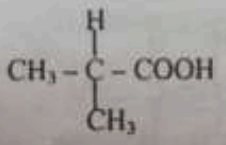
$Fe + 2HCl \rightarrow FeCl_2 + H_2$

Hence

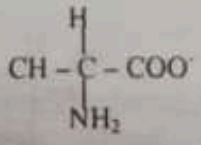
$2FeCl_2 + Cl_2 \rightarrow 2FeCl_3 + 6KOH \rightarrow 2Fe(OH)_3 + 6KCl$; B $\rightarrow FeCl_3$ & C $\rightarrow Fe(OH)_3$

ii. The colour of the solution changes from green to reddish brown when $FeCl_2$ in the reaction is converted to B while the solution changes from reddish brown solution to insoluble reddish brown solution when B convert to C.

c. Organic compound that are optically active (i.e. rotate the plane of polarized light) contain **chiral centre**. **Chiral centre is a carbon atom surrounded by four different group**.



2-methylpropanoic acid



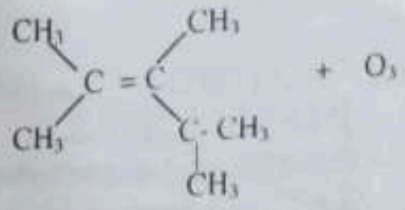
2-aminopropanoic acid

Hence only 2-aminopropanoic acid that is optically active because it contain a chiral centre.

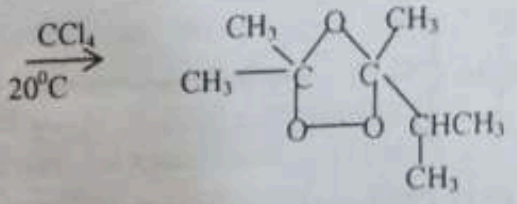
i. It does not rotate the plane of polarized light because it is not optically active.

ii. It rotates the plane of polarized light because it is optically nature.

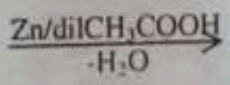
di.



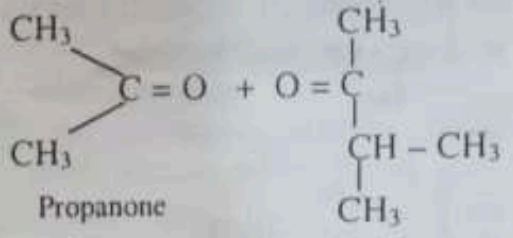
2,3,4-trimetylpent-2-ene



Ozonide



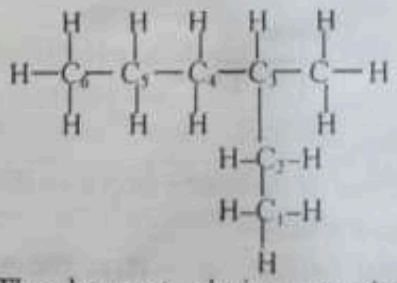
ii.



Propanone

3-methylbutan-2-ene

3a.

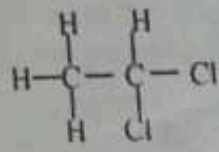


i. The longest chain contains 6 carbon atoms. Hence the parent Alkane is hexane.

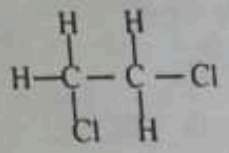
ii. There is a methyl group attached to carbon 3. Hence the substituent name is 3-methyl.

iii. The IUPAC nomenclature is 3-methylhexane.

3b.



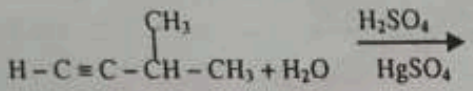
1, 1-dichloroethene

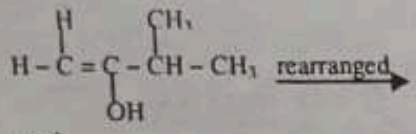


1, 2-dichloroethene

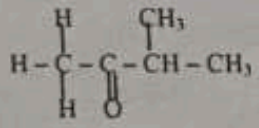
Hence $C_2H_4Cl_2$ has two structure isomers.

ci.



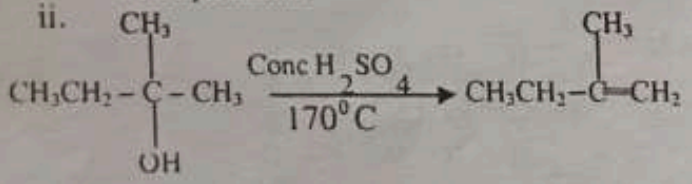


enol



3-methylbutanone

ii.



iii. Chlorination of Alkanes occur in three stages as shown below;

a. **Chain initiation** – it is the state in which molecules are converted to radical.

$$Cl_2 \xrightarrow{uv} 2\dot{Cl}$$

b. **Chain propagation** – it is the stage in which radical combine with molecules to form radicals and molecules.

$$CH_3\dot{C}H_2 + Cl \rightarrow CH_3CH_2 + HCl$$

$$CH_3\dot{C}H_2 + Cl_2 \rightarrow CH_3CH_2Cl + \dot{Cl}$$

c. **Chain terminal** – it is the stage in which radical combine to form molecules.

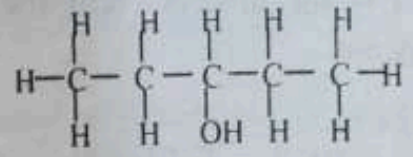
$$\dot{Cl} + \dot{Cl} + S \rightarrow Cl_2$$

$$CH_3\dot{C}H_2 + \dot{C}H_2CH_3 \rightarrow CH_3CH_2CH_2CH_3$$

Note that S is a third body use to absorb the large amount of heat given off when two chlorine free radical combine together.

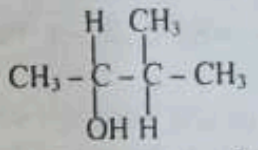
d.

i.



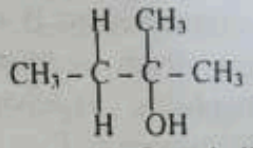
Pentan-3-ol

ii.



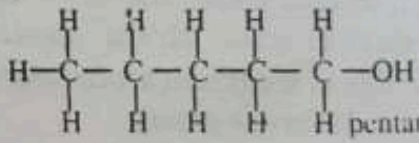
3-methylbutan-2-ol

iii.



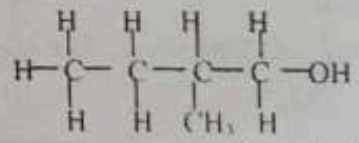
2-methylbutan-2-ol

iv.



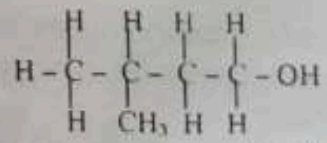
pentan-1-ol

v.



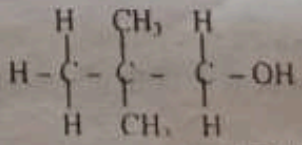
2-methylbutan-1-ol

vi.



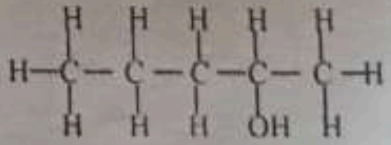
3-methylbutan-1-ol

vii.



2,2-dimethylpropan-1-ol

viii.



Pentan-2-ol

- **Primary monohydric Alkanols** are Alkanols in which the carbon atom that bear the –OH group is link directly to one alkyl group. Hence i-iv are primary Alkanols.
- **Secondary monohydric Alkanols** are Alkanols in which the carbon atom that bear the –OH group is link directly to two alkyl groups. Hence v-vii are secondary Alkanols.
- **Tertiary monohydric Alkanols** are Alkanols in which the carbon atom that bear the –OH group is link directly to three alkyl groups. Hence viii is a tertiary Alkanols.

e. $C_5H_{12}O + 15/2\ O_2 \rightarrow 5CO_2 + 6H_2O$

4a. i. It is coloured

ii. It has an empty d-orbital

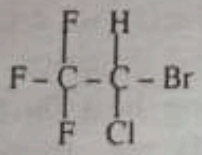
iii. It readily sublimes i.e. it form a loose bond.

The above properties of iodine enable it used in detecting the spots of colourless compounds on thin layer chromatograph.

b. i. Electrophiles

ii. It is because, it becomes polarized on approaching electron cloud and attack the election rich centre with it positive pole.

c.



2-bromo-2-chloro-1,1,1-trifloroethene

d. $Cl_2 + HCl \rightarrow HOCl + HCl$

chlorine water

$2HOCl \xrightarrow{\text{sunlight}} 2HCl + O_2$

e. i. Na_2CO_3

ii. $Na_2CO_3 + Ca(HCO_3)_2 \rightarrow NaHCO_3 + CaCO_3$

$Na_2CO_3 + CaSO_4 \rightarrow Na_2SO_4 + CaCO_3$

OBAFEMI AWOLOWO UNIVERSITY, ILE-IFE, NIGERIA

Pre-degree Programme 2006/2007 Session

CHM002 Second Contact Period Examination.

Instructions: Write your name (Surname first), Registration Number and Group on front cover of your Answer booklet.

Answer All Questions Time: 1 2/3 hour

1(a) For each of the following information/observations, (using one word or very few words) draw conclusions about the structure of the compound concerned.

(i) Three isomeric pentenes can each be hydrogenated to give 2-methylbutane.

(ii) An unknown organic compound gives steamy white fumes with PCl_5 and also gives positive Iodoform test.

(iii) An alkene upon ozonolysis gives one product.

(iv) An hydrocarbon K has a molecular formula $C_{10}H_{16}$. Find the number of Double Bond Equivalent in the compound.

(b) Deduce the IUPAC name for: $CH_3CH(Br)(CH_2)_3C(Cl)(C_2H_5)CH_3$.

(c) Consider the reaction below

$CH_3CH_2.O.CO.CH_2CH_3 \xrightleftharpoons[\text{reflux}]{\text{dil.HCl}} A + B$

Give the formula of products A and B

(d) The condenser is subjected to a number of different usages in the laboratory. State two of such usages and against each usage indicate the positioning of the condenser.

(e) (i) What do you observe when you heat a mixture of solid NaCl with conc. H_2SO_4 and solid MnO_2

(ii) Give equations for the synthesis of producer gas.

(g) With the aid equations show the bleaching action of SO_2. Include dye in your equation.

(h) Write for the reaction between ethanoic anhydride and 2-aminopropane.

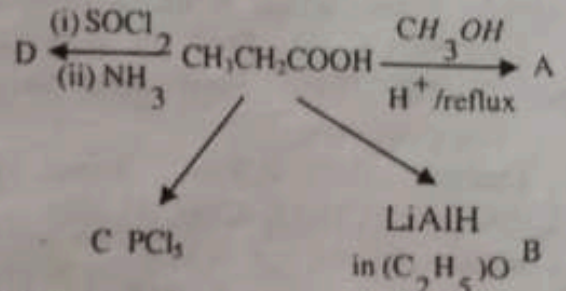
2.(a) Give two example in each case of metals that are (i) extracted by electrolysis
(ii) extracted by thermal reduction (ii) found free in nature.

(b) Name two gases that are found suitable for demonstrating fountains experiment and state their property that makes them suitable for the experiment.

(c) (i) Write an equation to show how hydrochloric acid reacts with 1-ammopentane.
(ii)What volume of 0.125 M hydrochlori acid would completely react with 0.30 g of 1-aminopentane? [H=1; C=12; N=14].

(d) List five oxides of Nitrogen and indicate the oxidation state of Nitrogen against each of the oxides.

(e) Give the names and the formulae of the compounds lettered A to D according to the scheme below.



3(a)State in one or two words, the property exhibited by hydrogen sulphide in each of the following reactions.
(i) $SO_{2(g)} + 2H_2S_{(g)} \rightarrow 3S_{(s)} + 2H_2O_{(l)}$
(ii) $Cu(NO_3)_{2(aq)} + 2H_2S_{(g)} \rightarrow CuS_{(s)} + 2HNO_3$
(iii) $Ca(OH)_2 + 2H_2S_{(g)} \rightarrow CaS_{(aq)} + 2H_2O_{(l)}$

(b) Consider the reaction scheme below -

$$Pb(NO_3)_{2(s)} \xrightarrow{A} PbO_{(s)} \xrightarrow{B} Pb(NO_3)_{2(aq)} \xrightarrow{C} PbSO_{4(s)}$$

Indicating in each case what A, B and C is, write a balanced equation for each of the reactions involved in the conversion.

(c) (i) Write a structure and give the name of an isomer of ethanoic acid
(ii) Write the formula of the organic compounds from which the isomer of the acid can be prepared.
(iii) Give the formula of a reagent which will give visible evidence and distinguish the acid from its isomer.

(d) An organic hydrocarbon compound upon complete combustion produced at s. t. p 67.2 dm^3 of CO_2 and 36 g of water [molar volume at s. t. p =22.4 dm^3].
(i) Deduce the molecular formula of the compound.
(ii) Name the reagent required to unambiguously identify the hydrocarbon series of the hydrocarbon.

4(a) Consider the following compounds.
(I) $CH_3CH_2CH_2CH_2CH_2CH_3$
(II) $CH_3CH_2C(CH_3)(CH_3)CH_3$
(III) $CH_3CH_2C(OH)(CH_3)CH_2CH_3$
(IV) $CH_3CH_2CH(CH_3)CH_2OH$
(V) $CH_3CH_2CH_2CH_2CH_2COOH$
(i) Using the corresponding number arrange the compounds in order of increasing volatility (No reason is required).
(ii) Which of compounds (1) - (IV) will be most soluble in water (no reason is required)

(b) Using balanced equation only show what happens when excess hydrogen bromide is made to react with prop-1-yne. Name the major product.

(c) Write balanced equation to show the action of strong heat on the following compounds. (i) potassium trioxonitrate (V) (ii) cupper(II) trixonitrate (V)

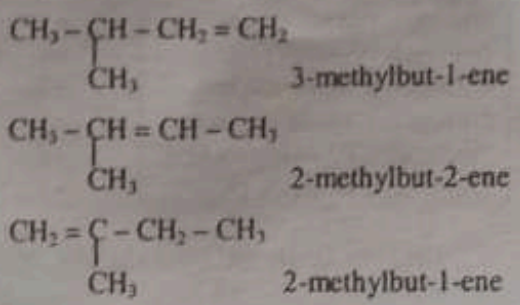
(d) State the differences (one each) between thermoplastic and thermosetting polymers under the following heading:
(i) Structural properties (ii) Physical properties.

(e) Draw the structures of all secondary amine with molecular formula $C_4H_{11}N$ and name them using IUPAC nomenclature.

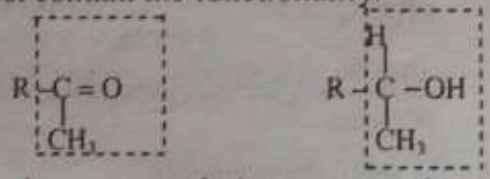
(f) State two advantages of hard water.

SOLUTION TO 2006/2007 EXAMS

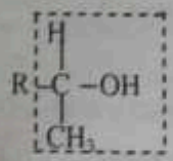
1a. i. The structures of the three isomeric pentene is



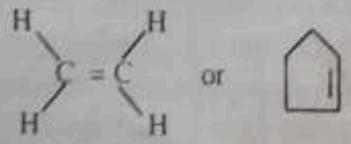
ii. Organic compound that give steamy white fume with PCl_5 contain either – **OH or –COOH group**. While organic compound that give positive Iodoform test contain the functionality.



Since the compound give steamy white fume with PCl_5 and also give positive Iodoform test, then the functionality present in the organic compound is



iii. It means that the alkene is symmetry i.e. it can be divided into two equal halves or it contains a cyclic ring with one double bond.



iv. **Double Bond Equivalence (DBE)** is the number of hydrogen molecules that would be added to a molecule to convert all pie bonds to single bonds and all rings to acyclic structures. One DBE means one ring structure or one double bond.Two DBE means two rings structure, two double bonds, one triple bonds or one ring plus one pie bond. Double Bond Equivalent(DBE) is also known as **unsaturation number**

$$DBE = \frac{2N_C - N_H - N_x + N_N + 2}{2}$$

N_C = Number of carbon atom

N_H = Number of hydrogen atom

N_x = Number of halogen atom

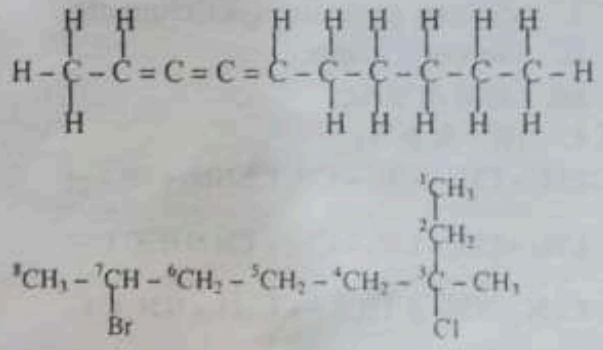
N_N= Number of nitrogen atom

For example the DBE of $C_{10}H_{16}$ is obtain as shown

$$DBE = \frac{2(10) - 16 - 0 + 0 + 2}{2}$$

$$= \frac{20 - 16 + 0 + 2}{2} = \frac{22 - 16}{2} = \frac{6}{2} = 3$$

Hence the double bond equivalent of the hydrocarbon is 3.



i. The longest chain contains 8 carbon atoms. Hence the parent Alkane is octane.

ii. There is a bromine, chlorine and methyl group attacked to carbon 7, 3 and 3 respectively. Hence the substituent name is 7-bromo-3-chloro-3-methyl.

iii. The IUPAC nomenclature is 7-bromo-3-chloro-3-methyloctane.

c. $CH_3CH_2O\,COCH_2CH_3 \underset{\text{reflux}}{\overset{\text{dil HCl}}{\rightleftharpoons}} CH_3CH_2OH + CH_3CH_2COOH$

di. Condensation of vapour into liquid. The position is slanting.

ii. Reflux of organic reaction. The position is vertical.

e. $NaCl + H_2SO_4 + MnO_2 \rightarrow Na_2SO_4 + MnSO_4 + 2H_2O + Cl_2$

Hence a chlorine gas is liberated.

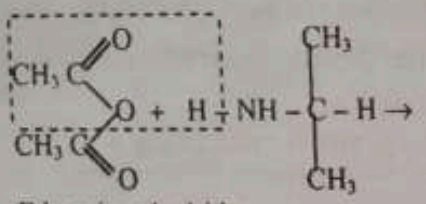
f. **Producer gas** is a fuel gas made by passing air through a thick layer of white-hot coke. It is a mixture of CO & N_2.

$2C + O_2 + 4N_2 \rightarrow 2CO + 4N_2$

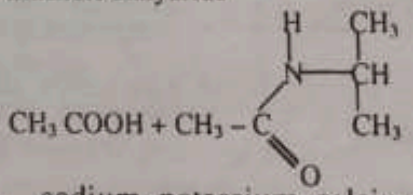
g. $SO_2 + H_2O \rightarrow H_2SO_3$

$H_2SO_3 + Dye \rightarrow H_2SO_4 + colourless\ dye$

h.



Ethanoic anhydride



2. i. sodium, potassium, calcium etc.
   ii. Mercury, copper etc.
   iii. Gold & silver

2b. i. HCl & NH_3

2c. $CH_3 - CH_2 - CH_2 - CH_2\ CHNH_2 + HCl \rightarrow$

$CH_3 - CH_2 - CH_2 - CH_2 - \overset{+}{C}H\ \overset{+}{N}H_3\ \overset{-}{Cl}$

ii. $C_5H_{10}NH_2 + HCl \rightarrow C_5H_{10}\overset{+}{N}H_3\overset{-}{Cl}$

0.3g

R.m.m of $C_5H_{11}NH_2 = 87g/mol$

$$\cap_{C_5H_{10}NH_2} = \frac{0.3g}{87g/mol} = 0.00344mol$$

$$\cap_{HCl} = \frac{1\ mole\ of\ HCl}{1\ mole\ of\ C_5H_{10}NH_2} x$$

0.0035mol of $C_5H_{10}NH_2 = 0.00344mol$

$$\cap_{HCl} = \left(\frac{V\ in\ cm^3}{1000}\right) dm^3 \times molar\ conc.$$

$$0.0044 = \frac{v}{1000} \times 0.125$$

$$V = \frac{0.00344 \times 1000}{0.125} = 27.52cm^3$$

$\Rightarrow V = 27.52cm^3$

The Volume of HCl needed to react with 0.3g of 1-aminopentane is $27.52cm^3$

d.

Oxides of nitrogen	Oxidation state of nitrogen
Nitrogen I oxide (N_2O)	+1
Nitrogen IV oxide (NO_2)	+4
Nitrogen II oxide (NO)	+2
Nitrogen V oxide (N_2O_5)	+5
Dinitrogen IV oxide (N_2O_4)	+4
Dinitrogen III oxide (N_2O_3)	+3

2e. $CH_3CH_2CONH_2 \xrightarrow[-HCl]{NH_2CH_3CH_2COCl} \xrightarrow[-SO_2\ -HCl]{SOCl_2}$

$\xrightarrow[H^+/Reflux]{CH_3OH} CH_3CH_2COOCH_3 + H_2O$

A → methylpropanoate
B → propan-1-oL
C → propanoyl chloride
D → propylamide

3. i. Reducing agent
   ii. Precipitating agent
   iv. Acid

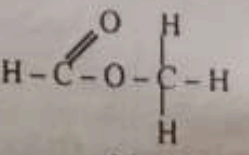
3b. $2pb(NO_3)_2 \xrightarrow{\Delta} 2PbO + 4NO_2 + O_2$

$PbO + 2HNO_3 \longrightarrow Pb(NO_3)_2 + H_2O$

$Pb(NO_3)_2 + H_2SO_4 \longrightarrow PbSO_4 + 2HNO_3$

A → heat
B → HNO_3
C → H_2SO_4

3c. i.



Methylmethanoate

ii. Methylmethnaote is prepared by the reaction of Methanoic acid and methanol (i.e. HCOOH & CH_3OH).

iii. $NaHCO_3$

3d. $\cap co_2 = \frac{67.2dm^3}{22.4dm^3/mol} = 3mol$

$Mco_2 = 3 \times 44g/mol = 132g$

Mass of c in 132g of CO_2 = 12/44 x 132g = 36g.
Mass of H in 36g of H_2O = 2/18 x 36g = 4g.

C	:	H
$\frac{36}{12}$	:	$\frac{4}{1}$
3	:	4

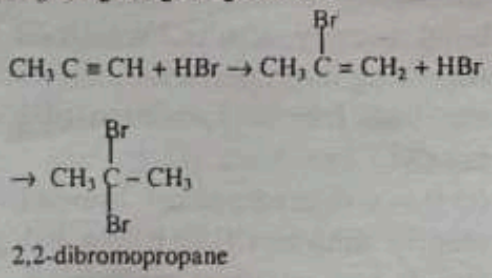
The empirical formula is C_3H_4. Hence the hydrocarbon is propyne.

iii. **Ammoniacal solution of CuCl or $AgNO_3$ is use to confirm the presence of terminal Alkyne or Alkanal.**

4. v < iv < iii < i < ii

iii. $CH_3CH_2CH_2CH_2COOH$

4b.



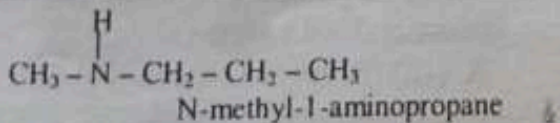
2,2-dibromopropane

4c. $2KNO_3 \rightarrow 2KNO_2 + O_2$
$2Cu(NO_3)_2 \rightarrow 2CuO + 4NO_2 + O_2$

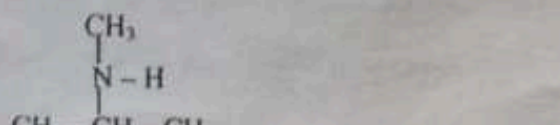
4d.

Thermoplastics polymers	Thermosetting polymers
The atoms of thermoplastic polymers are linearly linked or immensely alternating linked. Hence they can be remolded	The atoms of thermosetting polymers are massively cross-linked. Hence they cannot be remolded.

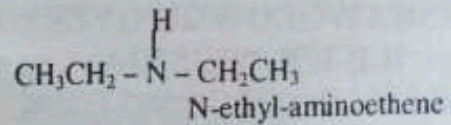
e.



N-methyl-1-aminopropane



N-methyl-2-aminopropane



N-ethyl-aminoethene

f. **Advantage of hard water**

i. It helps in bone formation
ii. It is not slippery when use for bathing.
iii. It has a pleasant taste because of the dissolve minerals in it.

CHAPTER FIVE

OBAFEMIAWOLOWOUNIVERSITY, ILE IFE, NIGERIA

CHM 002 Second Contact Period Examination (2007/2008)

Instructions

(a) Each questions is followed by FOUR options lettered A to D. Find out the correct option for each questions and write in INK in the space provided on the answer sheet, against each question number, the alphabet which corresponds to the correct alternative. Where there is no correct alternative write 'E'. Do not write in the 3rd column with blank as heading.

(b) Indicate your name (surname first) and Registration Number

(c) You are to answer (IN INK) those questions which you arc sure of, s negative narks shall be awarded for wrong guesses

(d) You must not bring in mobile phones into the test Room

1. The complete combustion of I mole of an Alkanol is represented by the equation:
$C_nH_{2n+1}OH + xO_2 \rightarrow yCO_2 + zH_2O$
Then x: y: z is equal to?
A.(3n+l)/2:n: (n+l). B.(3n-l)/2:n: (n-l) C. (3n+2)/2:n:(n+l) D.3n/2:n: (n+1)

2. If the complete combustion of 1. Mole of the above Alkanol required six moles of oxygen, then the Alkanol is? A. butanol B. methanol C. ethanol D propanol.

3. Which Alkanes are used in the scale of octane rating?
A. heptane and octane B. heptane and 2,2,4-trimethylpentane C. hexane and octane. D. pentane and octane

4. Let the Alkanes with 0 and 100 percent octane rating be X and Y respectively. What will be the rating of a fuel whose performance is the same as that of a mixture of 25.5g of X and 24.5g of Y.
A.55 B.49 C. 51 D.45

5. When but-l-yne is bubbled into dilute H_2SO_4 in the presence of $HgSO_4$, the final product of the reaction is: A. butan-1-ol B. butan-2-ol C. butanal D. butanone.

6. The respective numbers of isomeric alkanols and alkoxyalkanes with molecular formula $C_4H_{10}O$ are:
A. 4,3 B. 3,3 C. 4,4 D. 3,4

7. The spots of colourless organic compounds are usually made visible by inserting the plates into a tank containing iodine crystals. A loose bond usually results. Which of the following properties of iodine accounts for the formation of loose bonds?
(i) It is coloured reddish brown (ii) It readily sublimes (iii) It is a halogen (iv) It has empty d-orbitals. A. (i), (ii), (iii) & (iv) B.(i) (ii) & (iv) only C. (iv) only D. (i) &(ii) only

8. Which of the following contains compounds each of which can be produced using metal carbides as starting materials?
A. propane & propene B. ethane & ethyne C. methane & ethyne D. methane & propane

9. Consider the following structures: (i) $CH_3CH_2CH(OH)CH_3$
(ii) $CH_3CH(CH_3)CH_2OH$
(iii) $CH_3CH_2CH_2OCH_3$
(iy) $CH_3CH_2CH_2CH_2OH$
Which of them will form positional isomer(s) with (i).
A. (iii) B. (iv) C. (i) D (ii)

10. Consider the following reaction scheme:

$$CH_3(CH_2)_3CH_2OH \xrightarrow[180^oc]{H_2SO_4} X \xrightarrow{HBr} Y \xrightarrow[Reflux]{aq\ NaOH} Z$$

Zis ?A. pentan-2-ol B. pentan-1-ol C. butan-2-ol D. butan-1-ol

11. Ethane, Ethene and ethyne respectively passed into acidified $KMnO_4$ will produce:
A. ethane-1,2-diol, ethanedioic acid and ethane B. ethanedioic acid, ethane and ethane-1,2-diol C. ethanol, ethan-1,2-diol and ethanedioic acid D. ethane, ethane-1,2-diol and ethanedioic acid.

12. $20cm^3$ of a gaseous hydrocarbon were mixed with $160cm^3$ of oxygen (an excess), both at room temperature and later exploded. On cooling to the original temperature of measurement, $130cm^3$ of the residual gaseous mixture was obtained. After passing through conc. KOH solution the volume was reduced to $50cm^3$. The volume in cm^3 of O_2 used and CO_2 produced are respectively:
A. 80,110 B. 48,80 C. 30.48 D. 110,80

13. Consider the following compounds: (i) 2-methylpropan-2-ol (ii) propan-2-ol (iii) propan-1-o1 (iv) ethanol. Which of them can be attacked by warm $KMnO_4/H^+$
A. (i),(ii), (iii)& (v) B. (i)&(ii) only C. (ii),(iii) & (iv) only D.(ii) & (iii) only.

14. If the compound, $CH_3CH_2C(Cl)(CH_3)CH_2CH_3$ is heated with alcoholic KOH, which of the following compounds is/are not formed: (i) 3-methylpent-1-ene (ii) 2-ethylbut-1-ene (iii) 3-methylpent-2-ene. A. (i)&(iii) only B. (i)&(ii) only C. (i), (i)&(iii) only D. (ii) & (iii) only.

15. A developed chromatoplate showed that the height reached by the solvent front is 5 times that of a pure compound from the line of the origin. What is the R_f value of the compound? A. 0.2 B. 0.25 C. 0.5 D. 0,4

16. Consider the following types of overlapping of orbitals in organic molecules. (i) sp^3/sp^2 (ii) p/p (iii) sp^2/s (iv)sp^3/s (v) sp^2/sp^2 (vi) sp^3/s^3 Which of them is/are present in methylbenzene (toluene).
A. (i).(iii), & (iv) only B.(i) to (vi) C. (i),(ii) & (v) D. (i),(ii),(iii),(iv)& (v) only

17. 1.58g of an organic compound containing carbon, hydrogen and oxygen on combustion yielded 1.98g of H_2O and 4.4 g of CO_2 the percentages of carbon, hydrogen and oxygen in the compound are respectively. A.70.4, 14.0 & 15.6 B. 77.4, 14.0 & 8.6 C. 11.0, 70.4 &15.6 D.75.9, 13.9 & 10.2

18. Consider the following organic reagents: (i) $(CH_3)_3N$ (ii)Br_2 (iii) BF_3(iv) $CH_3CH_2^+$. Electrophiles are A. (i) & (iv) only B. (ii), (iii) & (iv) only C. (i) & (ii) only D. (iii) & (iv) only.

19. What mass of bromine will saturate completely 3.3g of pent-3-ene-1-yne? [C=12; H=1; Br=80]
A. 48g B. 32g C. 24.0g D. 0.30g

20. The following are isomeric dibromopropanes
(i) $CH_3C(Br)2CH_3$,
(ii) $BrCH_2CH_2CH_2Br$
(iii) $CH_3CH(Br)CH_2Br$
(iv) $CH_3CH_2CH(Br)_2$
which of them will yield three possible tribromo products on further bromination. A. (iii)) only B. (iv) only C. (iii) & (iv) only D. (i) & (ii) only

21. $11.2dm^3$ of hydrogen. at s.t.p is required to saturate 13.5g of an Alkyne. Calculate the molar mass the Alkyne (molar volume of any gas

at s.t.p = 2.4dm^3] A. 68g B 40g C.54g D.82g.

22. With measurements made at 120°C. 5.0cm^3 of steam were produced by complete combustion of 1cm^3 of an Alkane. What is the molecular formula of the Alkane.
A. CH_4 B.C_3H_8 C. C_2H_6 D. C_4H_{10}

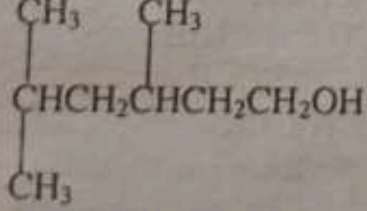
23. Which of the following alkenes will produce Ethanal and butanone on ozonolysis.
A. 3-methylpent-2-ene B. 3-methylpent-l-ene C. 3-methylbut-2-ene D. 3-methylhex-2-ene.

24

Compound	Operation performed	Product
2-bromopropane	fluxed with aq KOH	(i)
2-bromoprane	Heated with alcoholic KOH	(ii)
1–bromopropane	Refluxed with aq KOH	(iii)
1–bromopropane	Heated with alcoholic KOH	(iv)

Products (i),(ii), (iii) & (iv) are respectively
A. propene,propan-2-ol, propane and propan-1-ol B. propan-1-ol, propene, propan-2-ol & propane C. propene,propan-1-ol, propane and popan-2-al D. propan-2-ol,propene, propan-1-cl and propene.

25. Consider the structure: Which of the following is/are reasonable when named as Alkanol and Alkane.



(i)1-hydrox-3,5-dimethylhexane (ii) 6-hydroxy-2,3-dimethlhexane (iii) 5-hydroxyl-1,1,3-trimethylhpentane (iv)1-hyroxy-3,5,5-trimethylpentane (v) 3,5-dimethylhexan-1-ol (vi) 3,5,5-trimethypentan-1-ol
A. (v) & (vi) only B. (i), (ii) & (iii) only C. (i) & (v) only D. (ii) & (iii) only.

26. Which of the following reactions is/are involved in the bleaching action of chlorine?
(i) $Cl_2+2KOH \rightarrow KOCl + KCl + H_2O$
(ii) $H_2O + Cl_2 \rightarrow HCl+HOCl$ (iii) Dye + $HOCl \rightarrow HCl$ (dye + O).
A. (i) & (ii) only B. (i) & (iii) only C. (i), (ii) & (iii) D. (ii) & (iii) only

27. Which of the following statements is/are true? (i) All non-metals are held together by weak Van der Waals forces (ii) Water gas and producer gas are fuel containing carbon (II) oxide (iii) Chlorine can he absorbed by aqueous Sodium hydroxide.
A.(i) & (ii) only B. (i) & (iii) only C. (ii) & (iii) only D.(i), (ii) & (iii)

28. Consider the followings, each of which is to be treated with dilute tetraoxosulphate (vi) acid in an attempt to prepare Carbon (IV) oxide. Which of the trioxocarbonate (IV) is/are not suitable? (i) Na_2CO_3 (ii) $ZnCO_3$ (iii) $PbCO_3$ (iv) $BaCO_3$ (v) $CaCO_3$
A. (i) & (ii) only B. (ii) & (iii) only C. (i) & (v) only D. (iii), (iv) & (v) only.

29. In which of the following reactions is one of the reactants behaving both as oxidizing and reducing agent.
A. $HCl + KOH \rightarrow KCl + H_2O$
B. $Cl_2+2KOH \rightarrow KCl+KOCl + H_2O$
C. $Al_2O_3+2KOH+3H_2O \rightarrow 2K[Al(OH)_4]$ D. $CO_2 + 2KOH \rightarrow K_2CO_3 + H_2O$

30. Consider the following set of oxides (i) ZnO (ii) NO (iii) Na_2O (iv) CO (v) SO_2 (vi) N_2O which of them are neutral.
A (iv), (v) & (vi) only B. (i), (iii) & (v) only C. (i), (ii) & (iii) only D (ii), (iv) & (vi)only.

31. Which of the following is not as correct as far as purification of water, for town water supply, is concerned (i) Aeration kills bacteria (ii) Addition of alum removes suspended particles. (iii) Passage through filter beds effects filtration.
A. (ii) only B. (iii) only C. (i), (ii) & (iii) D. (i) only

32. Which of the following statements correctly represent(s) the method of collecting a dry sample of chlorine.(i) Downward delivery (ii) Upward delivery (iii) upward displacement of air (iv) Downward displacement of air
A. (ii) & (iv) only B. (i) & (ii) only C. (iii) & (iv) only D. (i) & (iii) only

33. Which of the following methods remove(s) both temporary and permanent hardness in water?
(i) Boiling (ii) Addition of calculated quantity of $Ca(OH)_2$ (iii) Addition of Na_2CO_3(iv) Passage through ion-exchanger A. (iii) & (iv) only B. (i) & (iii) only C. (ii) & (iv) only D: (i) &(ii) only

34. Consider the following terminologies (i) Polymorphism (ii) Isotropy (iii) Allotropy Which of (i),(ii) & (ii) is/are exhibited by carbon.
A. (i) only B.(i) , (ii) & (iii) C. (ii) only D. (iii) only

35. Which of the following trioxocarbonate (iv), cannot be decomposed by heat.
(j) $ZrCO_3$ (ii) Na_2CO_3 (iii) $PbCO_3$ (iv) K_2CO_3
A (ii) & (iii) only B (i), (ii) & (iii) only C (i) & (iii) only (i) (ii) & (iv) only.

36. Which of the following equations does not occur as written?
(i) $2KI + Cl_2 \rightarrow 2KCl + I_2$ (ii) $3Fe(s) + 6HCl(aq) \rightarrow 3FeCl_3 + 3H_2$ (iii) $2Fe(s) + 3Cl_2 \rightarrow 2FeCl_3$ A.(i) & (ii) only B. (ii) & (iii) only C. (i) & (iii) only D. (i),(ii) & (iii).

SOLUTION
2007/2008 MID-TEST

1. $C_nH_{2n+1}OH + \left(\frac{3n}{2}\right)O_2 \rightarrow nCO_2 + (n+1)H_2O$
Hence x = 3n/2, y = n & z = n+1
The correct option is D

2. If the combustion of the Alkanol required 6mole of oxygen then 3n/2 = 6.
$$n = \frac{6\times 2}{3} = 4mole$$
$\Rightarrow C_nH_{2n+1}OH \rightarrow C_4H_9OH$
The correct option is A

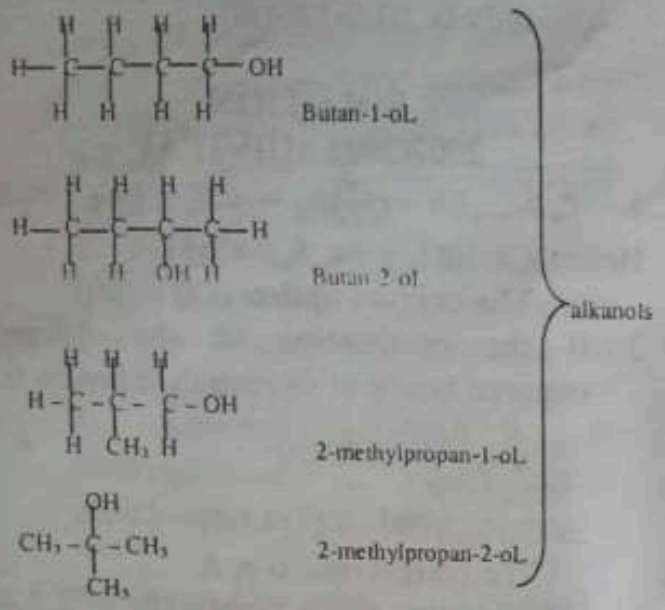
3. Octane rating is the percentage of 2,2,4-trimethylpentane in a mixture of n-heptane which give the same performance as the the petrol when both are used in a standard engine.
The correct option is B

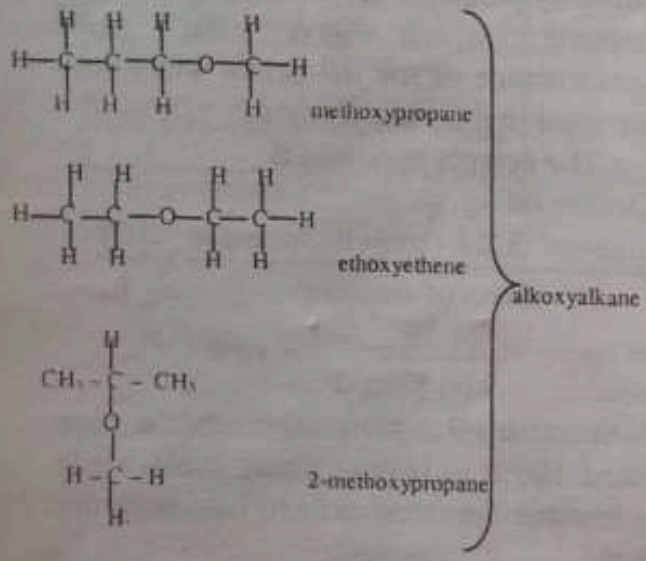
4. Octane rating =
$$\frac{\text{mass of 2,2,4 - trimethylpentane}}{\text{mass of mixture}} \times \frac{100}{1}$$
$$= \frac{24.5g}{50g} \times \frac{100}{1} = 49\%$$
Note that 2,2,4-trimethylpentane are rated 100% in octane rating scale while n-heptane are rated zero in octane rating scale.
The correct option is B

5. $CH_3CH_2C \equiv CH + H_2O \xrightarrow[HgSO_4]{H_2SO_4}$

$CH_3CH_2\underset{OH}{\underset{|}{C}} = CH_2 \xrightarrow{rearranges} CH_3CH_2\overset{O}{\overset{\|}{C}}CH_3$
butamol
The correct option is D

6.





There are 4 Alkanols and 3 alkoxyalkane.

The correct option is A

7. Iodine is use in chromatographic study because:
   i. It form loosely bond (i.e. it is easily sublime)
   ii. It is coloured.
   iii. It had a vacant/empty d-orbital

The correct option is B

8. $AL_4C_3 + 12H_2O \rightarrow 4AL(OH)_3 + 3CH_4$

$CaC_2 + 2H_2O \rightarrow H_2O + C_2H_2$

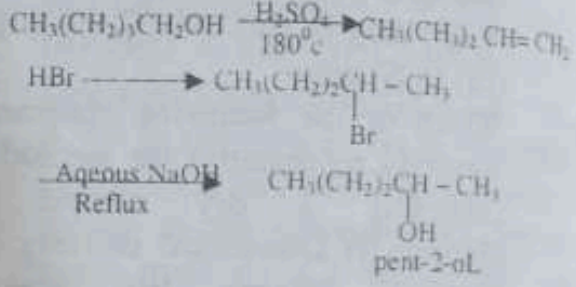
Hence methane and ethyne are produce by the action of carbide on water.

The correct option is C

9. Positional isomers have the same carbon chain but differs in the position occupy by substituent or functional group. Hence $CH_3CH_2CH(OH)CH_3$ & $CH_3CH_2CH_2OH$ are positional isomers.

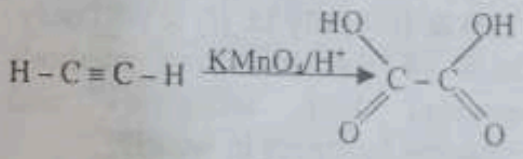
The correct option is B

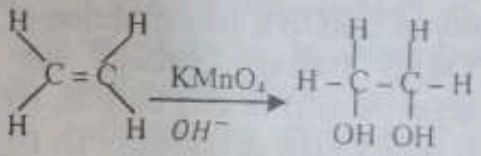
10.

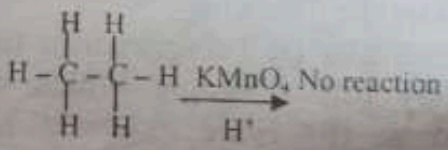


Hence Z is pent-2-oL

11. **The correct option is A**







Hence when ethane, ethene and ethyne is passed into $KnMO_4/H^+$ the products are ethane, ethane -1, 2-dioL and ethanedioic acid.

The correct option is D

12. $C_xH_y + (x + y/4)\ O_2 \rightarrow xCO_2 + y/2H_2O$

VBR	$20cm^3$	$160cm^3$	-
VOR	$20cm^3$	$110cm^3$	$80cm^3$
VAR	-	$50cm^3$	$80cm^3$

Hence the volume of O_2 used is $110cm^3$ while the volume of CO_2 produced is $80cm^3$.

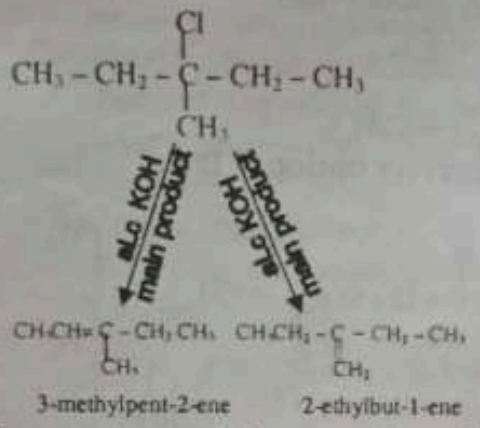
The correct option is D

13. Primary & secondary Alkanol, alkene & Alkanal are affected by $KMnO_4/H^+$. But tertiary Alkanol and Alkanone are not

affected because they do not have oxidizable hydrogen atom. Hence 2-methylpropan-2-oL will not be affected by $KMnO_4/H^+$ because it is a tertiary Alkanol.

The correct option is C

14.



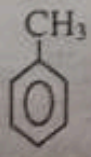
The product of the reaction above is 3-methylpent-2-ene and 2-ethylbut-1-ene.

The correct option is E meaning that none of the option correct.

15. $Rf = \frac{\text{distance move by substance}}{\text{distance move by solvent}} = \frac{1}{5} = 0.2$

The correct option is A

16.



In methylbenzene the overlapping orbitals are sp^3/s, sp^3/sp^2, sp^2/s, sp^2/sp^2 and p/p

The correct option is D.

17. Mass of C = 4.4g x 12/44 = 1.200g
Mass of H = 1.98g x 2/18 = 0.2200g
Mass of O = 1.58g – (1.2000g + 0.2200g) = 0.16g

$$\% \text{ of } C = \frac{1.2}{1.58} \times 100 = 75.9494\%$$

$$\% \text{ of } H = \frac{0.22}{1.58} \times 100 = 13.9241\%$$

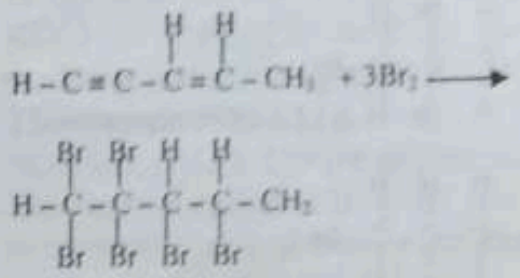
$$\% \text{ of } O = \frac{0.16}{1.58} \times 100 = 10.1266\%$$

The correct option is D

18. Br_2, BF_3 and $CH_3\dot{C}H_2$ are Electrophiles while $(CH_3)_3N$ is a Nucleophiles.

The correct option is B

19.



R.m.m of $C_5H_6 = 5(12) + 6(1) = 66g/mol$

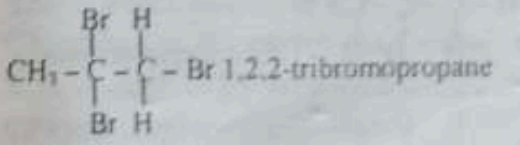
$$\cap_{C_5H_6} = \frac{3.30g}{66g/mol} = 0.05mol$$

$$\cap_{Br_2} = \frac{3 \text{ mole of } Br_2}{1 \text{ mole of } C_5H_6} \times 0.05 \text{ mol of } C_5H_6 = 0.15 \text{ mol}$$

Mass of $Br_2 = 160g/mol \times 0.15mol = 24g$

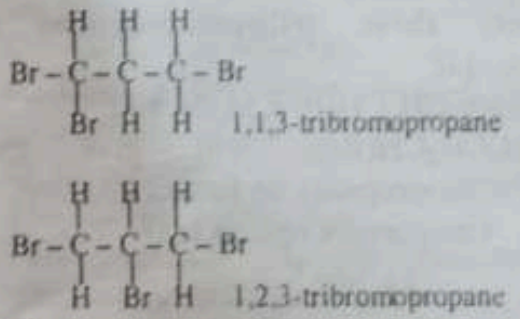
The correct option is C

20. i. $CH_3(CBr)_2CH_3$



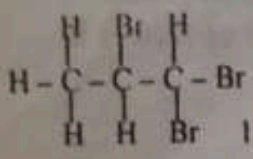
Only one tribromopropane is possible.

ii. $BrCH_2CH_2CH_2Br$

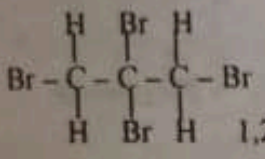


Only two tribromopropanes are possible.

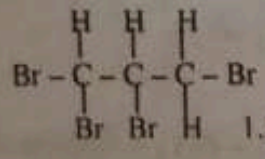
iii. $CH_3CH(Br)CH_2Br$



1,1,2-tribromopropane



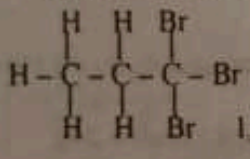
1,2,2-tribromopropane



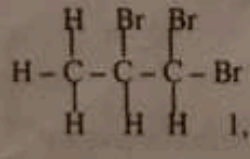
1.2.3-tribromopropane

Only **three tribromopropanes** are possible.

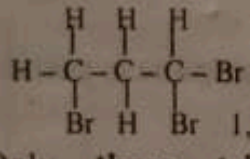
iv. $CH_3CH_2CH(Br)_2$



1,1,1-tribromopropane



1,1,2-tribromopropane



1,1,3-tribromopropane

Only **three tribromopropanes** are possible.

Hence $CH_3CH(Br)CH_2Br$ and $CH_3CH_2CH(Br)_2$ will give three tribromopropanes on further bromine.

The correct option is D

21. $\cap_{H_2} = \frac{11.2dm^3}{22.4dm^3/mol} = 0.5mol$

In addition reaction Alkyne always take two moles of any reagent because it contain two pie bonds

$C_nH_{2n-2} + 2H_2 \rightarrow C_nH_{2n+2}$

$\cap_{C_nH_{2n-2}} = \frac{1\,mole\ of\ C_nH_{2n-2}}{2\,mole\ of\ H_2} \times 0.5mol\ of\ H_2 = 0.25mol$

$\cap_{C_nH_{2n-2}} = \frac{Reacting\ mass}{molar\ mass}$

$Molar\ mass = \frac{Reacting}{\cap C_nH_{2n-2}} = \frac{13.5g}{0.25mol} = 54g/mol$

The correct option C

22. $C_nH_{2n+2} + \left(\frac{3n+1}{2}\right)O_2 \rightarrow nCO_2 + (n+1)H_2O$

Since the number of mole of steam produce is 5moles then

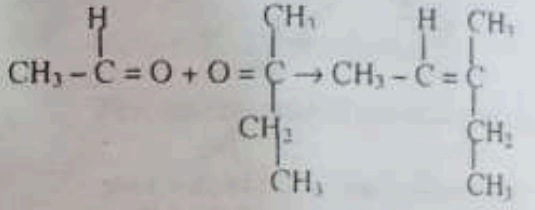
$n + 1 = 5$

$n = 4$

$\Rightarrow C_nH_{2n+2} = C_4H_{10}$

The correct option is D

23.



3-methylpent-2-ene

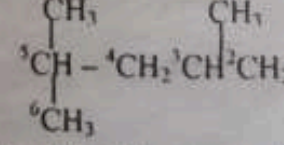
The correct option is A

24.

Compound	Operation performed	Products
2-bromo propane	Refluxed with aq KOH	Propan-2-oL
2-bromo propane	Heated with alcoholic KOH	Propene
1-bromo propane	Refluxed with aq KOH	Propan-1-oL
1-bromo propane	Heated with alcoholic KOH	Propene

The correct option is D

25. To name the compound as Alkanol the following are the steps



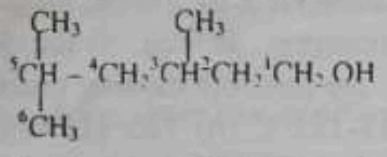
i. The longest chain contain 6 carbon atoms with an –OH group in carbon. **Hence the parent Alkanol is Hexan-1-ol.**

ii. There are two methyl groups attached to carbon 3 & 5 respectively. Hence the substituent name is 3,5-dimethyl.

iii. The IUPAC nomenclature is 3,5-dimethylhexan-1-oL.

As an Alkanol it is also possible to name the compound as 2,4-dimethylhexan-6-ol.This is wrong because the rule of naming is that,the lowest numbering must be given to the functional group

To name the compound as Alkane the following are the steps:



i. The longest chain contains 6 carbon atoms. Hence the parent Alkane is **hexane**.

ii. There are two methyl groups in carbon 3 and 5 respectively. There is hydroxyl group in carbon 1. Hence the substituent name is: **1-hydroxyl-3, 5-dimethylhexane**.

As an Alkane it is also possible to name the compound as 6-hydroxyl-2,4-dimethylhexane.This is wrong because the rule of naming is that,the lowest numbering must be given to the substituent or functional group

The correct option is C

26. The equation that involve the bleaching action of chlorine.

$Cl_2 + H_2O \rightarrow HOCl + HCl$

$HOCl + Dye \rightarrow HCl + [Dye+0)$

The correct option is D

27 Van der waal forces is an intermolecular force which exist within molecules but does not exist within the atoms of non-metals.Hence van der waal forces

The correct option is C

28. H_2SO_4 will not react with a given carbonate if the sulphate form by the metal in the carbonates is insoluble. $PbSO_4$, $CaSO_4$ and $HgSO_4$ are not soluble or sparingly soluble. Hence $PbCO_3$, $CaCO_3$& $HgCO_3$ are not suitable in the preparation of CO_2.

The correct option is D

29. In the reaction $Cl_2 + 2KOH \rightarrow KCl + KOCl + H_2O$. Cl_2 behaves as both oxidizing and reducing agents.

The correct option is B

30. NO, H_2O, N_2O & CO are neutral oxides.

The correct option is D

31. In the purification of town water supply:
    i. Aeration is used to kill bacteria
    ii. Addition of alum removes suspended particles.
    iii. Passage of the water through filter beds affects filtration.
    iv. Addition of chlorine kills bacteria.
    v. Addition of fluorine prevents tooth decay.
    vi. Addition of iodine prevent goitre

The correct option is C

32. Chloride gas is heavier than water; hence it is collected by downward delivery or upward displacement of air.

The correct option is D

33. Both temporal and permanent hardness are removed by
    i. Addition of Na_2CO_3
    ii. Passing the water through ion – exchanging resin.
    iii. Distillation

The correct option is A

34. **Polymorphism** is the phenomenon wherebya given compound exists in two or more form but in the same physical states e.g.

$$Hg\,I_{2(s)} > \underset{\text{red} < 126^0c}{\overset{126^0c}{\rightleftharpoons}} HgI_{2(s)}\ \text{yellow}$$

Allotropy is the phenomenon whereby an element can exist in two or more form but in the same physical states e.g. carbon which exist as diamond and graphite in the solid

state. That is Allotropy is polymorphism in element

The correct option is D

35. The carbonates of group I(except Lithium carbonate) are not decomposed by heat.

The correct option is D

36. $Fe(s) + 2HCl \rightarrow FeCl_2 + H_2$

$2Fe(s) + 3Cl_2 \rightarrow 2FeCl_3$

$2KI + Cl_2 \rightarrow 2KCl + I_2$

The correct option is E meaning none of the option is correct.

OBAFEMIAWOLOWOUNIVERSITY, ILE-IFE
CENTRE FOR DISTANCE LEARNING
SECOND CONTACT PERIOD EXAMINATION
COURSE CODE: CHM 001
TIME: lhr. 30mins

INSTRUCTIONS:

1. ALL EXAMINATIONS WILL BE MULTIPLE-CHOICE QUESTIONS
2. CORRECT ANSWERS TO QUESTIONS WILL BE SHADED ON OMR SHEETS.
3. YOU NEED AN HB PENCIL TO SHADE
4. WRITE YOUR NAME EXACTLY AS YOU HAVE IT ON THE LIST AT THE CENTRE FOR DISTANCE LEANING.
5. IN THE REGISTRATION NO, WRITE THE LAST NINE CHARACTERS. e.g A CANDIDATE WITH REG NO PDP/BS/BCPI/07/1002 SHOULD SHADE BCP 071002
6. COMBINATION CODE- LEAVE BLANK
7. QUESTION PAPER TYPE- LEAVE BLANK
8. COURSE CODE- COURSE CODE IS CHM 01

A1. Some or all of the following alkenes are obtainable from the dehydrobromination of a haloalkane using alcoholic KOH and heat:

i. 2-ethyl-3-methybut-1-ene
ii. 2,3-dimethylpent-2-ene
iii. 3,4-dimethylpent-2-ene
iv. 3,4-dimethylpent-1-ene.

Which of these would be obtained if the haloalkane used is 3-bromo-2,3-dimethylpentane?

(A) (i), (ii) and (iii) (B) (ii), (iii) and (iv) (C) (i), and (ii) only (D) (iii) and (iv) only

A2. Samples of two organic solids, each of which melts between 119 and 121°C, were subjected to mixed melting point determination. Which of the following values are possible melting points?

(i.) 119-121°C (ii) 123-125°C (iii) 110-120 C (iv) 122-124°C

(A.) (i) only (B) (ii) only (C) (iii) and (iv) (D) (I) and (iii).

A3. The IUPAC name of haloethane, $CF_3CH(Br)(Cl)$ is(A) 1-bromo-1-chloro-2,2,2-trffluoroethane(B)1-chloro-1-bromo-2,2,2-trifluoroethane(C)2-bromo-2-chloro-1,1,1-trifluoroethane(D)2-chloro-2-bromo-1,1,1-trifluoroethane.

A4. A chloroform solution of a pure organic compound was spotted at a distance 0.20cm from the base of a 10cm long chromatoplate upon elution, the solvent front got to a place 0.50cm from the top of the plate. If the compound moves half-way up the 10cm long plate, determine the R_F value of the compound.

(A.) 0.500 (B) 0.516 (C) 0.506 (D) 0.526

A5. Equal mole of two compounds an alkene and an-Alkanol, (each containing "n" carbon atoms in its molecule) were separately combusted in excess oxygen. The volume of steam produced by the compounds in the reaction was in the ratio 4:5. What are the respective molecular formula of the compounds?

(A.) C_3H_6, C_3H_7OH (B) C_4H_8, C_4H_9OH (C) C_5H_{10}, $C_5H_{11}OH$ (D) C_6H_{12}, $C_6H_{13}OH$.

A6. An alkene can be: (i) acyclic and symmetrical(ii)acyclic and unsymmetrical (iii) cyclic and symmetrical (iv) cyclic and unsymmetrical. Which of the descriptions above are applicable to an alkene which upon ozonolysis yields just one product?

(A.) (i),(iii) only (B) (ii) only (C) (i), (iii) and (iv) (D) (i), (ii), (iii) and (iv).

A7. In the production of a detergent 120g of sodium hydroxide was boiled with excess dodecabenzenesulphonicacid $CH_3(CH_2)_{11}$—  —SO_3H. What is the mass of the detergent produced? [H =1, C =12,0 = 16, Na = 23, S = 32]

(A.) 1044g (B)522g (C)783g (D)391.5g

A8. The reaction scheme below shows the conversion of ethanoic acid to two chloro derivatives of the acid:

Y and X are respectively:

(A.) ethanoylchloride and chloroethanoic acid (B)ethanoylchloride and chloroathanamide (C)chloroethanoic acid and chloroethanamide (D) chloro ethanoic acid and ethanoylchloride.

A9. What is isoelectric point of an aqueous solution of an amino acid placed in an electric field?

(A) The p^H at which the cationic form migrates to the cathode (B) The p^H at which the anionic form migrates to the anode (C) The p^H at which the zwitterions migrates to the anode and cathode (D) The P^H at which there is no net migration to the anode or cathode.

A10. 5.6g of iron filings is heated while a stream of dry chlorine is passed over it until the necessary reaction is complete. Determine the weight of product formed. [Fe =56 Cl = 35.5]

A. 16.3g B. 8.1g, C. 4.1g D. 12.2g

A11. The conversion of propan-1-ol to propan-2-ol involves the following reaction types i. Hydrolysis (ii) Hydrohalogenation (iii) Dehydration. Arrange these reaction types in the correct order:

(A.) (i), (ii), (iii) (B) (ii), (i), (iii) (C) (iii), (i) (ii) (D) (iii), (ii), (i)

A12. Which of the following is/are not false about ammonium chloride?

i. aqueous solution is neutral to litmus (ii) high solubility in water (iii) evolution of ammonia on warming with alkalis (iv) decomposition by heat

(A.) i only (B) ii&iii only (C) i&iv only (D) ii, iii &iv only.

A13. Vanadium (V) oxide is an important catalyst in the industrial manufacture of (i) Ammonia, (ii) Sodium hydrogen trioxocarbonate(iv),(iii) Tetraoxosulphate (vi) acid, (iv) Oxygen

(A). iv only, (B) iii only (C) ii only (D) i only

A14. Which of the followings is/are black in colour? (i) MnO_2 (ii) CuO (iii) Fe_3O_4

(A).i& ii only (B). ii& iii only (C). I & iii only (D). i, ii & iii.

A15. An alkene can be obtained by (i) subjecting polythene to strong heating (ii) thermal cracking of long chain hydrocarbons (iii) dehydro-halogenation of alkyl halides (iv)condensation reaction of ethanol with ethanoic acid.

(A) i - iv, (B) i - iii (C) ii and iii (D) iii and iv

A16. Which of the following features is/are responsible for the unique nature of carbon?

(i) Catenation, (ii) formation of multiple bonds, (iii) stable single oxidation state, (iv) formation of volatile compounds.

(A.) i - iii only (B) i and ii only (C) ii and iii only (D) i - iv

A17. If the complete combustion of 1 mole of an Alkanol is represented by the equation
$C_nH_{2n+1}OH + XO_2 \rightarrow yCO_2 + zH_2O$, then: which of the following is/are correct (i) x = n, (ii) y = 3n/2, (iii) x + y = 5n/2 (iv) y + z =2n+1
(A.) i only (B) iii only (C) ii only (D) iii and iv only

A18.Which of the followings is/are common to fructose and glucose? (i) They are isomers, (ii) They occur naturally, (iii) They are exactly identical in all respects (iv) They are reducing sugars.
(A.) i & ii only (B) i , ii & iii only (C) ii and iv only (D) i, ii and iv only

A19.A compound that will not give reddish brown ppt with ammoniacal copper (I) chloride solution is (i) pent -2-yne (ii) but -1-yne (iii) but -2-ene
(A.) i only (B) i&ii only 1(C) i &iii only (D) ii& iii only.

A20. Below is a list of some organic compound (i) methane (ii) ethene (iii) ethyne(iv) Chloroethanes (v) benzene. Which of these can undergo substitution reactions. (A.) (i), (ii) (iv) and (v) (B) (i), (iii) (iv) and (v) (C) (i) and (iii) only (D) (v) only

A21. Why does a solution containing zinc ions give a white precipitate which dissolves in excess on adding sodium hydroxide solution?
(A.) Sodium hydroxide is a strong base (B) Zinc hydroxide is a strong base(C) Zinc hydroxide reacts with sodium hydroxide to form a complex ion (D) Zinc hydroxide is water soluble.

A22. Which of the following equations will proceed as written? (i) $2KClO_{3(s)} \rightarrow 2KCl_{(s)} + 3O_{2(g)}$ (ii) $2H_2O_{2(aq)} \rightarrow 2H_2O_{(l)} + O_2$ (iii) $Zn_{(s)} + 2HNO_{3(aq)} \rightarrow Zn(NO_3)_{2aq} + H_{2(g)}$ iv $2Pb_3O_{4(s)} \rightarrow 6PbO_{(s)} + O_{2(g)}$
(A.) i & ii only (B) iii & iv only (C) i, ii & iv only (D)i, ii, iii & iv

A23 (i) An oxidizing agent (ii) A reducing agent (iii) An acid (iv) A dehydrating agent.In which of the above ways is tetraoxosulphate (vi) acid behaving when warned with copper metal to give off sulphur (iv) oxide gas.
(A.) I and ii only (B) iii &iv only (C) i & iii only (D) ii & iv only

A24. (i) Zn^{2+} (ii) Ca^{2+} (iii) Al^{3+} (iv) Pb^{2+} Which of the these ions in aqueous solution will give a white gelatinous precipitate upon adding a few drop of aqueous sodium hydroxide?
(A.) i, iii &iv only (B) i only (C) i, ii, iii & iv (D) i, & iii only

A25. Two portions of 0.1 mole of sodium in $25cm^3$ of liquid ammonia are prepared. The first portion was saturated with ethyne to give product A. The second portion of the sodium in liquid ammonia was added to product A to give product B. Then A and B are
(A.) $NaC{\equiv}CH$ & $NaC{\equiv}CNa$
(B) $HC{\equiv}CNa$, $NaC{\equiv}CH$
(C.) $NaC{\equiv}CNa$, $NaC{\equiv}CH$
(D) $HC{\equiv}CNa$, $HC{\equiv}CH$

A26. (i) C_2H_6 (ii) CH_3Cl (iii) $\dot{C}l$ (iv) $\dot{C}H_3$ Which of these can be obtained from either chain propagation or termination steps of the monochlorination of methane.(A.) i & ii only (B) ii & iii only (C) v, ii & iii only (D) i, ii, iii & iv

A27. (i)$CHCl_2CH_2CH_3$ (ii) $CH_2ClCHClCH_3$ (iii)$CH_3C(Cl_2)CH_3$(iv)$CH_2ClCH_2CH_2Cl$ Which of the above respectively has/have, (i) two trichloro products and (ii) optical activity?
(A). i & ii (B) ii & iii (C) iii & iv (D) iv & ii

A28. (i)but-1-yne (ii) but-2-yne (iii) butanal (Iv) butanone. Which of these will react with $NH_4OH/AgNO_3$.
(A.) i & iii only (B) ii & iv only (C) i & ii only (D) iii & iv only

A29. What product is formed when Calcium ethanoate is dry distilled?

(A.)Propanone(B)Propanal(C)Pentanal (D) Pentan-3-one

A30. Consider the following reaction scheme:

$CH_3(CH_2)_2CH_2OH \xrightarrow[180^0C]{X's\ C.H_2SO_4} X \xrightarrow{HBr} Y$

$\xrightarrow[NaOH,\ Heat]{alcohol} Z$

Product Z is?

(A) But-1-ene (B) Pent-1-ene (C) hex-1-ere (D) Hept-1-ene

A31. The number of 1^0 and 3^0 Alkanols is with molecular formula $C_5H_{12}O$ are:

(A) 2,2 (B) 1,4 (C) 4, 1 (D) 3,1

A32. $CH_3CH_2OCOCH_2CH_3 \xrightarrow[Reflux]{dil\ HCl} X + Y$.

X and Y are

(A.) ethanol and propanoic acid (B) methanol and propanoic acid (C) Propanol and ethanoic acid (D) ethanol and ethanoic acid.

A33. Upon heating an organic compound A ($C_5H_{10}O$) with excess concentrated tetraoxosulphate (vi) acid an organic compound B was formed. Ozonolysis of B gave an Alkanal C and Propanone. Deduce the names of A, B, and C in that order if A gives a positive Iodoform test

(A.) 2-ethylpropanol,2-ethylpropene and Ethanal (B) 2-methylbutan-1-ol, 2-methylbutan- 1- ene and propanal (C) 3-methylbutan-2-ol, 2-methylbut-2-ene and ethanal (D) 2-methylbutan-2-ol, 2-methylbut-2-ene and propanal.

A34. Which of the following have double bond equivalence (DBE) of 4 (i) C_6H_6 (ii) C_3H_2O (iii) C_6H_{12} (iv) C_6H_6O.

(A). (i) and (iv) (B) (i) and (ii) (C) (ii) (iii) and (iv) (D) (ii) and (iv).

A35. Which of the following are biodegradable?(i)Polythene (ii) Soapless detergent (iii) PVC (iv) Starch. (A). (i), (ii) and (iii) (B) (i) and (iv) only (C) (ii) and (iv) only (D) (iii) and (iv) only.

A36. one mole of an organic compound A, containing 4 carbon atoms reacted with $22.4dm^3$ of hydrogen at s.t.p to form compound B. which on ozonolysis gave two Alkanal C and D. What are A, B, and C or D respectively (A). But-1-yne, but-1-ene, propanal / ethanal (B). but-1 - ene, but-2-yne, ethanal / ethanol (C).pent-1-yne, pent-1-ene, propanal / propanal (D) pent-2-ene, pent-1-yne, ethanal / propanal

A37. Arrange the following in order of increasing boiling point (i) $CH_3(CH_2)_3CH_3$ (ii) $CH_3CH_2CH(CH_3)_2$ (iii) $C(CH_3)_4$ and (iv) $CH_3(CH_2)_4CH_3$

(A.) (i), (ii) (iii) and (iv) (B) (iii), (ii) (i) and (iv) (C) (ii), (iii), (iv) and (i) (D) (iv), (iii), (ii) and (i)

A38. Which of the following are soluble in excess sodium hydroxide solution but insoluble in excess ammonia solution (i) $Cu(OH)_2$ (ii) $AI(OH)_3$ (iii) $Ca(OH)_2$ (iv) $Zn(OH)_2$ and (v) $Pb(OH)_2$ (A). (i), (ii), (iii) and (iv) only (B) (ii), (iv), and (v) only (C) (iii), (iv) and (v) only (D) (i), (iv), and (v) only.

A39. Which of the following compounds can react with $NaOH/I_2$ to give a yellow precipitate?

(i) $CH_3CH_2OCH_2CH_3$ (ii) $CH_3COC_2H_5$ (iii) $C_2H_5CH(OH)CH_3$ (iv) CH_3CHO (v) $CH_3CHOHCH_3$

(A) (i), (ii) and (iii) only (B) (ii), (iii), (iv) and (v) only (C) (i), (iii) and (v) only(D) (i), (ii) and (v) only

A40. An Alkanal, $C_nH_{2n+1}CHO$ or $C_{n+1}H_{2n+2}O$ is combusted in excess oxygen according to the following equation. $C_{n+1}H_{2n+2}O + xO_2 \rightarrow yCO_2 + zH_2O$ x, y and z respectively are

(A).3n/2, (n +1), n (B) (3n+2)/2, (n+1), (n+1) (C) 3n/2, n, (n+1) (D) (n+l), n/2, n

B41 if one mole of the alkanal above requires 5/2mole of oxygen. Then the alkanal is (A). ethanal (B) propanal (C). methanal (D). Butanal

B42.How many gram of 1-aminobutane will react with $50cm^3$ of 2M solution of HCl.

(A). 8.7 (B) 17.4 (C) 7.3 (D) 14.6

B43. Some metals can only be extracted by: (i) electrolysis of their molten ore (ii) electrolysis of their molten ore after preliminary purification (iii) thermal treatment of their ore followed by some additives(iv)preliminary purification, thermal treatment, reduction and then electrolysis. Which of the above are used for the extraction of Fe, Al & Cu respectively?
(A). (i), (ii), (iii) (B) (iii), (ii), (i) (C) (iii), (ii), (iv) (D) (ii), (iv), (iii)

B44. Which of the following substances will dissolve in NaOH)? (i) Al (ii) glass (iii) Zn (iv) Cu (A). (i), (ii) and (iii) only (B) (I) & (iii) only (C) (ii) &(iv) only (D) (i) & (iii) only

B45. Chlorine is bubbled into 20g ethanoic acid boiling under reflux in the presence of red phosphorus. What weight of product is formed if the reaction is made to stop at the first stage? (A). 63.0 (B) 31.5 (C) 15.75 (D) 47.25

B46. 3-methylpentan-2-ol is warmed with NaOH/ I_2. The other product apart from Iodoform is
(A.) $CH_3CH_2CH(CH_3)COONa$
(B) $CH_3CH_2CH_2CH_2COONa$
(C) $CH_3CH\ (CH_3)CH_2COONa$
(D) $CH_3(CH_2)_2COONa$

B47. Arrange the following in their order of increasing R_f values
(i) $C_6H_5CH_2CH(OH)C_6H_5$
(ii) $C_6H_5COCOC_6H_5$
(iii) $C_6H_5CH_2CH_2C_6H_5$
(iv) $C_6H_5CH\ (OH)CH(OH)C_6H_5$
(A.) (iv), (i), (ii), (iii) (B) (iv), (iii), (1), (ii) (C) (i), (ii), (iii), (iv) (D) (iii), (iv), (1), (ii)

B48. (i) NO, (ii) O_2 (iii) NO_2 (iv) H_2O (v) H_2 .Which of the above, is/are present in the brown fumes that fills the flask during the preparation of HNO_3
(A.) (ii), (iii) & (iv) (B) (iii), (iv) & (v) (C) (i), (ii) & (v) (D) (I) (iii) & (v)

B49. An aqueous solution of sodium chloride gives a white precipitate upon treatment with silver trioxonitrate (v). The precipitate is insoluble in dilute. (i) HNO_3 but soluble in aqueous ammonia (ii) HCI but soluble in aqueous ammonia (iii) HCI and in aqueous ammonia
(A.) (ii) only (B) (iii) only (C) (i) & (ii) only (D) (i), (ii) & (iii)

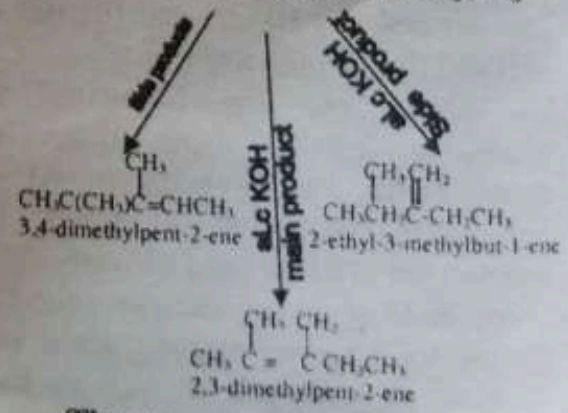
B50. Which process(es) is/are involved in the turning of starch-iodine paper blue-black by chlorine gas (i) Iodine attacks the starch to give the blue-black colour (ii) chlorine attacks the starch to give the blue-black colour (iii) chlorine attacks the iodide ion to give the blue-black colour (iv) Chlorine oxidizes the iodide ion to produce iodine which attacks the starch to give the blue-black colour.
(A.) (i) only (B) (ii) only (C) (iii) only (D) (iv) only.

B51. What is the IUPAC name for $C(CH_3)_3(CH_2)_2CH_2OH$.
(A.)7,7-dimethyloctan-1-ol(B)4,4-dimethylpentan-1-ol(C)5,5-dimethylhexan-1-ol(D)6,6-dimethylheptan- 1-ol

B52. When bromine-water is made to react with Ethene, how many products can be formed. (A.) 1 (B)2 (C)3 (D)4

SOLUTION
2007/2008 EXAM

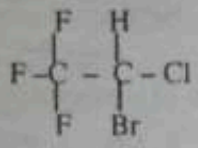
A1. $CH_3CH(CH_3)C(Br)(CH_3)CH_2CH_3$



The correct option is A

A2. If A(mp 119°C-121°C) and B(mp 119°C-121°C) are mixed together. They will act as impurities to each other. Impurities lower melting points. Therefore the lowest melting point recorded of the mixture will be slightly lower than 119°C while the highest melting point recorded cannot be greater than 121°C. Hence the mixture of A & B can have a melting point within the range of
(i) 110–120°C (ii) 119-121°C
The correct option is D

A3.



2-bromo-2-chloro-1,1,1-trifloroethene

The correct option is C

A4. D_1 = distance moved by substance
= 5-0.2 = 4.80cm
D_2 = distance moved by solvent front
= 10-0.2-0.5 = 9.30cm

$$R_f = \frac{D_1}{D_2} = \frac{4.80}{9.30} = 0.516$$

The correct option is B

A5 $C_nH_{2n+1} + \left(\frac{3n}{2}\right)O_2 \rightarrow nCO_2 + (n+1)H_2O$

$$\Rightarrow \frac{n}{n+1} = \frac{4}{5}$$
$$4(n+1) = 5n$$
$$4n + 4 = 5n$$
$$n = 4$$

$C_nH_{2n+1}OH \rightarrow C_4H_9OH$ (butanol)
$C_nH_{2n} \rightarrow C_4H_8$ (butyne)
The correct option is B

A6. If ozonolysis gives only one product it means that the alkene is symmetry or cyclic.
The correct option is A

A7 $CH_3(CH_2)_{10}CH_2$-  -SO_3H + NaOH
120g

$\rightarrow CH_3(CH_2)_{10}CH_2$-  -$SO_3Na + H_2O$

$$\cap_{NaOH} = \frac{120g}{40g/mol} = 3moles$$

$$\cap_{detergent} = 3moles$$

R.m.m of detergent =
{[12(12)+25(1)] + [6(12)+4(1)] + 32+48+23
= 348g/mol
Mass of detergent = 3 (348) = 1044g
The correct option is A

A8. $CH_3COCl \xleftarrow{PCl_5} CH_3COOH \xrightarrow{Cl_2} CH_2ClCOOH$
Ethanoyl Chloride — chloroethanoic acid

The correct option is D

A9. **Isoelectric point** is the p^H at which amino acids exist completely as a dipolar ion.i.e.The point at which electrophoresis does not take place. This implies that at the isoelectric point the ions in the solution does not migrate to either the cathode or anode.
The correct option is D

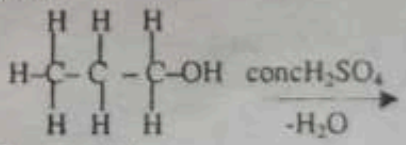
A10. $2Fe + 3Cl_2 \rightarrow 2FeCl_3$

$$\cap_{Fe} = \frac{5.6}{56} = 0.1$$

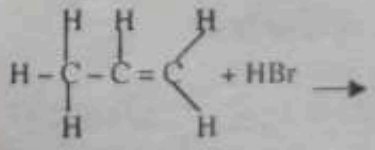
$$\cap_{FeCl_3} = \frac{2}{2} \times 0.1mol = 0.1mol$$

R.m.m of $FeCl_3$ = 56+3(35.5) = 162.50g/mol
Mass of $FeCl_3$ = 0.1 x 162.5 = 16.25g ≈16.30g
The correct option is A

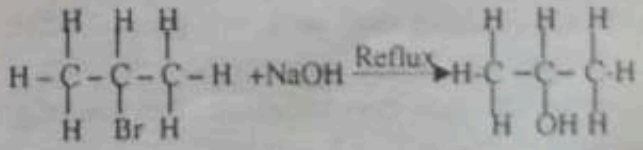
A11.



Propan-1-oL



Propene



2-bromoPropane — propan-2-ol

The conversion of propan-1-ol to propan-2-ol involves the following reaction.
(i) Dehydration
(ii) Dehydrohalogenation
(iii) Hydrolysis
The correct option is D

A12. i. $NH_4Cl + H_2O \rightarrow NH_4OH + HCl$ solution is acidic
ii. $NH_4Cl \xrightleftharpoons{Heat} NH_3 + HCl$
iii. It highly soluble in water
iv. $NH_4Cl + NaOH \rightarrow NH_3 + NaCl + H_2O$
The correct option is D

A13. Vanadium V oxide is used as catalyst in the production of SO_3 which in turn is used in the product of H_2SO_4.
The correct option is B

A14. MnO_2,CuO&Fe_3O_4 are black in colour.
The correct option is D

A15. Thermal cracking of long chain hydrocarbons and dehydrahalogenation of alkyl halides are used in the preparation of alkenes.
The correct option is C

A16. i. Ability to catenate
ii. Ability to form a double or triple i.e. formation of multiple bonds.
iii. The ease with which carbon combine with oxygen and hydrogen.
The correct option is B

A17. $C_nH_{2n+1} + \left(\frac{3n}{2}\right)O_2 \rightarrow nCO_2 + (n+1)H_2O$

$x \rightarrow 3x/2$, $y \rightarrow n$ and $z \rightarrow n+1$

$x + y = \frac{3n}{2} + \frac{n}{1} = \frac{3n+2n}{2} = 5n/2$

$y+z = n+n+1 = 2n+1$
The correct option is D

A18. Glucose and fructose are
(1) isomers (2) carbohydrates (3) sugars (4) occur naturally.
The correct option is A

A19. Compound that will not give reddish brown ppt with Ammoniacal copper I chloride are non-terminal Alkyne e.g. pent-2-yne & but-2-ene.
The correct option is C

A20. Substitution reaction is a characteristic reaction of Alkanes, benzenes & chloroethane.
The correct option is E

A21.

$$Zn^{2+} + 2NaOH \rightarrow 2Na^{+} + \underset{\text{white ppt}}{Zn(OH)_2}$$

$$Zn(OH)_2 + 2NaOH \rightarrow \underset{\text{Complex ion soluble}}{[Zn(OH)_4]^{2-}}$$

The correct option is C

A22. Only reaction i, ii and iv will proceed as written. Note that the reaction of Zn with HNO_3 is shown below;

$4Zn + 10HNO_3 \rightarrow 4Zn(NO_3)_2 + NH_4NO_3 + 3H_2O$

HNO_3 does not liberate Hydrogen gas with metal because it is a strong oxidizing agent.It oxidizes the Hydrogen gas to water
The correct option is C

A23. When tetraoxosulphate (iv) acid is concentrated it act as (i) oxidizing agent (ii) sulphonating agent and (iii) dehydration agent. Conc. H_2SO_4 removes the element of water from most substance.

$Cu + 2H_2SO_4 \rightarrow CuSO_4 + SO_2 + 2H_2O$

Hence in the reaction H_2SO_4 act as both oxidizing agent and as an acid. Note that H_2SO_4 only act as an acid only in diluted formed.
The correct option is C

A24. Ca^{2+} gives a white dirty ppt with NaOH. The ppt is insoluble in excess NaOH. Zn^{2+}, Al^{3+}& Pb^{2+} give a white gelatinous precipitate with drop wise NaOH, which is soluble in excess of NaOH.
The correct option is A

A25.

$$H-C\equiv C-H + Na \xrightarrow{liq\ NH_3} H-C\equiv C-Na$$

$$+ \tfrac{1}{2}H_2 \xrightarrow{Na/liq\ NH_3} Na-C\equiv C-Na + \tfrac{1}{2}H_2$$

$A \rightarrow H-C\equiv C-Na$
$B \rightarrow Na-C\equiv C-Na$
The correct option is A

A26. The only product of the chain initiation stage of the chlorination of methane is $\dot{Cl}$

CH_3Cl, $\dot{Cl}$ and $\dot{CH}_3$ are form in the chain propagation stage of chlorination of methane while C_2H_6 and Cl_2 are obtain in the chain termination stage of the chlorination of methane.

The correct option is D

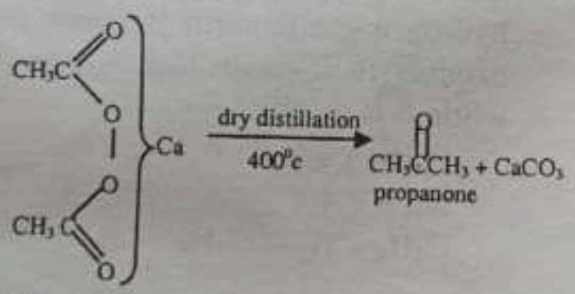
A27. $CH_2ClCH_2CH_2Cl$ has two trichloro products but it is not optically active.

The correct option is E

A28. **$NH_4OH/AgNO_3$ is known as Tollen's reagent. Tollen's reagent is used to distinguish Alkanal from Alkanone and terminal Alkyne from non-terminal Alkyne.** Hence butanal and But-1-yne with react with the reagent. Note that $NH_3/AgNO_3$ is known as Ammoniacal silver nitrate. It is use to distinquish terminal Alkyne from non-terminal Alkyne, Alkene and Alkane.

The correct option is A

A29.



The correct option is A

A30. $CH_3(CH_2)_2\,CH_2OH \xrightarrow[180^0C]{X's\ conc.\ H_2SO_4}$

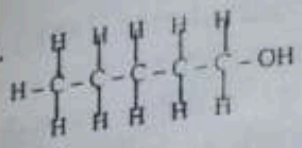
$CH_3CH_2CH=CH_2 \xrightarrow{HBr} CH_3CH_2\underset{Br}{C}HCH_3$

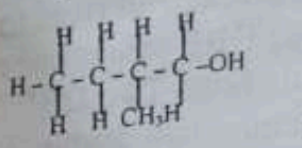
$\xrightarrow[NaOH,\ Heat]{alc} \underset{But\text{-}2\text{-}ene}{CH_3CH=CHCH_3} + \underset{but\text{-}1\text{-}ene}{CH_2CH_2CH=CH_3}$

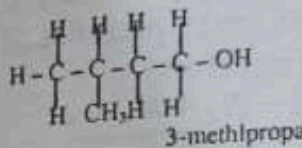
The major product of the reaction according to **Saytzeff's rule** is but-2-ene while the side product is but-1-ene.

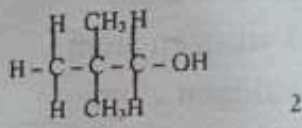
The correct option is A

A31.

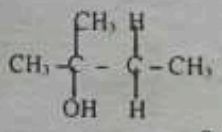








Tertiary Alkanol of $C_5H_{12}O$ are given below;



Hence there are four primary Alkanols and one tertiary Alkanol in $C_5H_{12}O$.

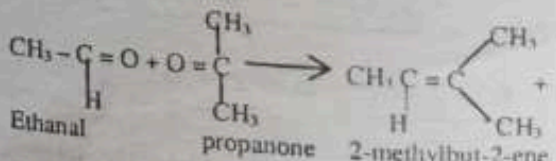
The correct option is C

A32. $CH_3CH_2O.COCH_2CH_3 \xrightarrow[Reflux]{dil\ HCl}$

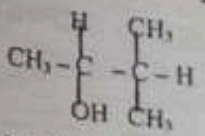
$\underset{ethanol}{CH_3CH_2OH} + \underset{propanoic\ acid}{CH_3CH_2COOH}$

The correct option is A

A33.



$H-OH \xrightarrow{conc\ H_2SO_4}$



A → 3-methylbutan-2-oL

B → 2-methylbut-2-ene

C → ethanal

The correct option is C

A34. **Double Bond Equivalence (DBE)** is e number of hydrogen molecules that ould be added to a molecule to convert all e bonds to single bonds and all rings to cyclic structures. One DBE means one ring tructure or one double bond Two DBE neans two rings structure, two double bonds one triple bonds or one ring plus one pie bond.So DBE is refers to the presence of double, triple or ring structural

$$DBE = \frac{2N_C - N_H - N_x + N_N + 2}{2}$$

N_C = Number of carbon atom

N_H = Number of hydrogen atom

N_x = Number of halogen atom

N_N= Number of nitrogen atom

DBE of C_6H_6 is obtain as shown below

$$DBE = \frac{2(6) - 6 - 0 + 0 + 2}{2}$$

$$= \frac{12 - 6 + 2}{2} = \frac{14 - 6}{2} = \frac{8}{2} = 4$$

C_6H_6contains four Double Bond Equivalent.

DBE of C_6H_{12} is obtain as shown below

$$DBE = \frac{2(6) - 12 - 0 + 0 + 2}{2}$$

$$= \frac{12 - 12 + 2}{2} = \frac{14 - 12}{2} = \frac{2}{2} = 1$$

C_6H_{12}contains four Double Bond Equivqlent

DBE of C_3H_2O is obtain as shown below

$$DBE = \frac{2(3) - 2 - 0 + 0 + 2}{2}$$

$$= \frac{6 - 2 + 2}{2} = \frac{8 - 2}{2} = \frac{6}{2} = 3$$

C_3H_2O contains four Double Bond Equivalent.

DBE of C_6H_6O is obtain as shown below

$$DBE = \frac{2(6) - 6 - 0 + 0 + 2}{2}$$

$$= \frac{12 - 6 + 2}{2} = \frac{14 - 6}{2} = \frac{8}{2} = 4$$

C_6H_6Ocontains four Double Bond Equivalent.

Hence C_6H_6 and C_6H_6O have 4 double equivalents.

The correct option is A

A35. **Biodegradables** are usually dead plants, animals, paper, starch etc they

i. can be decomposed
ii. cannot be recycled
iii. do not form permanent environmental waste
iv. do not, if burnt, produce thick toxic smoke that is harmful.

Non-biodegradables are usually items like plastics, polyethene bags, PVC, soapless detergent etc. They

i. cannot be decomposed
ii. Usually can be recycled when recycling fails, they can be used to fill up swamps (mixed with sand).
iii. Produce very thick harmful toxic smokes when burnt
iv. Cause permanent environmental waste.

The correct option is E meaning that none of the option is correct.

A36.

$$\cap_{H_2} = \frac{\text{vol at s.t.p}}{22.4\text{dm}^3/\text{mol}} = \frac{22.4\text{dm3}}{22.4\text{dm3/mol}} = 0.1\text{mol}$$

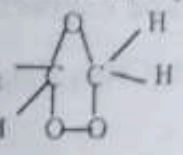
Since compound A take one mole of hydrogen gas to form B which undergo ozonolysis. It means that A is an Alkyne while B is an alkene.

$C_nH_{2n-2} + H_2 \rightarrow C_nH_{2n}$

but n = 4

$C_4H_6 + H_2 \rightarrow C_4H_8$

$CH_3CH_2C \equiv C - H + H_2 \longrightarrow CH_3CH_2C$

$= CH_2 + O_3 \xrightarrow[<20^0c]{CCl_4} CH_3CH_2$ 

$\xrightarrow[-ZnO]{Zn\,/\,dilCH_3COOH}$ $CH_3CH_2CHO + HCHO$

propanal methanal

A → but-1-yne

B → but-1-ene

C → propanal

D → methanal

The correct option is E.

A37. $C(CH_3)_4 < CH_3CH_2CH(CH_3)_2 < CH_3(CH_2)_4CH_3 < CH_3(CH_2)_4CH_3$

The correct option is B

A38. Pb^{2+}, Zn^{2+} & Al^{3+} are soluble in excess NaOH but only Zn^{2+} are soluble in excess NH_4OH. Also Cu^{2+} is soluble in excess NH_4OH.

The correct option is E.

A39. $C_2H_5CH(OH)CH_3$, CH_3CHO and $CH_3CHOHCH_3$ will give positive Iodoform test because they have the require functionality.

The correct option is B

A40. $C_{n+1}H_{2n+2}O + \left(\frac{3n+2}{2}\right)O_2 \rightarrow (n+1)CO_2 + (n+1)H_2O$

$\Rightarrow x = \frac{3n+2}{2}$; $y = n+1$ & $z = n+1$

The correct option is B

B41. Since 5/2 mole of oxygen are required

$\Rightarrow \frac{5}{2} = \frac{3n+2}{2}$

$\Rightarrow 3n+2 = 5$

$3n = 5-2 = 3$

$n = 1$

$C_{n+1}H_{2n+2}O = C_2H_4O$ (i.e. Ethanal)

The correct option is A.

B42. $CH_3CH_2CH_2CH_2NH_2 + HCl \rightarrow$

$CH_3CH_2CH_2CH\overset{+}{N}H_3Cl^-$

$\cap_{HCl} = \frac{50}{1000} \times 2 = \frac{100}{1000} = 0.1mol$

$\cap_{CH_3CH_2CH_2CH_2NH_2} = 0.1mol$

R.m.m of $CH_2CH_2CH_2CH_2NH_2$ = 73g/mol

Mass of $CH_3CH_2CH_2CH_2NH_3$ = 73g/mol x 0.1mol = 7.35

The correct option is 7.3

B43. Fe is extracted by thermal treatment of its ore followed by some additives. AL is extracted by electrolysis of its molten ore after preliminary purification which as is extracted by preliminary purification, thermal treatment reduction and then electrolysis.

The correct option is C

B44. AL, glass and Zn are affected by NaOH. NaOH are not stored in glass vessel because it attacks glass to form trioxosilicates.

The correct option is A

B45. $CH_3COOH + Cl_2 \xrightarrow{red\ P} CH_2ClCOOH + HCl$

$\cap_{CH_3COOH} = \frac{20g}{60g/mol} = 0.3333mol$

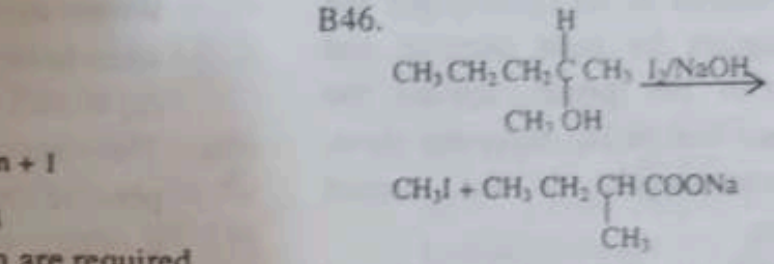
$\cap_{CH_2ClCOOH} = 0.3333mol$

R.m.m. of $CH_2ClCOOH$ = 94.5g/mol

$M_{CH_2ClCOOH} = 94.5g/mol \times 0.3333mol = 31.50g$

The correct option is B

B46.



The correct option is A

B47. The greater the intermolecular formula the lesser the R_f value. iv < i < ii < iii

The correct option is A

B48. $4HNO_3 \rightarrow 2H_2O + 4NO_2 + O_2$

The correct option is A

B49. $NaCl + AgNO_3 \rightarrow \underset{ppt}{AgCl} + NaNO_3$

The AgCl will not dissolve in dilute HCl.

The correct option is A

B50. $I^- + Cl_2 \rightarrow I_2 + Cl^-$

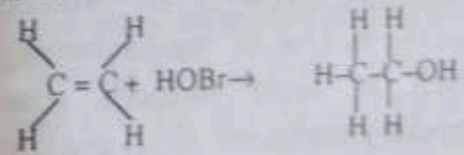
blueblack colour

The correct option is C

B51. The IUPAC nomenclature of $C(CH_3)_3(CH_2)_2CH_2OH$ is 4,4-dimethylpentan-1-oL.

The correct option is B

B52.



Only one product is form.

The correct option is A

CHAPTER SIX

OBAFEMI AWOLOWO UNIVERSITY
PRE-DEGREE PROGRAMME ILE-IFE
2ND CONTACT MID EXAMINATION
CHEMISTRY SET II
JUNE 2009 30 MINS

INSTRUCTIONS

(a) Each question is followed by FOUR options lettered A to D. find out the correct option for each question and shade, with HB pencil, options the appropriate box on the computer sheet, which corresponds to the correct alternative.

(b) Shade "E" if there is no correct alternative

(c) Fill in your full names (surname first and in capital) as well as your registration number

(d) Each correct answer attracts + 2.0 and a wrong answer -0.5

(e) Submit your question paper with your name and Reg. No properly written.

(f) ANY HAND PHONE BROUGHT INTO THE EXAM HALL WILL BE SEIZED.

QUESTION

1. Hardness of water can be removed by the following methods: i. Boiling ii. Distillation iii. Addition of calculated amount of $Ca(OH)_2$ iv. Addition of Na_2CO_3 v. Use of ion-exchange resin. Which of these methods remove(s) temporary hardness? A. (i) and (iii) only B. (ii), (iv) and (v) C. None D. All

2. The chemical equal below represent the reaction that occur during the 'brown ring' test for trioxonitrate (V) ion in qualitative analysis.

   i. $FeSO_{4(aq)} + NO \rightarrow FeSO_4.NO$

   ii. $NO_3^- + H_2SO_4 \rightarrow HNO_3 + HSO_4^-$

   iii. $6FeSO_4 + 2HNO_3 + 3H_2SO_4 \rightarrow 3Fe_2(SO_4)_3 + 4H_2O + 2NO$

   Arrange these equations in the correct order. A(i), (ii), (iii) B. (i), (iii), (ii) C. (ii), (iii), (i) D.(iii), (ii), (i)

3. Consider the following salts (i) CH_3COONa (ii) K_2SO_4 (iii) $NaCl$ (iv) $KClO_3$ (v) $Pb(NO_3)_2$
   Which of these salts will decrepitates when heated in a dry test tube? A (i) and (ii) B. (iii), (iv) and (v) C. All D. None

4. The equations below represent the possible reactions of chlorine.

   i. $Cl_{2(g)} + 2HF_{(aq)} \rightarrow 2HCl_{(aq)} + F_{2(g)}$

   ii. $2Fe_{(s)} + 3Cl_{2(g)} \xrightarrow{\Delta} 2FeCl_{3(s)}$

   iii. $Fe_{(s)} + 2HCl_{(aq)} \rightarrow FeCl_{2(aq)} + H_{2(g)}$

   iv. $Cl_2 + 2NaOH_{(aq)} \rightarrow NaOCl + NaCl + H_2O$

   v. $Cl_2 + H_2O \rightarrow HOCl + HCl$

   Which of these reactions is/are feasible A. (i) only B. (ii) only C. (i), (ii) and (v) D. (ii), (iv) and (v)

5. The following are chemical entities identifiable during qualitative analysis: (i) SO_4^{2-} (ii) H_3O^+ (iii) NO_3^- (iv) NH_4^+ (v) OH^-
   Which of these is/are detected by litmus paper? A. (i) and (iii) B. (i) and (iv) C. (ii) and (v) D. (i), (iii) and (iv)

6. The following species are organic reagents or potential sources: (i) $CH_3\overset{+}{C}H_2$ (ii) NH_3 (iii) BF_3 (iv) Br_2 (v) H_2O (vi) Cl^-. Which of these reagents is/are electrophilic? A. (i), (iii) and (iv) B. (iii), (v), and (vi) C. None D. All.

7. Consider the following molecules:
   (i) $CH_3CH = CHCH_2CH_3$
   (ii) $CH_3CH(Br)CH_3$ (iii) H_2NCH_2COOH
   (iv) $CH_3CH(Cl)CH_2Cl$
   (v) $CH_3CH_2CH_2CH(CH_3)CH_2CH_3$
   (vi) $CH_3CH = CH_2$

Which of these molecules can be resolved into appropriate stereoisomers? A. (iii) only B. (vi) only C. (ii), (iii) and (vi) D. (i), (iv) and (v)

8. Complete and balance the following equation in alkaline medium. $CrO_4^{2-} + Br^- \rightarrow Cr^{3+} + BrO$. The coefficients of $CrO_4^{2-} + Br^-$ and H_2O respectively in the balanced equation are:- A. 1, 2 & 3 B. 5, 2 & 3 C. 5, 3 & 2 D. 2, 3 & 5
9. $531.32cm^3$ of a dry gas at s.t.p. weighs 0.664g. Which of the following can the gas be? (i) N_2 (ii) NH_3 (iii) CO (iv) CO_2 [H = 1, N = 14, O = 16, C = 12, S = 32] A. (i) & (iii) B. (ii) & (iv) C. (i) & (ii) D. (iii) & (iv).
10. Which of the followings can be ultimately converted into ethanal using appropriate reagents/steps (i) ethanol (ii) ethyne (iii) Chloroethane (iv) but-2-ene (v) ethane A. all B. (ii), (iii), (iv) & (v) C. (iii), (iv) & (v) D. (i), (iii), (iv) & (v)
11. An exothermic reaction $A + B \rightarrow C$, has $-3kJ$ and $+20kJ$ as ΔH and activation energy respectively. What will be the activation energy of the reverse reaction? $A + 20kJ$ B. $-10kJ$ C. $+50kJ$ D. $-50kJ$
12. (i) $3-methylhex-2-ene$ (ii) $3-methylhex-3-ene$ (iii) $2-ethylpent-1-ene$. Which of the above is/are formed when $3-methylhexan-3-o1$ is heated with excess conc. H_2SO_4 A. (i) & (ii) B. (ii) & (iii) C. (i) & (iii) D. (i), (ii) & (iii)
13. Two $25cm^3$ portions of NaOH solution are pipetted (i) The first portion was just saturated with SO_2 (ii) the second portion of NaOH solution was added to the content of the first flask. The production formed under (i) and (ii) respectively are: A. Na_2SO_3 & $NaHSO_3$ B. Na_2SO_4 & $NaHSO_4$ C. $NaHS3$ & Na_2SO_4 D. $NaHSO_3$ & Na_2SO_3
14. In which of the following is the central atom subjected to excitation before hybridization. (i)CH_4 (ii) BF_3 (iii) $BeCl_2$ (iv) NH_3 (v) H_2O (vi) CO_2 A. (i), (ii) & (iii) B. All C. (i), (ii), (iii) & (v) D. (i), (ii), (iii) & (vi)
15. $CH_3CH_2CHO \xrightarrow[10-45^0]{KCN\ dil\ HCL} X \xrightarrow[reflux]{c.HCL} Y$. Y is A. 1-cyanopropan-1-ol B. 2-hydroxylbutanoic acid C. 2-cyanopropane D. 2-cyanopropanoic acid.
16. A saturated solution of silver trioxocarbonate (iv) was found to have a concentration of 1.30×10^{-5}mold.dm^{-3} of the salt. Calculate its solubility product without units [Ag = 108, C = 12, O = 16] A. 8.79×10^{-15} B. 1.69×10^{-10} C. 7.25×10^{-15} D. 2.50×10^{-10}
17. $2X_{(g)} + Y_{(g)} = Z_{(g)}$. In the equation, the rate of formation of Z is found to double when the concentration of Y is doubled and to quadruple when the concentration of X is doubled. Determine an expression for the rate of the reaction. A. $r = k[X][Y]$ B. $r = k[X]^2[Y]$ C. $r = k[X]^4[Y]^2$ D. $r = k[X][Y]^2$
18. Calculate the weight of bromine that will saturate 6.6g of pent-2-ene-1-yne [Br = 80; C = 12; H = 1] A. 4.8g B. 48.0g C. 3.2g D. 480g
19. A given quantity of electricity was passed through each of two cells in series. The cells contain Al^{3+} and Ag^+ ions respectively. If 0.27g of Al is deposited in the first cell calculate the weight in grams of silver that will be deposited in the second cell? [Al = 27;

Ag = 108; O = 16; H = 1] A. 0.324 B. 0.36 C. 3.24 D. 3.6

20. If the complete combustion of 1 mole of an Alkanol is represented by the equation:- $CnH_{2n+1}OH + yO_2 \rightarrow yCO_2 + zH_2O$. Then which of the following is/are correct?
(i) $x = \frac{3n+1}{2}$ (ii) $y = \frac{3n+1}{2}$ (iii) $x + y = \frac{5n}{2}$ (iv) $y + Z = 2n + 1$ A. (i) & (ii) only B. (iii) & (iv) only C. (iv) only D. (ii), (iii) & (iv).

21. (i) Principal Quantum number (ii) Azimuthal Quantum number (iii) Magnetic Quantum number (iv) Spin quantum number. Which of above respectively divides shells into orbitals and corresponds with the energy derived from the orientation of orbitals in space A. (i), (ii) and (iv) B. (i) and (ii) C. (ii) and (iii) D. (iii) and (iv).

22. Which of the following salts will, when heated together, produce N_2O (i) $NaNO_2$& NH_4Cl (ii) $NaNO_3$& NH_4Cl (iii) KCl & NH_4Cl (iv) NH_3& CuO A. (i) only B. (ii) only C. (i) & (ii) only D. (i), (ii), (iii) & (iv).

23. Which of the following statements is/are true (i) water gas and producer gas are gaseous fuels containing carbon(ii) oxide (ii) Chlorine is absorbed by sodium hydroxide (iii) Sulphur is a polymorphous element A. i & ii only B. ii & iii only C. I & iii only D. I, ii & iii.

2008/2009
TEST SOLUTION

1. **Hard water** is one that does not form lather readily with soap. Hardness of water is usually caused by the presence of dissolved salts of calcium and magnesium.

Temporary hardness of water can be removed by distillation, boiling, addition of calculated amount of $Ca(OH)_2$, addition of Na_2CO_3 and the use of ion-exchange resin. While **permanent hardness** of after is removed by distillation, addition of Na_2CO_3, and the use of ion-exchange resin.

Hence **both temporary and permanent hardness of water are removed by distillation, addition of Na_2CO_3 and the use of ion-exchange resin.**

The correct option is D

2. **The "Brown Ring" test is a confirmatory test for trioxonitrate V ion NO_3^-.** In this test, a freshly prepared iron II tetraoxosulphate VI, $FeSO_4$ solution [$FeSO_4$ must be freshly prepared to prevent it oxidation into $Fe_2(SO_4)_3$] is added to about $1cm^3$ of the solution. The test tube bearing the solution is then slant/or place in a slanting position) and a few drops of concentrated H_2SO_4 is then added along the side of the test tube. The formulation of a brown ring of $FeSO_4.NO$ complex between the junction of the acid and solution confirm the presence of NO_3^-. The formulation of the brown ring is shown below.

(i) Acidify the nitrate solution with conc. H_2SO_4

$$2Zn(NO_3)_2 + 2H_2SO_4 \rightarrow 2ZnSO_4 + 4HNO_3$$

(ii) The freshly prepared $FeSO_4$ combine with the conc H_2SO_4

$$4FeSO_4 + 2H_2SO_4 \rightarrow 2Fe_2(SO_4)_3 + 2H_2$$

(iii)The HNO_3 form decomposed to form NO

$$4HNO_3 \rightarrow 2H_2O + 3O_2 + 4NO$$

(iv) The NO form combine with both $Fe_2(SO_4)_3$ and H_2

$$Fe_2(SO_4)_3 + 2H_2 + 4NO \rightarrow 4[Fe(H_2O)_5NO]SO_4 + H_2SO_4$$

(v) The dissociation of $[Fe(H_2O)_5NO]SO_4$ to form $FeSO_4.NO$

$$[Fe(H_2O)_5NO]SO_4 \rightarrow FeSO_4.NO + 5H_2O$$

The $FeSO_4.NO$ is responsible for the brown ring.

So the order of the reaction of the brown ring test is that HNO_3 to form NO and then the formation of the brown ring, $FeSO_4.NO$

The correct option is C

3. Decrepitation is the phenomenon whereby a crystalline solid gives a cracking noise on heating due to the removal of water of crystallization. Examples of salts that undergo decrepitation are sodium chloride (NaCl), potassium trioxochlorate (v), ($KClO_3$), two more of lead II trioxonitrate v, $Pb(NO_3)_2$.

The correct option is B

4. The feasible reaction of Chlorine are:

(i) $2Fe + 3Cl_2 \rightarrow 2FeCl_3$ (the higher oxidation state is form).

(ii) $Cl_2 + H_2O \rightarrow HOCl + HCl$ (the bleaching action of Cl_2)

(iii) $Cl_2 + \overset{2NaOH_{(aq)}}{dilute} \rightarrow NaOCl + NaCl + N_2O$ (all halogen dissolve in alkaline)

(iv) $3Cl_2 + \overset{6NaOH}{Conc} \rightarrow 5NaCl + NaClO_3 + 3H_2O$ (all halogen dissolve in alkaline)

The correct option is D

5. The oxonium ion, H_3O^+ is acidic but the OH^- is alkaline. Hence OH^- & H_3O^+ are detected by a litmus paper.

The correct option is C

6. Electrophiles are substance or reagent which attack electron-rich centre. They are also known at Electrophilic reagent. The following always act as Electrophiles.

(i) All electron-deficient species e.g. $AlCl_3$, BF_3, $Becl_2$ etc.

(ii) All positive speciese.g. $CH_3\overset{+}{C}H_2$, Ca^+, Mg^{2+}

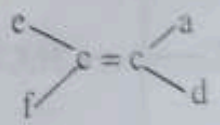
(iii) A molecules which is easily polarized and attack electron rich centre with their positive pole e.g. $Br_2\left(\overset{\delta+}{Br} - \overset{\delta-}{Br}\right)$

The correct option is A.

7. **Stereo isomers** are isomer with the same molecular formula but different configuration. Geometric isomers and optical isomers are both stereo isomers. For molecules to be geometric isomers, the conditions below must be satisfied.

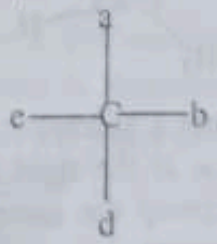
(i) A double bond or ring structure must be present

(ii) The structure below must be satisfy



Where e ≠ f and a ≠ d but e = a or e = d

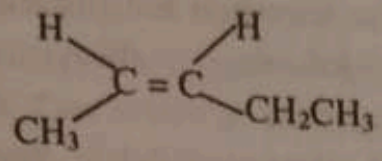
For a molecule to be optical isomers it must have a chiral centre. A chiral centre is a carbon atom surrounded by four different group.



To pick the stereo-isomers, we check whether for a chiral centre or the

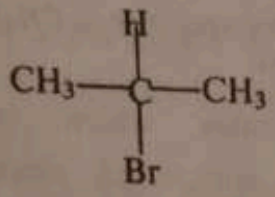
structure for geometric isomers. So we draw the structure of each of the molecules.

(i)



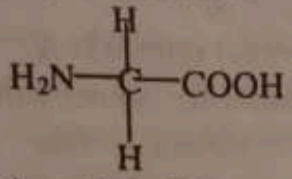
It is a geometric isomers

(ii)



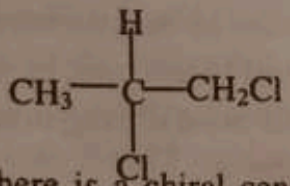
There is no chiral centre. Hence it is not optical isomers

(iii)



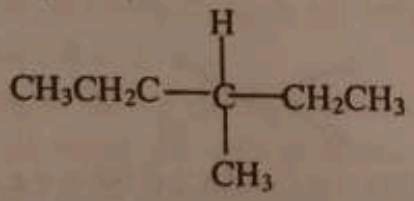
No chiral centre. Hence not an optical isomers

(iv)



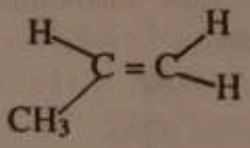
There is a chiral centre. Hence it is an optical isomers.

(v)



There is a chiral centre. Hence it is a optical isomers.

(vi)



It is not a geometric isomers sins the carbon at the right hand size has it two group the same (i.e. hydrogen-hydrogen).

Note that the chiral carbon can be any of the carbon in the molecule provided it is surrounded by four different group.

The correct option is D

8. $CrO_4^{2-} + Br^- \rightarrow Cr^{3+} + BrO^-$

(i) Separation the reaction into oxidation reduction half-react.

$CrO_4^{2-} \rightarrow Cr^{3+}$ (reduction)

$Br^- \rightarrow BrO^-$ (oxidation)

(ii) Balance each half reaction

$8H_2O + CrO_4^{2-} \rightarrow Cr^{3+} + 4H_2O + 8OH^-$

$4H_2O + CrO_4^{2-} + 3e^- \rightarrow Cr^{3+} + 8OH^-$

.....(1)

$2OH^- + Br^- + H_2O \rightarrow BrO^- + 2H_2O$

$2OH^- + Br^- \rightarrow BrO^- + H_2O + 2e^-$

..... (2)

Balance the number of electron in the two half reaction.

$4H_2O + CrO_4^{2-} + 3e^- \rightarrow Cr^{3+} + 8OH^-$ ..... $\times 2$)

$2OH^- + Br^- \rightarrow BrO^- + H_2O + 2e^-$ ..... $\times 3$)

$8H_2O + 2CrO_4^{2-} + 6e^- \rightarrow 2Cr^{3+} + 16OH^-$

$6OH^- + 3Br^- \rightarrow 3BrO^- + 3H_2O + 6e^-$

$5H_2O + 3Br^- + 2CrO_4^{2-} \rightarrow 2Cr^3 + 3BrO^- + 10OH^-$

The coefficient of CrO_4^{2-}, Br^- and H_2O are respectively 2, 3 & 5.

The correct option is D

9. To identify a gas we can either use a confirmatory test or its molar mass.

$$\text{No of mole} = \frac{\text{Reacting mass}}{\text{molar mass}} = \frac{\text{Vol at s.t.p}}{\text{Molar gas volume}}$$

$$\Rightarrow \frac{0.664}{Molar\ mass} = \frac{531.32}{22400}$$

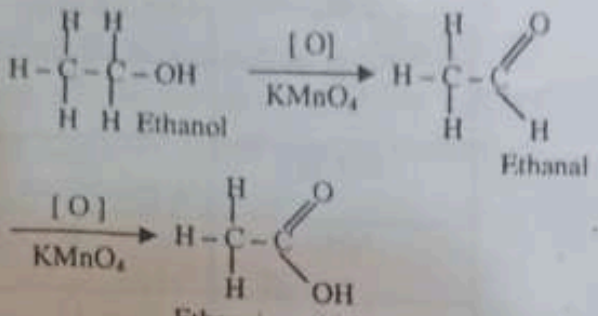
$$Molar\ mass = \frac{0.664 \times 22400}{531.32} = 27.99 g/mol$$

Hence the molar mass of the gas is 28g/mol. Hence the gas is N_2 or CO.

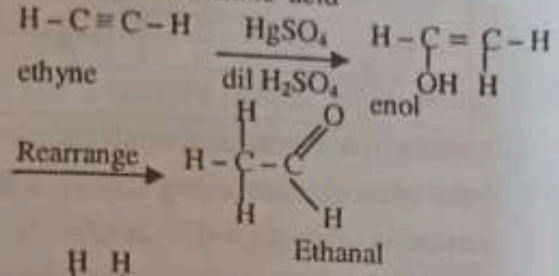
The correct option is A

10.

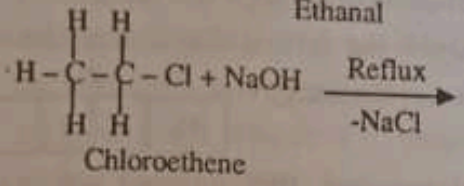
(i)

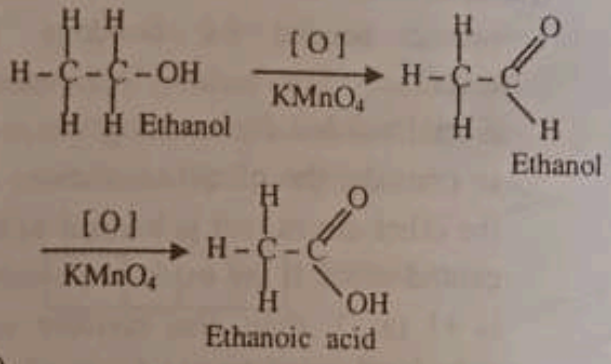


(ii)

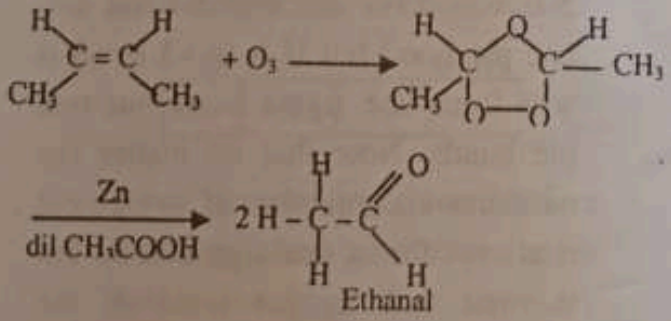


(iii)

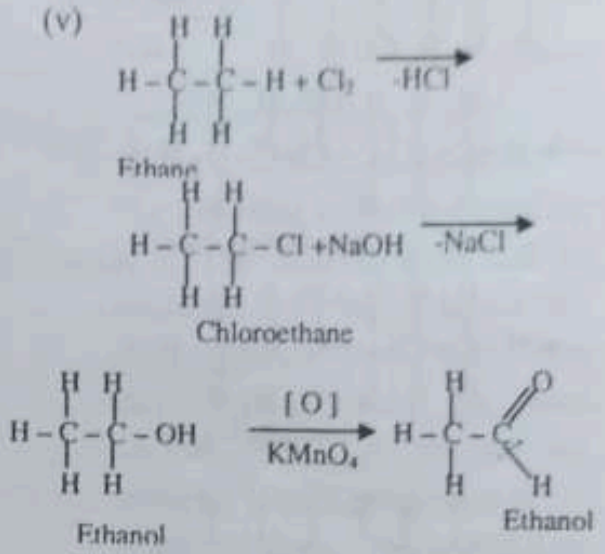




(iv)

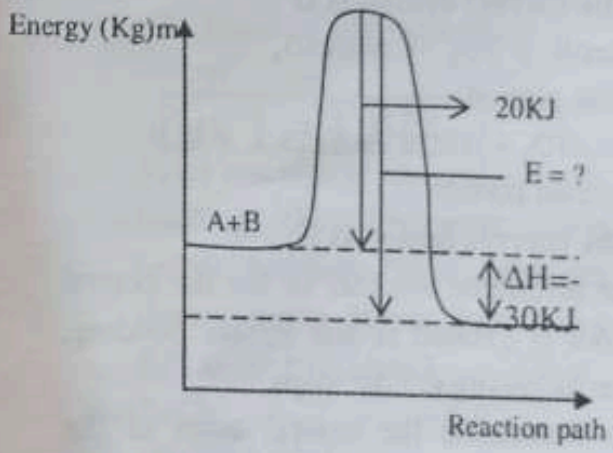


(v)



The correct option is A

11.



If $A + B \longrightarrow C\ \Delta H = -30KJ$ *then*

$C \longrightarrow A + B \quad \Delta H = 30KJ$

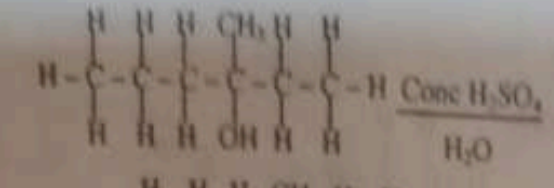
$E = 30KJ + 20\ KJ$

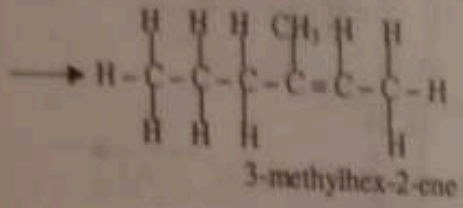
$E = 50KJ$

Note that the activation energy of the backward reaction is measure from the product level to the nitration complex. Besides if a reaction is reverse, the sign of ΔH is reverse.

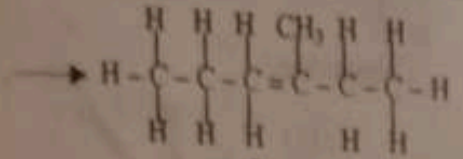
The correct option is C.

12.

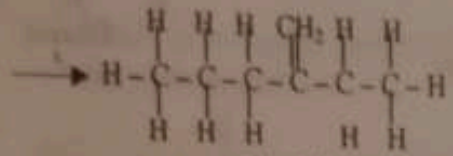




3-methylhex-2-ene



3-methylhex-3-ene



2-ethylpent-1-ene

Note that the reaction above is on saytzeff's empirical rule.

The correct option is D

13. $NaOH + SO_2 \rightarrow NaHSO_3$

First portion

$NaHSO_3 + NaOH \rightarrow Na_2SO_4 + H_2O$

Second portion

The correct option is C

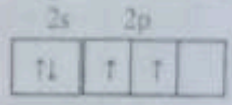
14. To determine whether or not the central atom is excited or not before bonding, the following are the steps.

(i) Determine the central atom of the molecules or ions. The central atom is the atom with the highest oxidation number e.g.

Species	Central atom
CH_4	C
BF_3	B
$BeCl_2$	Be
NH_3	N
H_2O	O
CO_2	C

(ii) Write the electronic configuration of the central atom using the s,p,d & f – notation e.g. ${}_6C \rightarrow 1s^2\,2s^2\,2p^2$

(iii) Draw the orbital diagram of the outer most shell e.g.

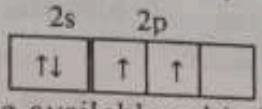


(iv) Determine the number of vacant orbital needed for bonding. To determine the number of vacant orbital needed for bonding we need to consider the oxidation number of the other atoms that is bonded to the central atom. If the oxidation number is +1 or -1, than, that element will only form sigma bond, if it is +2 or -2 it will form one sigma bond and one pie bond but if it is +3 or -3 it will form one sigma bond but two pie bonds. Note that no matter the oxidation state/number of an element it always forms one sigma bond but the rest will be pie bond. If the vacant orbital is not available to accommodate the incoming electrons for the formation of sigma and pie bonds, then an electron must be promoted from orbital with a lower energy to orbital with a higher energy. (This is called exciation).

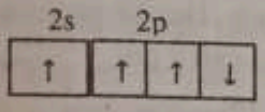
But if the space available is enough to accommodate the incoming electron for both sigma and pie bond formation, no promotion is done (i.e. there will be no excitation). We will then apply the above steps to each of the molecules given.

(i) CH_4

$_6C \rightarrow 1s^2\ 2s^2\ 2p^2$

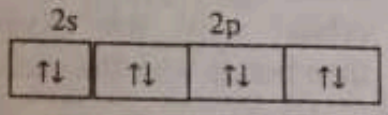


The available orbital for bonding is 2. (vacant orbital for bonding, is one than contain only one electron). The hydrogen atom has an oxidation state of +1. Hence an hydrogen atom can only form a sigma bond. The four hydrogen atoms will form four sigma bones. So four vacant orbital is needed for bonding. So an electron is promoted from the 2s-orbital to the 2p-orbital.



Excited state

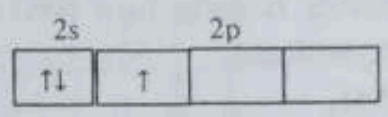
Since we now have four vacant orbital, bonding will now occur.



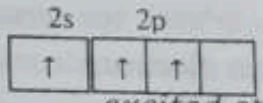
Since electron is promoted before bonding, then excitation occur before bonding. Since there are four sigma bonds form, then CH_4 is sp^3-hybridized.

(ii) BF_3

$_5B \rightarrow 1s^2\ 2s^2\ 2p^1$

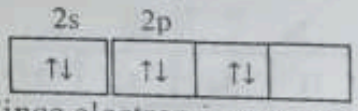


The available orbital for bonding is 1. The fluorine atom has an oxidation state of -1. Hence the three fluorine atom will form three sigma bonds. So three vacant orbital is needed for bonding. Hence an electron is promoted from the 2s-orbital to the 2p-orbital.



excited state

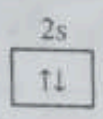
Since we now have three vacant orbitals, bonding will now occur.

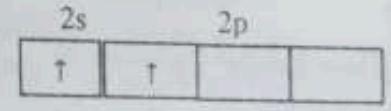


Since electron is promoted before bonding, then excitation occur before bonding. Since there are three sigma bonds form, then BF_3 is sp^2 hybridized.

(iii) $BeCl_2$

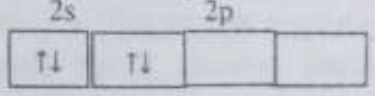
$_4Be \rightarrow 1s^2\ 2s^2$





Excited state

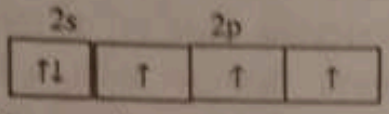
Since there are two vacant orbital now, bonding can now occur.



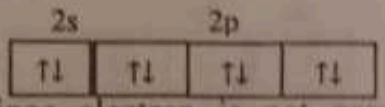
Since electron is promoted before bonding then excitation occur before bonding. Since two sigma bonds is form then $BeCl_2$ is sp-hybridized.

(iv)NH_3

$_7N \rightarrow 1s^2\ 2s^2\ 2p^3$



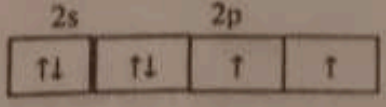
Since the oxidation state of hydrogen is +1, then the three hydrogen atoms will require three vacant orbital for bonding in HN_3. Since there are three vacant orbital to accommodate the three electrons coming from the three hydrogen atoms, promotion of electron is not needed.



Since electron is not promoted before bonding then excitation does not occur before bonding. Note that the NH_3 is sp^3-hybridized. Since bonding was not carry out in the 2s-orbital, it means that NH_3 has one cone pair of electron on the central atom.

(v) H_2O

$_8O \rightarrow 1s^2\ 2s^2\ 2p^4$

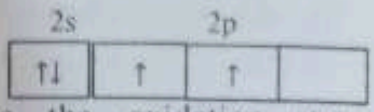


Since the oxidation state of hydrogen atoms will require two vacant orbital. Since there are two vacant orbital to accommodate the two electrons coming from the two hydrogen atoms, promotion of electron is not needed.

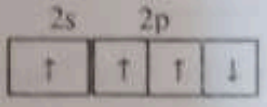
Since electron is not promoted before bonding then excitation does not occur before bonding. Note that H_2O, is sp^3-hybridized. Since bonding was not carry out in the 2s and $2p_x$-orbital, it means that H_2O molecules have two lone pair of electron on the central atom.

(vi)CO_2

$_6C \rightarrow 1s^2\ 2s^2\ 2p^2$

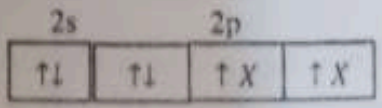


Since the oxidation state of oxygen is -2. It will form one sigma bond and one pie bond. The two oxygen atom will form two sigma bonds and two pie bond. All the sigma bonds will be form first before the pie bonds are form. So the two oxygen atoms need four vacant orbital for bonding. Hence promotion of electron is carry out.



excited state

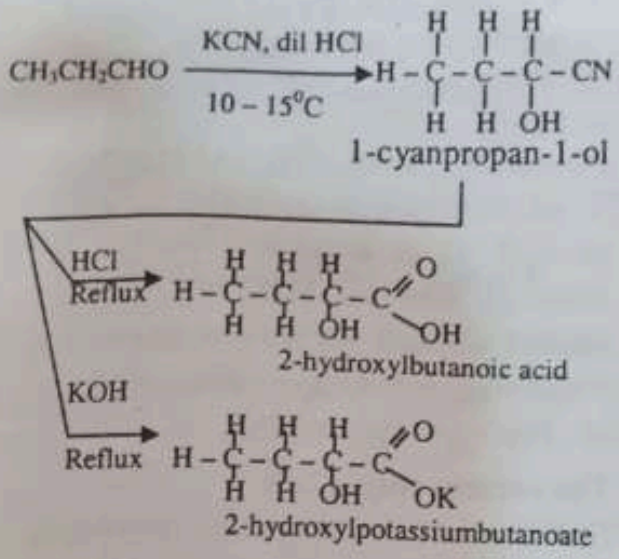
Since there are now four vacant orbital now, the oxygen atom then bonds with the carbon atom.



Note that we denote the pie bond with X. Since only two sigma bonds are form, therefore CO_2 is sp-hybridized. Since electron is promoted before bonding, the excitations occur before bonding.

The correct option is D.

15.



The correct option is B

16. $Ag_2CO_{3(s)} \rightleftharpoons 2Ag^+ + CO_3^{2-}$

$xm \qquad 2xm \quad xm$

$Ksp = [Ag^+]^2[CO_3^{2-}]$

$= (2x)^2.x$

$Ksp = 4x^3$

But $x = 1.3 \times 10^{-5}$

$Ksp = 4(1.3 \times 10^{-5})^3$

$Ksp = 8.79 \times 10^{-15}$

The correct option is A

17. Generally let the rate law be:

$R = K[X]^m[Y]^n$

If the concentration of Y is double, the rate F, will also double

$R_1 = K(2[Y])^n[X]^m$

$R_1 = 2^nK[X]^m[Y]^n$

For the rate to double $R_1 = 2R$. But

$R = K[X]^m[Y]^n$

$2R = 2^nR$

$2^1 = 2^n$

$\Longrightarrow n = 1$

If the concentration of X is double, the rate R, quadruple (i.e. 4 times increases)

$R_2 = K(2[X])^m[Y]^n$

$R_2 = 2^mK[X]^m[Y]^n$

But $R_2 = 4R$ and $R = K[X]^m[Y]^n$

$4R = 2^mR$

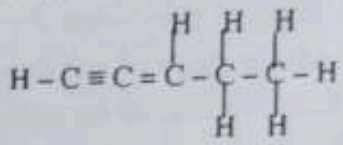
$2^2 = 2^m$

$\Longrightarrow m = 2$

$R = K[X]^2[Y]$

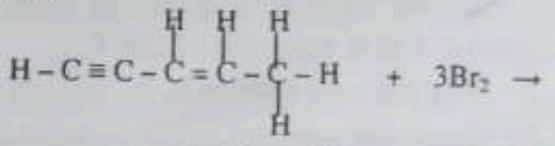
The correct option is B

18.

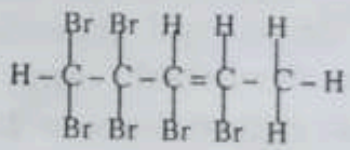


pent-2-ene-1-yne

The graphic structural formula of the compound above shows that pent-2-ene-1-yne does not exist because the second carbon atom from the left hand since contain five bond but carbon can only form four bonds, because it is tetravalent. The major thing to note about the compound is that it has one triple bond and one double bond, so it will take three moles of a reagent in addition reaction. So we will represent the compound as pent-3-ene-1-yne (C_5H_6).



pent-3-ene-1-yne



R.m.m of C_5H_6 = 5(12g/mol) + 6(1g/mol) = 66g/mol

$\cap_{C_5H_6} = \frac{6.6g}{66g/mol} = 0.1mol$

$\cap_{Br_2} = \frac{3mol\ of\ Br_2}{1\ mole\ of\ \cap_{C_5H_6}} \times 0.1mol\ of\ \cap_{C_5H_6}$

$= 0.3mol$

But $\cap_{Br_2} = \frac{Reacting\ mass\ of\ Br_2}{Molar\ mass\ of\ Br_2}$

Reacting mass of Br_2

$= \cap_{Br_2} \times molar\ mass\ of\ Br_2$

$= 0.3mol \times 160g/mol$

$= 48g$

The correct option is B

19. $\frac{M_{Ag}}{M_{AL}} = \frac{M_{Ag} \times C_{AL}}{M_{AL} \times C_{Ag}}$

where m = mass of substance deposited

M = Molar mass of substance

c = Relative charge on substance

$$\frac{M_{Ag}}{0.27} = \frac{108 \times 3}{27 \times 1}$$

$$M_{Ag} = \frac{0.27 \times 108 \times 3}{27} = 3.24g$$

The correct option is C

20. $C_nH_{2n+1}OH + xO_2 \rightarrow yCo_2 + zH_2O$

The equation of the complete combustion of 1 mole of any alkanol is given as

$$C_nH_{2n+1}OH + \left(\frac{3n}{2}\right)O_2 \rightarrow nCo_2 + (n+1)H_2O$$

$$\Rightarrow x = \frac{3n}{2}, \quad y = n, \quad z = n+1,$$

$$x + y = \frac{3n}{2} + \frac{n}{1} = \frac{5n}{2},$$

$$y + z = n + n + 1 = 2n + 1$$

The correct option is B

21. Quantum number is the number given to each energy level of an atom.

(i) The principal quantum number (n) deals with (a)the energy possesses by an electron due to its distances from the nucleus (b)The size of an electron cloud (c)The distance of an electron from the nucleus.

(ii) The subsidiary or aziminthal quantum number (L) divides sub-shells into orbital.

(iii)The magnetic quantum number (m) deals with the orientation of electron in space or orbital.

(iv)The spinning quantum number (s) deals with the spinning properties of an electron in an orbital.

The correct option is C

22. (i) $NaNO_{2(s)}NH_4Cl_{(s)} \xrightarrow{\Delta} NH_4NO_{3(g)} + NaCl_{(g)}$

$$NH_4NO_{3(g)} \xrightarrow{\Delta} N_{2(g)} + 2H_2O_{(g)}$$

(ii) $NaNO_{3(s)} + NH_4Cl_{(s)} \xrightarrow{\Delta} NH_4NO_{3(g)} + NaCl_{(g)}$

$$NH_4NO_{3(g)} \xrightarrow{\Delta} N_2O_{(g)} + 2H_2O_{(g)}$$

(iii) $KCl + NH_4Cl \xrightarrow{\Delta}$ No reaction

(iv) $2NH_{3(g)} + 3CuO_{(s)} \rightarrow 3Cu_{(s)} + 3H_2O_{(L)} + N_{2(g)}$

The correct option is B

23. (i) Producer gas is a mixture of nitrogen and carbon II oxide prepared by passing a steam of air through red-hot coke.

Air + C → CO + N_2

Water gas is a mixture of equal volumes of hydrogen and carbon II oxide, prepared by passing steam over white-hot coke at 1000^0C

$C_{(s)} + H_2O_{(g)} \rightarrow Co_{(g)} + H_{2(g)}$

(ii) $6NaOH + 3X_2 \rightarrow 5NaX + NaXO_3 + 3H_2O$

Hot conc

$NaOH + X_2 \rightarrow NaX + NaOX + H_2O$

Cold diluted

where $X_2 \rightarrow I_2, Cl_2, Br_2 \& F_2$

All the Halogen dissolve in alkaline

(iii)Sulphur does not undergoes polyprophsm but allotropy.

Note that in the pre-degree syllabus it is assure that polymorphism is the same as allotropy but the two terms do not mean the same thing.

Base on these the correct option is D. However the most correct option is A.

OBAFEMI AWOLOWO UNIVERSITY
PRE-DEGREE PROGRAMME ILE-IFE
2ND CONTACT PERIOD
EXAMINATION CHEMISTRY SET 5
OCTOBER 2009 1HR 15MINS
INSTRUCTIONS

(a) Each question is followed by FOUR options lettered A to D. Find out the correct option for each question and shade, with HB pencil, options the appropriate box on the computer sheet, which corresponds to the correct alternative.

(b) Shade "E" if there is no correct alternative

(c) Fill in your full names (surname first and in capital) as well as your registration number.

(d) Submit your question paper with your name and Reg. no properly written i.e.

(e) Each correct answer attracts + 2.0 and a wrong answer -0.5

(f) Q1 – Q40 IMPLIES A1-A40 and Q41-Q47 IMPLIEB1 – B7 ON THE OMR SHEET

1. A certain solution of tetraoxosulphate (VI) acid has density 1.2g.cm^{-3} and contain 60% of the pure acid. Determine the molarity of the acid. [H = 1; S = 322; O = 16] A. 7.3mol dm^{-3} B. 7.5mol dm^{-3} C. 9.5mol dm^{-3} D. 9.1mol dm^{-3}
2. 210cm^3 each of a 0.1 mol dm^{-3}solutions of lead (II) trioxonitrate (V) and sodium chloride were mixed. Assuming that lead (II) chloride is completely insoluble, calculate the mass of lead (II) chloride that was precipitated. [Pb = 207; Cl = 35.5; N = 14; O = 16]. A 5.838g B. 2.919g C. 3.054g D. 6.116g.
3. Assume that you have a cylinder with a movable piston. What would happen to the gas pressure inside the cylinder if you decrease the volume by a factor of four while holding the temperature constant. A. it will increase by a factor of 4. B. it will decrease by a factor of 4 C. pressure will be raised to a power of 4. D. it will remain constant
4. Arrange the following compounds in the order of their decreasing boiling points using their Roman figures. (i) $CH_3(CH_2)_3CH_3$ (ii) $CH_3C(CH_3)_3$ (iii) $CH_3(CH_2)_4CH_3$ (iv) $CH_3CH_2CH(CH_3)_2$ A. (iii), (i), (iv), (ii) B. (i), (iv), (ii), (iii) C. (ii), (iv), (i), (iii) D. (iii), (iv), (i), (ii)
5. Calculate the weight of bromine that will saturate 3.3g of 3-methylbut-3-ene-1-yne. [Br = 80; Cl = 35.5; C = 12; H = 1] A. 21.3g B. 24.0g C. 213g D. 240g
6. An aqueous solution of sodium hydroxide has of P^H 12.0. What is the hydroxide ion concentration of the solution? A. 10^{-12} moldm^{-3} B. 10^{-6} moldm^{-3} C. 10^{-4} moldm^{-3} D. 10^{-2} moldm^{-3}
7. 25cm^3 portions of sodium trioxocarbonate (IV) were titrated with 0.12 moldm^{-3} solution of hydrochloric acid using phenolphthalein as indicator. The average titre was 15.25cm^3. Determine the concentration in moldm^{-3} of the trioxocarbonate (IV) solution. A. 0.0366 B. 0.0427 C. 0.0732 D. 0.0854
8. (i) Tollen's reagent (ii) Fehling's reagent (iii) Bromine water (iv) Million's reagent (v) Acidified potassium tetraoxomanganate (VII). Which of these reagents can be used to establish the presence of C/C double or triple bond A.

(i) & (v) only B. (i), (ii) & (iv) only C. (ii) & (iv) only D. (iii) & (v) only.

9. A solid substance is burned in excess oxygen and the gaseous products successively passed through: (a) lime water which is turned milky (b) white anhydrous $CuSO_4$ which is turned blue. Which of the following conclusions can be taken as being absolutely correct (i) Carbon is present in the solid (ii) hydrogen is present in the solid (iii) Carbon and hydrogen are both preset in the solid (iv) Chlorine is present in the solid A. (i) only B. (ii) only C. (iii) only D. (iv) only

10. A chemical reaction proceeds with increase in both enthalpy and entropy. This reaction will be spontaneous if A. $\Delta H = T\Delta S$ B. $\Delta H < T\Delta S$ C. $\Delta H > T\Delta S$ D. none of these

11. If the complete combustion of one mole of an alkanol is represented by the equation: $C_nH_{2n+1}OH + xO_2 \rightarrow yCO_2 + zH_2O$, then which of the following is/are correct. (i) $x = \frac{3n+2}{2}$ (ii) $x = n$ (iii) $x + y = \frac{5n}{2}$ (iv) $y + z = 2n + 1$ A. (ii), (iii) & (iv) B. (i), (ii) & (iii) C. (i), (iii) & (iv) D. (i), (ii), (iii) & (iv)

12. Consider the following reactions:
(i) $2AgNO_3 + CaCl_2 \rightarrow 2AgCl + Ca(NO_3)_2$
(ii) $2SO_3 + 4Sn \rightarrow SnS_2 + 3SnO_2$
(iii) $HCl + NaOH \rightarrow NaCl + H_2O$
(iv) $Cu_2S + 2HBr \rightarrow 2CuBr + H_2S$
(v) $2H_2 + O_2 \rightarrow 2H_2O$. Which of these reactions is/are redox? A. (i) & (iv) only (B) (ii) & (v) C. (i) & (ii) only D. (iii), (iv) & (v) only.

13. Consider nuclides represented as follows: (i) $^{90}X_{46}$ (ii) $^{90}Y_{47}$ (iii) $^{88}Z_{44}$ (iv) $^{89}M_{45}$ (v) $^{91}S_{47}$. Which of them are isotones to one another? A. (i), (ii), (iii) and (v) only B. (i), (iii), (iv) & (v) only C. (ii), (iii), (iv) and (v) only D. (iii), (iv) & (v) only

14. (i) p/p (linearly opposed) (ii) p/p (parallel) (iii) sp/sp (iv) sp^2/sp^2 (v) sp/p (linearly opposed). Which of these mode(s) of overlappings is/are found in Carbon (IV) oxide molecule? A. (i), (ii) & (iii) only B. (ii) and (v) only C. (i) & (v) only D. (iii), (iv) & (v) only

15. Which of the following compounds will give positive iodoform test (i) ethanol (ii) propan-1-ol (iii) ethanal (iv) propanal (v) propan-2-ol A. (ii), (iii) & (v) B. (i), (iii) & (v) only C. (i) & (iii) only D. (iii) & (v) only

16. A hydrated metallic chloride ($MCl_2.xH_2O$) contain 49.32% of water of crystallization. Calculate the value of x [$MCl_2 = 111$; $H_2O = 18$] A. 5 B. 6 C. 7 D. 2

17. $20cm^3$ of a gaseous hydrocarbon were mixed with $120cm^3$ of oxygen (an excess) and both at room temperature and later exploded. On cooling to original temperature of measurement, $100cm^3$ of residual gaseous mixture was obtained. After passing through concentrated KOH solution, the volume was reduced to $40cm^3$. Calculate the molecular formula of the hydrocarbon A. C_2H_4 B. C_3H_6 C. C_2H_6 D. C_3H_4

18. The correct number of sigma bonds respectively present in ethyl benzene and methylbenzene can be obtained from the followings: (i) 15 (ii) 16 (iii) 17 (iv) 18 A. (iv) & (i) B. (ii) & (iii) C. (i) & (ii) D. (iii) & (iv)

19. In Organic Chemistry, we talk about "Double Bond Equivalence". What brings about this terminology? (i) presence of double bonds (ii) presence of triple bonds (iii) presence of rings A. (i), (ii) & (iii) B. (ii) & (iii) only C. (i) & (iii) only D. (i) & (ii) only

20. Complete and balance the following equation in alkaline medium: $Br^- + CrO_4^{2-} \rightarrow BrO^- + Cr^{3+}$ The coefficients of BrO^-, Cr^{3+} and OH^- in the balanced equation are: A. 3, 2, 10 B. 5, 3, 2 C. 2, 3, 5 D. 2, 3, 10

21. The followings are uses of allotropes of carbon (i) making of printers ink (ii) making of lead pencil (iii) making of shoe polish (iv) decolorizing sugar (v) making of black paints. Which of these involve(s) lamp black. A. (i), (iii) & (iv) B. (ii), (iii) & (v) C. (i), (iii) & (v) D. (i), (ii) & (iv)

22. Which of the following chemical reactions is/are involved in the industrial preparation of H_2SO_4? (i) $H_2 + SO_3 + \frac{1}{2}O_2 \rightarrow H_2SO_4$ (ii) $H_2O + SO_3 \rightarrow H_2SO_4$ (iii) $H_2SO_4 + SO_3 \rightarrow H_2S_2O_7$ (iv) $H_2S_2O_7 + H_2O \rightarrow 2H_2SO_4$ A. (i) & (ii) only b. (i) & (iii) only C. (ii) & (iv) only D. (iii) & (iv) only

23. $Na_2CO_3 + HCl \rightarrow NaHCO_3 + NaCl$ ..... 1; $NaHCO_3 + HCl \rightarrow NaCl + H_2O + CO_2$ 2

Using the above equations, calculate the total volume (cm^3) at s.t.p. of CO_2 that can be produced when 0.12 mole of Na_2CO_3 is added to 180cm^3 of a 1 mole dm^{-3} solution of HCl [Na = 23; C = 12; O = 16; H = 1; molar volume of gas at s.t.p = 22.3dm^3 A. 1100 B. 1344 C. 1300 D. 1120

24. The electron affinity of an element depends on its (i) atomic size (ii) nuclear charge (iii) electronic configuration A. (i) & (ii) only B. (i), (ii) & (iii) C. (ii) & (iii) only D. (i) & (iii) only.

25. Which of the followings is/are true of both electrochemical and electrolytic cells? (i) oxidation takes place at the anode (ii) the anode is negatively (iii) reduction takes place at the cathode (iv) the cathode is positively charged. A. (i) & (ii) only B. (i) & (iii) only C. (ii) & (iv) only D. (iii)& (iv) only

26. Consider the following equations in which P and Q are metals while X and Y are non metals. $2H^+ + P \rightarrow P^{++} + H_2, 2H^+ + Q \rightarrow Q^{++} + H_2, Q^{++} + P \rightarrow P^{++} + Q, X^- + Y \rightarrow Y^- + X$ Arrange the elements according to their order in the electrochemical series. A. PQXY B. PQYX C. QPXY D. QPYX

27. Consider the reaction $A + B \rightarrow C$; The rate of this reaction was found experimentally to be independent of the concentration of A and to quadruple when the concentration of B is doubled. The rate law for the reaction is
A. $r = k[A]^2$ B. $r = k[A]^1[B]^4$ C. $r = k[A]^4[B]^1$ D. $r = k[B]^2$

28. Which of the following statements is/are true of the bleaching actions of Chlorine and Sulphur (IV) oxide? (i) water must be present for the bleaching to occur (ii) chlorine bleached by oxidizing the dye while sulphur (IV) oxide bleaches by reducing it (iii) the bleaching temperature must be very low A. (i) (iii) only B. (i) & (ii) only C. (i) only D. (i), (ii) & (iii)

29. Which of the methods below can be used for collecting wet/dry chlorine gas? (i)

over water (ii) downward delivery (iii) upward displacement A. (i) only B. (i) & (ii) only C. (i), (ii) & (iii) D. (ii) only

30. (i) Industrial effluents (ii) Dust (iii) Agricultural practices (iv) vehicular emissions (v) oil spillage (vi) emission of smoke and gaseous oxides of Nitrogen and Sulphur from Chimneys of industrial equipments (vii) domestic wastes. Which of these environmental pollutants are responsible for water pollution? A. (ii), (iv) (vi) & (vii) B. (i), (iii), (v) & (vii) C. (i), (iii), (v) & (vi) D. (i), (ii), (iii) & (vii).

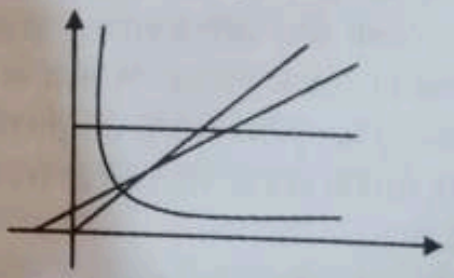
31. (i) Deliquescence is the absorption of moisture from the atmosphere with subsequent dissolution (ii) Efflorescence is a process by which a crystalline compound loses all or part of its water of crystalisation (ii) All deliquescent substances are hygroscopic. Which of the above statements is/are ABSOLUTELY correct? A. (i), (ii) & (iii) B. (i) & (iii) only C. (ii) & (iii) only D. (i) & (ii) only.

32. An unknown gas composed of homonuclear diatomic molecules effuses at a rate that is 0.671 times that of O_2 at the same temperature and pressure. Calculate the relative molar mass of the unknown gas A. 80g/mole B. 28g/mole C. 71g/mole D. 160g/mole

33. (i) Chlorine attacks starch to turn it blue-black (ii) iodide ion attacks starch to turn it blue-black (iii) chlorine attacks iodide ion to give iodine (iv) chlorine attacks start-iodide paper to turn it blue-black. (v) iodine attacks starch to turn it blue-black. Which is correct order for any of the operations that actually takes place in the use of starch iodide paper in confirming chlorine in qualitative analysis? A. (i) & (ii) B. (iii) & (v) C. (iii) & (i) D. (iii) & (iv)

34. Benzoic acid (B) and a compound (K) each melts at 119-121^{0}C. a mixed melting point determination of B and K can be used to confirm: (i) whether K is pure (ii) the identity of K with B (iii) whether benzoic acid is pure (iv) the none identity of K with B A. (ii) & (iv) only B. (i) & (ii) only C. (iii) & (iv) only D. (i) & (iv) only

35. With the appropriate choice of axes, which of the following graphs can be associated with Boyle's Law?



A. (i) & (ii) only B. (i), (iii) & (iv) C. (iii) & (iv) only D. (i), (ii) & (iv)

36. A dry gas sample with volume 531.32cm^3 at s.t.p weighs 0.664g. Which of the followings can the gas be? A. N_2 (ii) NH_3 (iii) CO (iv) CO_2 [H = 1; C = 12; N = 14; O = 16; S = 32] A. (ii) &(iv) only B. (iii) & (iv) only C. (i) & (ii) only D. (i) & (iii)

37. In which of the followings is hydrogen bond present (i) HCl (ii) H_2O (iii) NH_3 A. (i) & (iii) only B. (i) & (ii) only C. (ii) & (iii) only D. (i), (ii) & (iii)

38. Which of the following compounds can react with aminoethanoic acid under suitable conditions? (i) HNO_2 (ii) $NaOH_{(aq)}$ (iii) $H_2SO_{4(aq)}$ (iv) PCl_5 (v) CH_3COCl (vi) Na/liq NH_3 A. (i), (ii),

(iv) & (v) only B. (i), (ii), (iii), (iv) & (v) only C. (ii), (iii), (v) & (vi) only D. (ii), (iii), (iv), (v) & (vi) only.

39. In the reaction:

$CH_3CH_2CH_2OH$ x'sc. $\xrightarrow[180^0C]{H_2SO_4}$ X

HBr Y $\xrightarrow{NaOH_{(aq)}\text{reflux}}$ Z

If you are given the following list of compounds (i) propan-1-ol (ii) propan-2-ol (iii) 2-bromopropane (iv) propanone (v) propene (vi) 1-bromopropane. Which of these are respectively X & Z A. (i) & (ii) B. (v) & (i) C. (v) & (ii) D. (ii) & (vi)

40. (i) $aqCH_3COOK, pH > 7$

(ii) $aqPb(NO_3)_2,\ pH = 7$

(iv) $aq\ MgCl_2, pH = 7$

(v) (iv) $aq\ NH_4Cl,\ pH < 7.$

(vi) Which of the above statements is/are correct. A. (i) & (iv) only B. (iii) & (iv) only C. (i), (ii), (iii) & (iv) D. (ii) & (iv) only

41. Which of the following is/are correct about pH (i) $pH = -log_{10}[H^+]$ (ii) $pH = \log_{10} 1/[H^+]$ (iii) $[H^+] = 10^{-pH}$ (iv) $[H^+] = \log_{10} pH$ A. (i), (ii) & (iii) only B. (i) & (ii) only C. (iii) & (iv) only D. (i), (ii) & (iv) only.

42. Which of the followings will turn colourless if treated with the appropriate reducing agent? (i) chlorine gas (ii) acidified potassium trioxoiodate (V) solution (iii) iodine solution (iv) acidified potassium heptaoxodichromate (VI) solution (v) acidified potassium tetraoxomanganate (VII) solution A. (i), (iii) & (v) only B. (i), (ii)& (iii) only C. (ii), (iv) & (v) only D. (ii), (iii) & (v) only

43. Two compounds A and B of about the same relative molecular mass melt at 119-121^{0}C and 219-221^{0}C respectively. Which of the followings would you consider as reasonable for the melting point(s) of a homogenous mixture of 1g A and 10g of B (i) 100-110^{0}C (ii) 210-215^{0}C (iii) 110-115^{0}C (iv) 205-210^{0}C A. (i) & (iv) only B. (ii) & (iii) only C. (ii) & (iv) only D. (i), (ii), (iii) & (iv)

44. If the cost of electricity required to deposit 1g of aluminium is N40, how much would it cost to deposit 24g of copper? [Al = 27; Cu = 64] A. N270.00 B. N370.00 C. N470.00 D. N540.00

45. Which of the following equations represent(s) the reaction(s) taking place during the preliminary purification of bauxite in the extraction of aluminum? (i) $2FeO_{(s)} + O_{2(g)} \rightarrow 2Fe_2O_{3(s)}$ (ii) $Al_2O_{3(s)} + 2NaOH_{(aq)} \rightarrow 2NaAlO_{2(aq)} + H_2O_{(1)}$ (iii) $Al_2O_{3(s)} + 2NaOH_{(aq)} + 2H_2O \rightarrow 2Na[Al(OH)_4]$ A. (i) only B. (i) & (ii) only C. (ii) only D. (i), (ii) & (iii)

46. (i) But-1-ene (ii) Cyclobutene (iii) Cyclohexene (iv) Hex-1-ene (v) Pent-2-ene. Which of the above compounds will give just one product upon ozonolysis (a) (i), (ii) & (v) B. (ii), (iii) & (vi) C. (i), (iii) & (vi) D. (i), (ii) & (iv)

47. (i) $4Na + O_2 \rightarrow 2Na_2O$ (ii) $2Na + O_2 \rightarrow Na_2O_2$ (iii) $Na_2O + H_2O \rightarrow 2NaOH$ (iv) $Na_2O + CO_2 \rightarrow Na_2CO_3$ (v) $2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$ (vi) $NaOH + CO_2 \rightarrow NaHCO_3$. Which of the above equation(s) represent(s) reaction(s) that can readily occur when sodium metal is exposed to air? A (i), (iii) & (v) only B. (ii), (iii) & (v) C. (ii), (iv) & (vi) only D. (i) – (vi)

2008/2009 EXAM SOLUTION

1. Conc of acid $= \frac{10pd}{M}$

Where p = % by mass = 60%. Note if the reagents pure then p = 100%

d = density in g/cm^3 or related density (also know as specific gravity) = 1.2g/cm^3

M = molar mass = 98g/mol

$C = \frac{10\times60\times1.2}{98} = 7.35 moldm^{-3}$

The correct option is A

2. $2NaCl + Pb(NO_3)_2 \rightarrow PbCl_2 + 2NaNO_3$

$210cm^3, 0.1M \quad 210cm^3, 0.1M$

$\cap_{NaCl} = \frac{210}{1000} \times 0.1 = 0.021mol$

$\cap_{Pb(NO_3)_2} = \frac{210}{1000} \times 0.1 = 0.021mol$

$\cap_{NaCl} : \cap_{Pb(NO_3)_2}$

$\frac{0.021}{2} : \frac{0.021}{1}$

$0.0105 : 0.021$

The smallest moles give the limiting reagent.

The limiting reagent is NaCl

The excess reagent is $Pb(NO_3)_2$

$\cap_{Pbcl_2} = \frac{1\ mole\ of\ PbCl_2}{2\ mole\ of\ NaCl} \times 0.021mol\ of\ Nacl$

$= 0.0705mol$

$R.m.m\ of\ Pbcl_2 = \frac{278g}{mol}$

Mass of $Pbcl_2\ form$

$= \frac{278g}{mol} \times 0.0105mol = 2.919g$

The correct option is B

3. $P_1 = P,\ V_1 = V \quad P_2 = ?\ \ V_2 = \frac{v}{4}$

$P_1V_1 = P_2V_2$

$P_2 = \frac{P_1V_1}{V_2} = \frac{P \times V}{\frac{V}{4}} = \frac{4PV}{V} = 4P$

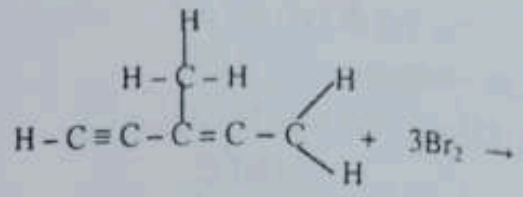
The pressure increases by a factor of 4.

The correct option is A.

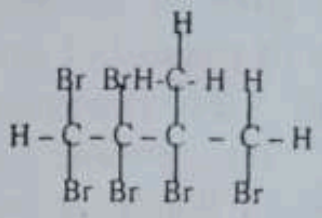
4. Boiling point $\propto \frac{Relative\ molecular\ mass}{Degree\ of\ branching}$

iii > i > iv > ii

The correct option is A

5. 

3-methylbut-3-ene-1-yne



Note that an organic compound with one double bond will take one mole of any reagent in an addition reaction. While an organic compound with a triple bond will take two moles of a reagents in an addition reaction. So are organic compound with a double and triple bond will take 3 mole of any reagent in an addition reaction.

$R.m.m\ of\ 3-methylbut-3-ene-1-yne\ (C_5H_6) = 66g/mol$

$\cap_{C_5H_6} = \frac{3.3g}{66g/mol} = 0.05mol$

$\cap_{Br_2} = 3 \times 0.05mol = 0.15mol$

$mass\ of\ Br_2 = 0.15mol \times 160g/mol$

$= 24g$

The correct option is B

6. $P^H + P^{OH} = 14$

$12 + P^{OH} = 14$

$P^{OH} = 14 - 12$

$P^{OH} = 2$

$[OH^-] = 10^{-P^{OH}} = 10^{-2}M$

The correct option is D

7. The use of phenolphthalein indicate that the resultant solution is basic. That is the base is in excess

$Na_2CO_3 + HCl \rightarrow NaCl + CO_2 + NaOH$

$25cm^3\ 15.25cm^3, 0.12M$

$\cap_{Hcl} = \frac{15.25}{1000} \times 0.12 = 0.00183mol$

$$\cap_{Na_2CO_3} = \frac{0.00183mol}{1} = 0.00183mol$$

$$\cap_{Na_2CO_3} = \frac{25}{1000} \times molar\ conc.$$

$$0.00183 \times 1000 = 25 \times molar\ conc.$$

$$molar\ conc = \frac{0.00183 \times 1000}{25}$$

$$= 0.0732M$$

The correct option is C

8. (i) Tollen's reagent is used to confirm the presence of terminal alkyne and to differentiate alkanal from alkanone.
(ii) Fehling's reagent is used to differentiate alkanal from alkanone i.e. test for reducing sugar which are alkanal
(iii) Browine water (HOBr) is use to confirm the presence of double or triple bonds in an organic compound.
(iv) Million reagent is an analytical reagent use to detect the presence of soluble proteins.
(v)A acidified potassium tetraoxomangnate (vii) is used to confirm the presence of double or triple bonds in an organic compound.
The correct option is E, meaning none of the option is correct.

9. $Solid + O_2 \rightarrow CO_2 + H_2O$
CO_2 turns lime water milky and H_2O turn white anhydrous $CuSO_4$ blue or blue colbalt II chlorine, $COCl_2$ to pink or purple. This confirms that carbon and hydrogen is present in the solid.
The correct option is C.

10. Condition for spontaneity of the reaction
(i) $\Delta G = -ve\ i.e\ \Delta G < 0$
(ii) $\Delta H < T\Delta S$
(iii) $E^\theta = +ve\ i.e\ E^\theta > 1$
(iv) $\sum G_p < \sum G_R$
(v) $K > 1$
The correct option is B

11. $C_nH_{2n+1}OH + xO_2 \rightarrow yCo_2 + ZH_2O$
The equation of combustion of one mole of any alkanol of $C_nH_{2n+1}OH + \frac{3n}{2}O_2 \rightarrow nCo_2 + (n+1)H_2O$

$$x = \frac{3n}{2}, \quad y = n, \quad z = n+1,$$

$$x + y = \frac{3n}{2} + n = \frac{5n}{2},$$

$$y + z = n + n + 1 = 2n + 1$$

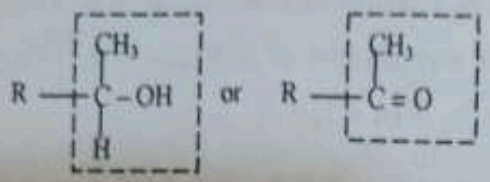
The correct option is A

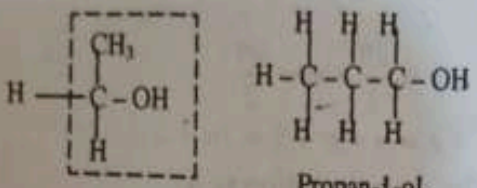
12. A redox reaction is a reaction in which oxidation and reduction reactions occurs simultaneously. This implies that the species will undergo change in oxidation state or number:
$2SO_3 + 4Sn \rightarrow SnS_2 + 3SnO_2$
$2H_2 + O_2 \rightarrow 2H_2O$
The correct option is B

13. Isotones are atoms of different element with the same neutron number e.g. $^{90}_{46}X, {}^{88}_{44}Z, {}^{89}_{45}M$, and $^{91}S_{47}$
The correct option is B

14. $\ddot{O} = C = \ddot{O}$
From the lewis structure of CO_2 it is seen that CO_2 contain double bond. Any double bond contains one pie bond and one sigma bond. Pie bond are form by P/P orbital laterally or parallel oriented. But sigma bond are form by
(i) P/P orbital linearly opposed
(ii) S/hybride orbital
(iii)S/S orbital
(iv)Hybride/hydrial orbital
Since the carbon atom in Co_2 is Sp-hybridized and the outer must shell of carbon and oxygen is the P-subshell then the overlapping orbital in Co_2 are P/P parallel (for the pie bond) SP/P (between C and O).
The correct option is B

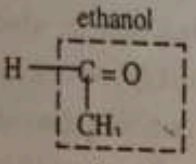
15. For an organic compound to give positive iodoform test it must contain the functionality.



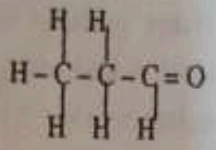


Propan-1-oL

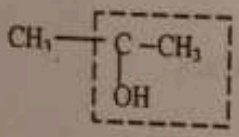
ethanol



ethanal



Propanal



Propan-2-ol

Hence ethanol, ethanal and propan-2-ol will give positive iodoform test.

The correct option is B

16. % of anhydrous $MCl_2 = 100 - 49.32 = 50.68\%$

Assuming 100g of the compound

Mass of $MCl_2 = \frac{50.68}{100} \times 100g = 50.68g$

Mass of $H_2O = \frac{49.32}{100} \times 100g = 49.32g$

$$MCl_2 : H_2O$$
$$\frac{50.68}{111} : \frac{49.32}{18}$$
$$0.4566 : 2.74$$
$$1 : 6$$
$$\Rightarrow MCl_2 \cdot xH_2O = MCl_2 . 6H_2O$$

Method 2

$$\frac{mass\ of\ anhydrous\ salt}{R.m.m.of\ anhydrous\ salt} = \frac{mass\ of\ water}{R.m.m\ of\ water}$$
$$\frac{50.68}{111} : \frac{49.32}{18x}$$
$$x = \frac{111 \times 49.32}{50.68 \times 18} = 6.0012$$
$$x = 6$$

The correct option is B

17. Reaction $C_xH_y + \left(x + \frac{y}{4}\right)O_2 \rightarrow xCO_2 + \frac{y}{2}H_2O_{(L)}$

VOR	$20cm^3$	$80cm^3$	$60cm^3$
VAR	-	$40cm^3$	$60cm^3$

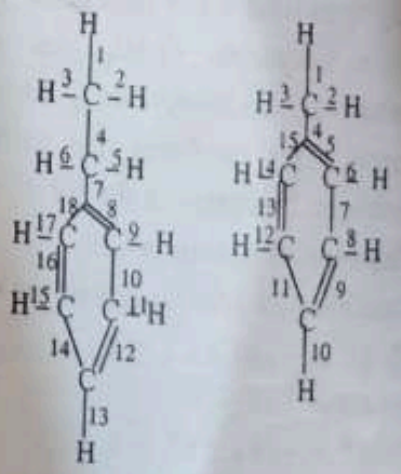
Since the mixture of the hydrocarbon and oxygen is cool to room temperature, then the water will be in liquid state, meaning that it gaseous mole will be zero. Since after passing the residual gas over KOH, only $40cm^3$ of the residual gas is left over. Then the excess oxygen unreacted is $40cm^3$ and $60cm^3$ of CO_2 form is absorb by KOH.

From the reaction 1mole of C_xH_y produce $x$mole of CO_2.

$$\Rightarrow \frac{1}{x} = \frac{20}{60}$$
$$x = \frac{60}{20} = 3$$
$$\frac{x + \frac{y}{4}}{x} = \frac{80}{60}$$
$$\frac{3 + \frac{y}{4}}{3} = \frac{4}{3} \times 3$$
$$3 + \frac{y}{4} = 4$$
$$\frac{y}{4} = 4 - 3 = 1$$
$$y = 4$$
$$\Rightarrow C_xH_y = C_3H_4$$

The correct option is D

18.



All the single bonds are sigma bonds. For every double bond, there is one sigma and one pie bond. But for every

triple bond there is one sigma and two pie bonds. The sigma bonds are numbered in the two compounds. Ethylbenzene contains 18 sigma bonds but methylbenzene contains 15 sigma bonds.

The correct option is A

19. **Double Bond Equivalence (DBE)** is the number of hydrogen molecules that would be added to a molecule to convert all pie bonds to single bonds and all rings to acyclic structures. One DBE means one ring structure or one double bond Two DBE means two rings structure, two double bonds, one triple bonds or one ring plus one pie bond.

$$DBE = \frac{2N_C - N_H - N_x + N_N + 2}{2}$$

N_C = Number of carbon atom

N_H = Number of hydrogen atom

N_x = Number of halogen atom

N_N = Number of nitrogen atom

For example the DBE of C_5H_{10} is obtain as shown

$$DBE = \frac{2(5) - 10 - 0 + 0 + 2}{2}$$

$$= \frac{10 - 10 + 2}{2} = \frac{2}{2} = 1$$

C_5H_{10} contain one double bond or one ring structure. So DBE is refers to the presence of double, triple or ring structural.

The correct option is A

20. $Br^- + CrO_4^{2-} \rightarrow BrO^- + Cr^{3+}$

$Br^- \rightarrow BrO^-$ (oxidation)

$CrO_4^{2-} \rightarrow Cr^{3+}$ (red)

$2OH^- + Br^- + H_2O \rightarrow BrO^- + 2H_2O$

$2OH^- + Br^- \rightarrow BrO^- + H_2O + 2e^- \ldots\ldots(1)$

$CrO_4^{2-} + 8H_2O \rightarrow Cr^{3+} + 4H_2O + 8OH^-$

$3e^- + CrO_4^{2-} + 4H_2O \rightarrow Cr^{3+} + 8OH^- \ldots\ldots(2)$

$2OH^- + Br^- \rightarrow BrO^- + H_2O + 2e^- \ldots\ldots \times 3$

$3e^- + CrO_4^{2-} + 4H_2O \rightarrow Cr^{3+} + 8OH^- \ldots\ldots \times 2)$

$6OH^- + 3Br^- \rightarrow 3BrO^- + 3H_2O + 6e^-$

$6e^- + 2CrO_4^{2-} + 8H_2O \rightarrow 2Cr^{3+} + 16OH^-$

$3Br^- + 2CrO_4^{2-} + 5H_2O \rightarrow 3BrO^- + 2Cr^{3+} + 10OH^-$

The coefficient of BrO^-, Cr^{3+} and OH^- are 3, 2 and 10.

The correct option is A

21.

Allotropes of carbon		Uses
1.	Diamond	For cutting and sharpening of hard tools.
2.	Graphite	It is used as lubricant and in the manufacturing of lead pencils.
3.	Amorphous carbon (i) Wood Charcoal (ii) Annual charcoal (iii) Carbon black	It is used for adsorbing gases. It is used for adsorb colouring matter. It is used for making printers ink and shoe polish, rubber tyres, typewriting ribbons,carbon paper

Hence i, ii, iii & iv are correct

The correct option is C

22. The reaction involves in the industrial preparation of H_2SO_4 are:

$S + O_2 \rightarrow SO_2$

$2SO_2 + O_2 \xrightarrow{V_2O_5} 2SO_3$

$SO_3 + H_2SO_4 \rightarrow H_2S_2O_7$

$H_2S_2O_7 + H_2O \rightarrow 2H_2SO_4$

The correct option is D

23. $Na_2CO_3 + HCl \rightarrow NaHCO_3 + NaCl$

$0.12mol$ $180cm^3, 1M$

$$\cap_{HCl} = \frac{180}{1000} \times 1 = 0.18mol$$

$\cap_{Na_2CO_3}$: $\cap_{HCl}$

$\frac{0.12}{1}$: $\frac{0.18}{1}$

0.12 : 0.18

The limiting reagent is Na_2CO_3

The excess reagent is HCl

$\cap_{NaHCO_3} = 0.12mol$

Excess $\cap_{HCl} = 0.18 - 0.12 = 0.06mol$

$NaHCO_3 + HCl \rightarrow NaCl + H_2O + CO_2$

0.120.06

$\cap_{NaHCO_3} = \cap_{HCl}$

$\frac{0.12}{1}$: $\frac{0.06}{1}$

0.12 : 0.06

The limiting reagent is HCl

The excess reagent is $NaHCO_3$

$\cap_{CO_2} = 0.06 = \frac{Vol\ at\ s.t.p}{22.4}$

$Vol\ at\ s.t.p = 0.06 \times 22.4 = 1.344dm^3$

$= 1344cm^3$

Since the limiting reagent in equation 1 & 2 are not the same don't add the two reactions together and cancel similar species before you perform the calculation. It is wrong in this case.

The correct option is B

24. **Electron affinity** is the energy accompanying one mole of electrons being added to one mole of gaseous atoms or ions. Electron affinity is affected by effective nuclear charge, atomic size and other factors like electronic configuration stability of orbital.

The correct option is B

25. In both electrolytic and electrochemical cells oxidation takes place at the anode and reduction take place at the cathode.

The correct option is B

26. $2H^+ + P \rightarrow P^{2+} + H_2$ P is more reactive than H_2

$2H^+ + Q \rightarrow Q^{2+} + H_2$ Q is more reactive than H_2

$Q^{2+} + P \rightarrow P^{2+} + Q$ P is more reactive than Q

$X^- + Y \rightarrow Y^- + X$ Y is more reactant X

To determine reactivity of a substance in a reaction we use the movement of species.The substance in a reaction that move from the solid state to the aqueous state is the most reactive. The species in aqueous state always carried electrical charge. Hence the order of the electrochemical series will be $PQYX$.

The correct option is B

27. $R = K[A]^m[B]^n$

Since the rate of formation of C is independent of the concentration of A then m = 0.

But doubling the concentration of $A = 2[A]$ $R_1 = 4R$

$R_1 = K[A]^m(2[B])^n$

$R_1 = K[A]^m 2^n[B]^n$

$= 2^n K[A]^m[B]^n$

But $R = K[A]^m[B]^n$

$R_1 = 2^n R$

also $R_1 = 4R$

$4R = 2^n R$

$4 = 2^n$

$2^2 = 2^n \Rightarrow n = 2$

$R = K[A]^m[B]^n = K[A]^0[B]^2 = K[B]^2$

The correct option is D

28.

	Bleaching action of Cl_2	Bleaching action of SO_2
1.	It bleaching by reduction	It bleaching by oxidation
2.	It bleaching action is temporary	It bleaching action is permanent
3.	It equation of bleaching is: $H_2SO_{3(aq)} + Dye_{(aq)} \rightarrow H_2SO_{4(aq)} +$ Bleaching $dye_{(aq)}$ colourless	It equation of bleaching is: $HOCl_{(aq)} \rightarrow HCl_{(aq)} + [O]$ Dye + [0] → (Dye+0) colourless

N.B. water must be present for both SO_2 and Cl_2 to act as a bleaching agent.

The correct option is B

29. Chlorine gas is collected by downward delivery or upward displacement of air and over water.

The correct option is C

30. Oil spillage, Agricultural practices such as washing of fertilizer,insecticides etc into water bodies and domestic waste constitute water pollution while vehicle emission, dust, emission of smoke and gaseous oxide of nitrogen and sulphur from chimneys of industrial equipment consist air pollution.

The correct option is B

31. i, ii and iii are all absolute correct.

The correct option is A

32. Let the unknown gas be X

$R_x = 0.671R_{02}$

$\frac{R_x}{R_{02}} = 0.671$

$\frac{R_x}{R_{02}} = \sqrt{\frac{M_{02}}{M_x}}$

$0.671 = \sqrt{\frac{32}{M_x}}$

$0.671^2 = \frac{32}{M_x}$

$M_x = \frac{32}{0.671^2} = \frac{32}{0.4502} = 71.073$

The gas is Cl_2 because the relative atomic mass of Cl_2

The correct option is C

33. (i) Chlorine attacks iodide ion to give iodine

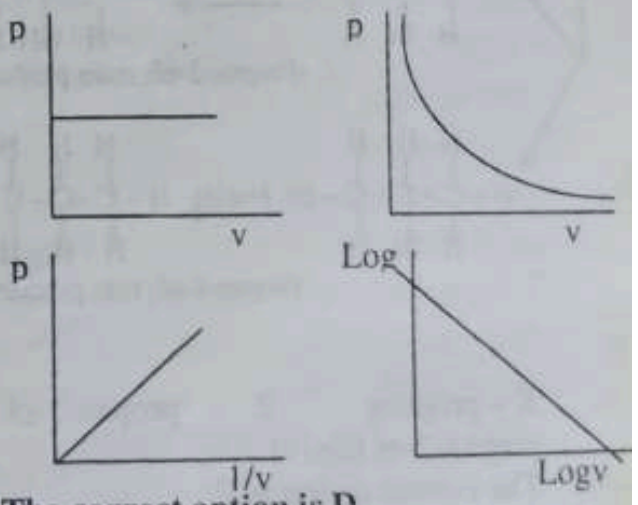
(ii) Chlorine attacks starch-iodine paper to turn it blue-black.

The correct option is D

34. Since B and K melts at 119-121^{0}C. If a mixture of B and K melts at 119-121^{0}C then B and K are identical. If the melting point of a mixture of B and K differs from 119-121^{0}C then B and K are non-identical.

The correct option is A

35. The graph of Boyle's law (Boyle's law is also known as Marriote's law) are:



The correct option is D

36. $\cap_{gas} = \frac{Reacting\ mass}{Molar\ mass} = \frac{vol\ at\ s.t.p}{22.4}$

$\frac{0.664}{Molar\ mass} = \frac{531.32}{22400}$

Molar mass $= \frac{0.664 \times 22400}{531.32} = 27.9937$

$\frac{1}{\frac{3}{8}} = \frac{2}{y} \quad \Rightarrow \frac{8}{3} = \frac{2}{y} \quad = 8y = 6$

$y = \frac{6}{8} = \frac{3}{4} \quad \Rightarrow y = \frac{3}{4}F$

Cost of electricity of depositing 24g of Cu $= \frac{3}{4} \times N360 = N270$

The correct option is A

45. The equation that are involve in the preliminary purification of bauxite in the extraction of aluminium are:

i. $Al_2O_{3(g)} + 2NaOH_{(aq)} + 3H_2O_{(L)} \rightarrow 2NaAL(OH)_{4(aq)}$

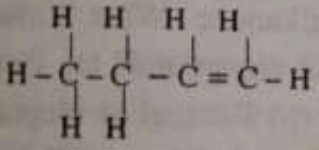
ii. $NaAL(OH)_{4(aq)} \rightarrow AL(OH)_{3(g)} + NaOH_{(aq)}$

iii. $2AL(OH)_{3(aq)} \rightarrow Al_2O_{3(s)} + 3H_2O_{(L)}$

The correct option is E

46. For an organic compound is give one product on ozonolysis it must be symmetry (i.e. it can be divided into two equal halves) or it contain a cyclic ring with one double bond

(i)



More than one product because it is not symmetry

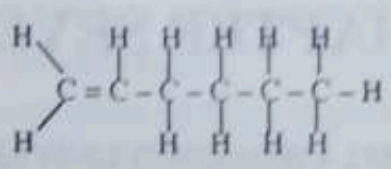
(ii)

One product because of the cyclic ring with one double bond

(iii)

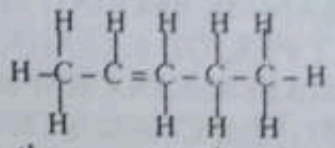
One product because of the cyclic ring with one double bond

(iv)



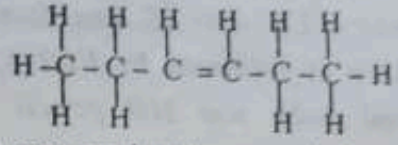
More than one product because it is not symmetry.

(v)



More than one product because it is not symmetry.

(vi)



Only one product because it is symmetry

The above option is E

47. When sodium metal is expressed to air the following reaction occur

$4Na_{(s)} + O_{2(g)} \rightarrow 2Na_2O_{(s)}$

$Na_2O_{(5)} + H_2O_{(g)} \rightarrow 2NaOH_{(aq)}$

$2NaOH_{(aq)} + CO_2 \rightarrow Na_2CO_{3(s)} + H_2O_{(L)}$

But when sodium is heated with air the following reaction occur

$2Na_{(s)} + O_{2(g)} \rightarrow Na_2O_{2(s)}$

excess

$Na_{(s)} + O_{2(g)} \rightarrow Na_2O_{(s)}$

limited

The correct option is A

CHAPTER SEVEN

OBAFEMI AWOLOWO UNIVERSITY, ILE-IFE, NIGERIA CENTRE FOR DISTANCE LEARNING PRE-DEGREE PROGRAMME SECOND MID-CONTGACT PERIOD EXAMINATION 2009/2010 SESSION.CHM 002: PRE-DEGREE CHEMISTRY II
TIME ALLOWED: 50 Minutes Only
Instruction: question Type 2

(i) *Answer ALL the 25 questions. Each question is followed by FOUR options lettered A-D. use HB pencil only to shade the appropriate space corresponding to the correct alphabet of the correct option in your OMR sheet*

(ii) *Shade your question type on the OMR sheet.*

(iii) *Write your names as you have it on the list at the Centre for Distance Leaning.*

(iv) *Do the shadings of the OMR sheet according to the invigilator's instruction.*

1. 0.51g of an organic compound was burnt in excess oxygen. If 1.32g carbon (IV) oxide and 0.63g steam were produced, what is the empirical formula of the compound? (a) $C_6H_{12}O$ (b) $C_6H_{10}O$ (c) $C_6H_{14}O$ (d) $C_6H_{16}O$
2. The boiling points of alkanols are much higher than those of alkanes with similar molecular masses because (a) there are both covalent and Van der Waal's force in alkanols. (b) Alkanes have weaker carbon to carbon covalent bonds. (c) There exists intermolecular hydrogen bonding in alkanols molecules. (d) Alkanols are normally made up of linear molecules.
3. A compound with molecular formular $C_4H_{10}O$ gives no reaction with cold aqueous $KMnO_4$, but reacts with PCl_5, evolving HCl gas. What is the most likely structural formula of the compound?
   (a) $C(CH_3)_4$
   (b) $CH_3CH(OH)CH_2CH_2CH_3$
   (c) $CH_3CH(CH_3)OCH_3$
   (d) $CH_3CH_2CH(CH_3)OH$
4. Which of the following molecules can exhibit geometrical isomerism? (i) 2-methylbut-2-ene (ii) But-2-ene (iii) propene. (a) i & ii only (b) i & iii only (c) ii only (d) i only
5. A compound having 85.6% C and 14.4% H content with relative molar mass of 56.1 reacts with water and tetraoxosulphate (VI) acid to produce a compound that reacts with acidified heptaoxodichromate (VI) solution to produce an alkanone. What is the name of the original compound? (a) But-1-yne or but-2-yne (b) Butanal or Heptan-2-ol (c) But-1-ene or but-2-ene (d) Butan-1-ol or butan-2-ol
6. A pre-degree student, in an attempt to test for unsaturation, added a few drops of a reddish-brown solution of bromine to an unknown compound and observed immediate disappearance of the colour. Which of the following is/are not likely to be the unknown compound? (i) butene (ii) butyne (iii) benzene (iv) butane (a) iii and iv only (b) i, ii and iii only (c) iv only (d) i and ii only.
7. Which of the following are polyfunctional organic compounds? (i) Benzoic acid (ii) Citric acid, (iii) Lactic

acid (iv) polyvinyl chloride (a) ii, iii (b) i, iv (c) iii, iv (d) i, ii

8. An alkanal, $C_nH_{2n+1}CHO$, undergoes combustion in excess supply of oxygen according to the following equation: $C_nH_{2n+1}CHO + xO_2 \rightarrow yCO_2 + zH_2O$. The respective values of x, y and z are (a) 3n/2, (n+1), n (b) (3n+2)/2, (n+1), (n+1) (c) (n+1), n/2, n (d) 3n/2, n, (n+1)
9. What is the correct IUPAC name of 3,3,4-Trimethylpentane?
   (a) 2,3,3-Trimethylpentane
   (b) 2,3,4- Trimethylpentane
   (c) 3,3,2- Trimethylpentane
   (d) 2,2,3- Trimethylpentane
10. The conversion of propan-1-ol to propan-2-ol involves the following reaction types (i) Dehydration (ii) Hydrolysis (iii) Hydrohalogenation. Arrange these reaction types in the correct order (a) iii, ii, i (b) ii, i, iii (c) i, ii, iii (d) i, iii, ii
11. When an alcohol is treated in excess concentrated tetraoxosulphate (VI) acid at 145°C, which of the following products are expected to be formed? (a) An alkene (b) An ester (c) A carboxylic acid (d) An ether
12. Which of the following will give positive iodoform test? (i) ethanol (ii) propan-2-one (iii) ethanol (a) i and ii only (b) i and iii only (c) ii and iii only (d) i, ii and iii
13. What product(s) would you expect from oxidation of propanol? (a) propanal (b) propanal & propanoic acid (c) none (d) propanoic acid.
14. Name the hydrolysis products of ethylbutanoate (a) Ethanol and butanoic acid (b) Butanoic acid and ethanoic acid (c) Butan-1-ol and ethanoic acid (d) Butanol and ethanol.
15. The respective numbers of pie bonds and zigma bonds in a benzene molecule are (a) 3,6 (b) 6,6 (c) 3,12 (d) 6,3
16. From the list below, select the molecule(s) that could exhibit stereoisomerism (i) But-2-ene (ii) But-1-ene (iii) Butan-1-ol (iv) Butan-2-ol (a) iv only (b) ii and iii (c) i and iv (d) i only
17. The fermentation of starch to ethanol involves stages I, II and III

    Starch $\rightarrow$ Maltose $\rightarrow$ Glucose $\rightarrow$ Ethanol
    I II III

    The type of reaction in stages I, II and III respectively are (a) hydrolysis, hydrolysis, decomposition (b) hydrolysis, glucolysis, hydrolysis (c) decomposition, hydrolysis, hydrolysis (d) hydrolysis, decomposition, hydrolysis.
18. Dry distillation of calcium ethanoate gives (a) methanol (b) propan-2-one (c) none (d) ethanal.
19. Arrange the following haloalkanes in increasing order of boiling points (i) fluorethane (ii) bromoethane (iii) chloroethane (a) i < ii < iii (b) i < iii < ii (c) iii < ii < i (d) ii < iii < i
20. Which alkanol fits into the following descriptions? (i) It is a thick colourless liquid that has the consistency of honey (ii) It has a sweet taste (iii) It is polyhydric in nature (iv) It is a by-product of saponification. (a) Propane-1,2,3-triol (b) Ethane-1,2-diol (c) Butane-2,3-diol (d) Butane-1,2,3,4-tetraol.
21. Ozonolysis of an alkene gives only ethanal. The alkene is (a) propene (b)

none of these (c) 2-methypropene (d) but-2-ene.

22. Which of the following will not react with ammoniacal silver oxide (i) But-2-yne (ii) But-1-yne (iii) Butanal (a) (ii) and (iii) only (b) (i) and (ii) only (c) (i), (ii) and (iii) (d) (i) and (iii) only.
23. The IUPAC nomenclature of the polyhaloalkane, $CH(F)(I)CCl_3$, is (a) 1-fluoro-1-hydrido-1-iodo-2,2,2-trichloroethane (b) 2-fluoro-2-hdrido-2-iodo-1,1,1-triehloroethane (c) 1-fluoro-1-iodo-2,2,2-trichloroethane (d) 2-fluoro-2-iodo-1,1,1-trichloroethane
24. For the organic molecules (i) C_4H_{10} (ii) C_4H_6 (iii) C_4H_8 (iv) C_4H_6 (v) C_7H_8 the double bond equivalents (DBEs) are respectively. (a) 0, 1, 4, 2, 4 (b) 0, 1, 2, 4, 4 (c) 0, 2, 1, 4, 4 (d) 0, 4, 4, 1, 2
25. The correct IUPAC name corresponding to the condensed structural formula below is $(C_2H_5)_2CHCH(CH_3)CH_2CH_2CH_3$ (a) 4-methyl-5-ethylheptane (b) 2-see-pentylpentane (c) 1, 1-diethyl-2-methylpentane (d) 3-ethyl-4-methylpentane.

SOLUTION, 2009/2010 CHEMISTRY TEST

1. Mass of the organic compound = 0.51g

Mass of CO_2 = 1.32g

Mass of H_2O = 0.63g

Mass of C in 1.32g of CO_2

$$= \frac{12g/mol}{44g/mol} \times 1.32g = 0.36g$$

Mass of H in 0.63g

$$= \frac{2g/mol}{18g/mol} \times 0.63g = 0.07g$$

Mass of oxygen present

$$= 0.51g - (0.36g + 0.07g)$$

$$= 0.08g$$

C	:	H	:	O
$\frac{0.36}{12}$		$\frac{0.07}{1}$		$\frac{0.08}{16}$
0.03		0.07		0.005
1		$\frac{7}{3}$		$\frac{1}{6}$ Multiply by 6
6		14		1

The empirical formula is $C_6H_{14}O$

The correct option is C

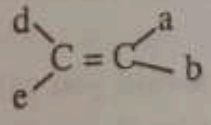
2. The boiling points of alkanols are higher than that of alkanes with similar molecular masses because of the intermolecular hydrogen bonding that occur in alkanols.

The correct option is C

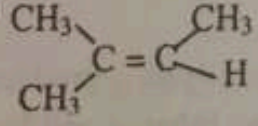
3. An organic compound with molecular formula of $C_4H_{10}O$ can be either alkanols alkanal, ether or alkanone because they all contain one oxygen atom,of all the listed compound only alkanol are affected by $KMnO_4$. However tertiary alkanols are not affected by $KMnO_4$. Besides, an organic compound that gives white fume with PCl_5 or $SOCl_2$ is either an alkanol or alkanoic acid. Hence the organic compound is tertiary alkanol e.g. $CH_3CH(OH)CH_2CH_2CH_3$.

The correct option is B

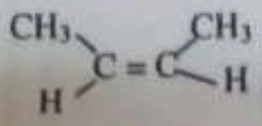
4. For a molecules to exhibit a geometric isomers it must have the structures below



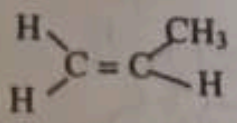
Such that d ≠ e and a ≠ b

(i) 

2-methylbut-2-ene (No geometric isomer)

(ii) 

But-2-ene (exhibit a geometric isomers)

(iii) 

Propene (No geometric isomers)

The correct option is C

5. Assuming 100g of the compound

$$\text{Mass of C} = \frac{85.6}{100} \times 100\text{g} = 85.6\text{g}$$

$$\text{Mass of H} = \frac{14.4}{100} \times 100\text{g} = 14.4\text{g}$$

C	:	H
$\frac{85.6}{12}$		$\frac{14.4}{1}$
7.1333		14.4
1		2

The empirical formula is CH_2

$(CH_2)n = 56.1$

$(12 + 2)n = 56.1$

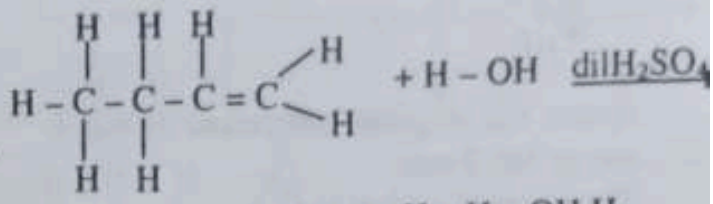
$14n = 56.1$

$n = \frac{56.1}{14} = 4$

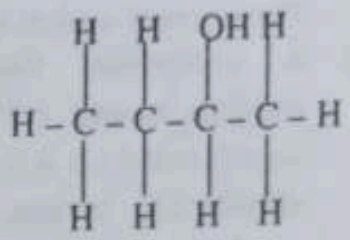
$(CH_2)n = (CH_2)4 = C_4H_8$ alkenes

C_4H_8 have two isomers which are but-1-ene and but-2-ene.

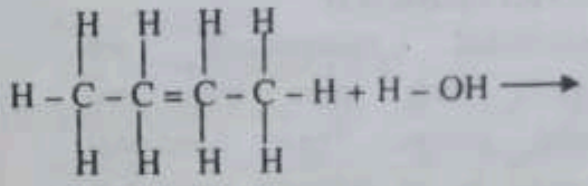
When alkenes are hydrated in the presence of dilute H_2SO_4 alkanols are obtain which are further oxidize to form alkanols or alkanals.



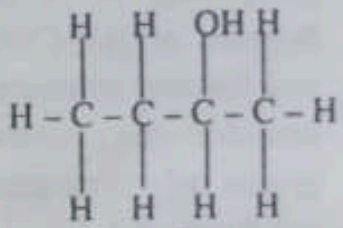
But-1-ene



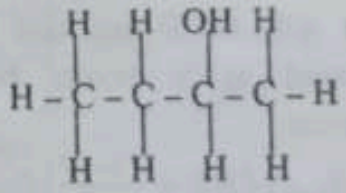
Butan-2-ol



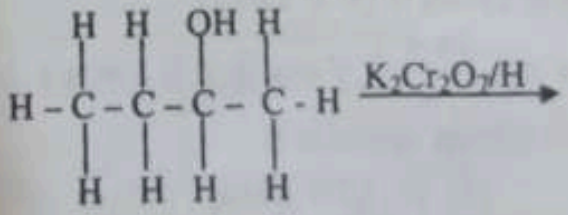
But-2-ene

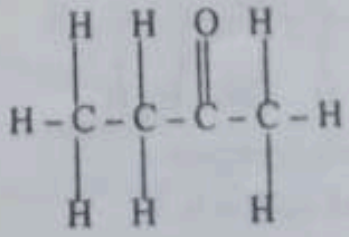


Butan-2-ol

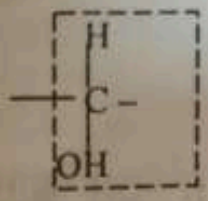


Butan-2-ol





Butanone



Hence the original compound is but-1-ene or but-2-ene.

The correct option is C

6. **A compound that discharge the reddish brown colour of bromine is unsaturated** i.e. it is either an alkenes or alkyne e.g. butane, butyne. Note that aromatic hydrocarbon will not decolourize bromine water e.g. benzene.

The correct option is D

7. **Polyfunctional compounds** are compounds with more than two functional groups. These functional group must be of different types e.g. Benzoic acids (-COOH, double bonds and the ring structure). However, if we consider the number of functional groups only citric acid will be said to be polyfunctional (three OH groups, one COOH group making 4 groups).

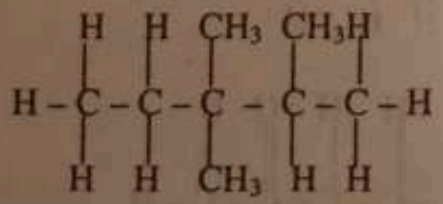
Base on the above explanation **the correct option will be D** but this question was considered as a bonus because it is ambiguous.

8. $C_nH_{2n+1}CHO + \left(\frac{3n+2}{2}\right)O_2 \rightarrow$

$(n+1)CO_2 + (n+1)H_2O$

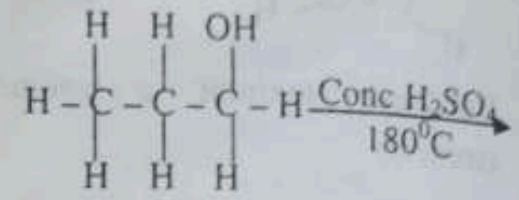
$\Rightarrow x = \frac{3n+2}{2}, y = n+1, \& z = n+1$

The correct option is B

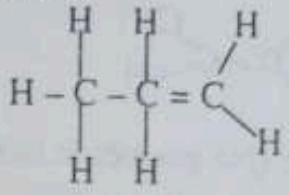
9. 

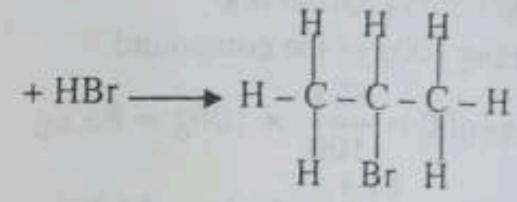
2,3,3-trimethylpentane

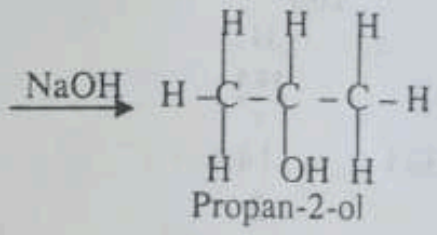
The correct option is A

10. 

Propan-1-ol







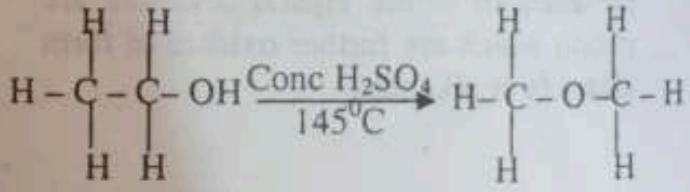
Propan-2-ol

The processes are:

(i) Dehydration (ii) Halogenection (iii) Alkaline Hydrolysis

The correct option is D

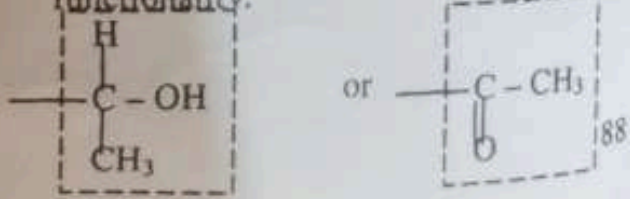
11. When an alcohol is treated with excess concentrated H_2SO_4 at 145°C, ethers are form

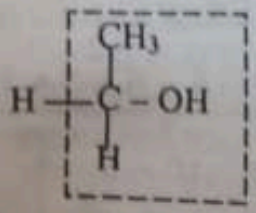


Limited MethoxyMethane

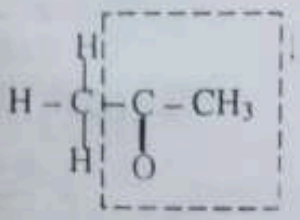
The correct option is B

12. For a compound to give positive iodoform test it must have the functionality.

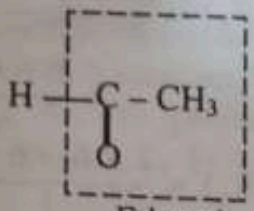




ethanol



propanone

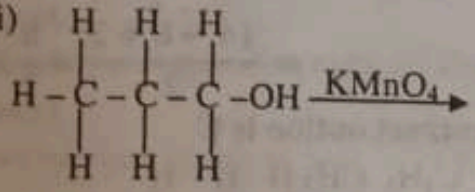


Ethanal

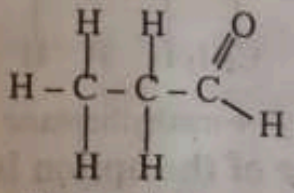
Hence ethanol, propanone and ethanal will form positive iodoform test.

The correct option is D

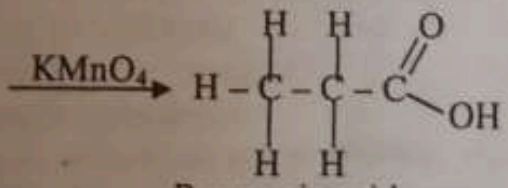
13. (i)



Propan-1-OL



Propanal



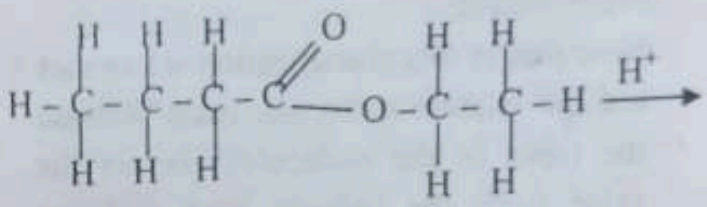
Propanoic acid

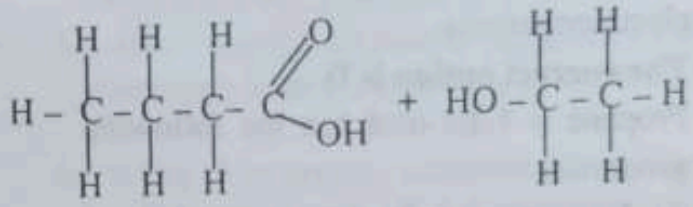
(ii)

Propanols are of two types which are propan-1-ol and propan-2-ol. We work with propan-1-ol, we will obtain two products:

Propanol and propanoic acid. But if we walk with propan-2-ol, we obtain propanone. Since the question demands products, the examiners must be working with propan-1-ol.

The correct option is B





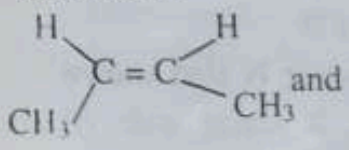
Butanoic Acid ethanol

The correct option is A

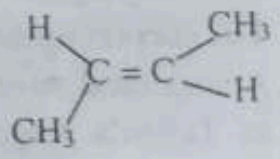
15. Benzene molecule has 3 pie bonds and 12sigma bonds.

The correct option is C

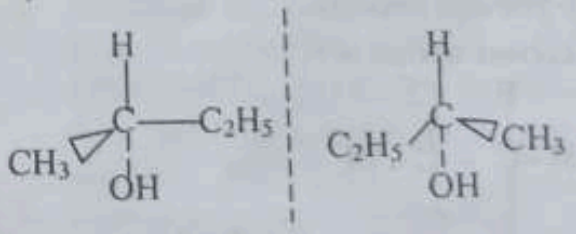
16. Stereoisomerism are of two types: optical somerism & geometric isomerisms



Cis-but-2-ene



Trans-but-2-ene

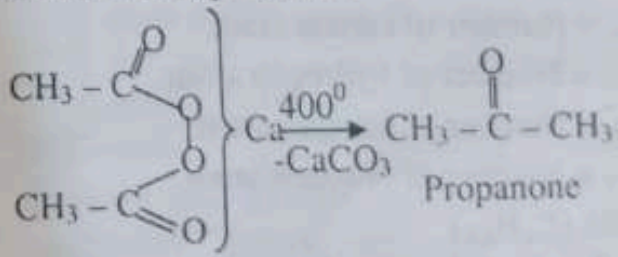


The correct option is C

17. Starch $\xrightarrow{\text{Hydrolysis}}$ Maltose $\xrightarrow{\text{Hydrolysis}}$ Glucose $\xrightarrow{\text{Decomposition}}$ Ethanol

The correct option is A

18.



Calcium ethanoate Propanone

The correct option is B

19. Bromoethane < Chloroethane < Fluoroethane

Note that in this classification we cannot use the relative molecular mass because the types in the molecules are not the same since the halogen have different electronegativity.

The correct option is D

20. Propane – 1,2,3-triol has the following properties

(i) It is a thick colourless liquid that has the consistency of honey

(ii) It has a sweet taste

(iii)It is polyhydric in nature

(iv)It is a by-product of saponification

The correct option is A

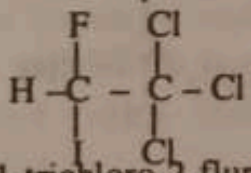
21. If the ozonolysis of an alkane gives only ethanol it means that the alkene is symmetry e.g but-2-ene.

The correct option is D

22. Ammoniacal silver oxide is also known as Tollen's reagent. It reacts with (i) Terminal-alkyne & (ii) Alkanals e.g. but-1-yne and butanal.

The correct option is A

23.



1,1,1-trichloro-2-fluro-2-iodoethene

None of the option is correct.

24. Double bond equivalent

$$(DBE) = \frac{2N_c - N_4 - N_x + N_N + 2}{2}$$

N_c = Number of carbon atom

N_H = Number of hydrogen atom

N_x = Number of halogen atom

N_N = Number of nitrogen atom

$$DBE\ (C_4H_{10}) = \frac{2\times4 - 10 - 0 + 0 + 2}{2}$$

$$= \frac{8 - 10 + 2}{2} = \frac{10 - 10}{2} = 0$$

$$DBE\ (C_4H_6) = \frac{2\times4 - 6 - 0 + 0 + 2}{2}$$

$$= \frac{8 - 6 + 2}{2} = \frac{10 - 6}{2} = \frac{4}{2} = 0$$

$$DBE\ (C_4H_8) = \frac{2\times4 - 8 - 0 + 0 + 2}{2}$$

$$= \frac{8 - 8 + 2}{2} = \frac{2}{2} = 1$$

$$DBE\ (C_6H_6) = \frac{2\times6 - 6 - 0 + 0 + 2}{2}$$

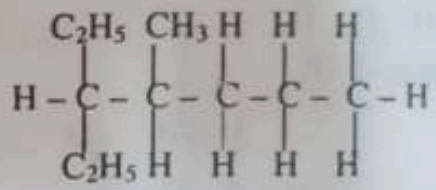
$$= \frac{12 - 6 + 2}{2} = \frac{8}{2} = 4$$

$$DBE\ (C_7H_8) = \frac{2\times7 - 8 - 0 + 0 + 2}{2}$$

$$= \frac{14 - 8 + 2}{2} = \frac{8}{2} = 4$$

The correct option is C

25.



3-ethyl-4-methylheptane

None of the option is correct

OBAFEMI AWOLOWO UNIVERSITY, ILE-IFE, NIGERIA
CENTRE FOR DISTANCE LEARNING
PRE-DEGREE PROGRAMME
SECOND CONTACT PERIOD EXAMINATION 2009/2010 SESSION.
CHM 002: PRE-DEGREE CHEMISTRY II TIME ALLOWED: 75 minutes only.
INSTRUCTIONS (Question Type 3):

(i) Answer ALL the 40 questions. Each question is followed by FOUR options lettered A-D. Use HB pencil only to shade the appropriate space corresponding to the correct alphabet of the correct Option in your OMR sheet.

(ii) Shade your question type on the OMR sheet.

(iii) Write your name as you have it on the list at the Centre for Distance Learning.

(iv) Do the shadings of the OMR sheet according to the invigilator's instruction.

1. The common reagents available on the benches in an organic chemistry laboratory include (i) Lucas reagent (ii) Fehling's solutions A and B (iii) Clemmenson reagent (iv) 2,4-dinitrophenylhydrazine (v) Tollen's reagent. Which of these reagents is/are suitable for distinguishing the three classes of alkanols? A. iii, iv and v B. all. C. i only D. ii only
2. Which of the following IUPAC nomenclature is/are wrong? (i) 2-ethylpentane, (ii) 5,5 dimethyl-3-ethylhexane, (iii) 2-dimethylpentane. A. i, ii and iii, B. iii only C. i and iii only D. ii and iii only
3. The IUPAC name for the compound $CH_3CH(CH_2CH_3)CH(CH_3)CH=CHCH_3$ is A. 2-ethyl-3-methylhex-4-ene. B. 5-ethyl-4-rnethylhex-2-ene, C. 3,4-dimethylhept-5-ene, D. 4,5-dirnethylhept-2-ene,
4. Arrange the following haloalkanes in increasing order of boiling points. (i) fluoroethane (ii) bromoethane (iii) cliloroethane. A. iii < ii < i. B. ii < iii < i C. i < ii < iii D. i < iii < ii
5. How many alkanone structures are isomeric with pentanal? A. 2. B. 4 C. 1. D.3
6. 0.51g of an organic compound was burnt in excess oxygen. If 1.32g carbon (IV) oxide and 0.63g steam were produced, what is the empirical formula of the compound? A. $C_6H_{12}O$ B. $C_6H_{14}O$ C. $C_6H_{10}O$ D. $C_4H_{16}O$.
7. The fermentation of starch to ethanol involves stages I, II and III

   Starch→ Maltose → Glucose → Ethanol
   I II III

   The type of reaction in stages I, II and III respectively are A. decomposition, hydrolysis, hydrolysis B. hydrolysis, glucolysis, hydrolysis C. hydrolysis, decomposition, hydrolysis D. hydrolysis, hydrolysis, decomposition
8. Which of the following species behave as nucleophiles? (i) $AlBr_3$, (ii) Cr^{3+}, (iii) $CH3CH=CH_2$, (iv) $BeBr_2$, (v) NH_3.
   A. ii and v B. i and iv C. iii and v D. i and iii
9. Consider the following organic molecules: (i) $CH_3(CH_2)CH_3$ (ii) $CH_3CH(CH_3)CH_3$ (iii) $CH_3CH_2OCH_2CH_3$ (iv) $CH_3CH_2CH_2COOH$ (v) $CH_3CH_2CH_2CH_2OH$
   The correct order of increasing volatility of these molecules is A. i, iii, ii, v, iv, B. ii, i, iii, v, iv, C. iv, ii, iii, v, i. D. iv, v, iii, i. ii.
10. Consider the following organic molecules: (i) CH_3CH_2OH, (ii) $CH_3CH_2CH(OH)CH_3CH_3$ (iii) CH_3CHO (iv) $CH_3CH_2(OH)CH_3$ (v) $CH_3CH(OH)CH_3$.
    Which of these molecules would produce a yellow antiseptic solid when

treated with a hot alkaline solution of iodine? A i, iii and v B. ii and iv, C. ii only D. i only

11. An unknown solution upon addition of a few drops of Barium chloride gives a white precipitate. This observation shows that the unknown solution contains A.CO_3^-, SO_3^{2-} and SO_4^{2-} B.SO_4^{2-} and NO_3^-C. NO_3^-, SO_3^{2-} and SO_4^{2-}D. CO_3^-, SO_3^{2-} and NO_3^-

12. Consider the following reactions of iron (i) $Fe + Cl_2 \rightarrow FeCl_2$, (ii) $2Fe + 3Cl_2 \rightarrow 2FeCl_3$, (iii) $Fe + 2HCl \rightarrow FeCl_2 + H_2$ (iv) $2Fe + 6HCl \rightarrow 2FeCl_3 + 3H_2$. Which of these reactions is/are not feasible? A. ii and iii B. none C. all D. i and iv

13. Ozonolysis of an unknown alkene gave propanone and methanal as final products. The unknown alkene is most likely A. propene B. 2-methylbutene, C. 2-niethyipropene, D. 2,3-dimethylbutene

14. Arrange the following in increasing order of volatility. (i) $CH_3CH_2CH_2CH_3$ (ii) $CH_3CH(CH_3)CH_3$, (iii) $CH_3CH_2CH_2$ $CH_2CH_2CH_3$,(iv)$CH_3CH(CH_3)CH$ $(CH_3)CH_3$ (v) $CH_3CH_2CH(CH_3)CH_2CH_3$ A. i < ii < iii < v < iv, B. iii < i <ii<v<iv, C. iii<v<iv<i<ii, D. i<iii<ii<v<iv

15. Which of the compounds listed below is not obtainable when 3-bromo-2,3 - dimethylpentane is dehydrobrominated using alcoholic KOH and heat? An oxidizing agent, A reducing agent, An acid (iv) A dehydrating agent. (i) 2-ethyl-3-mcthytbut-1-ene, (ii) 2,3-dimethylpent-2-ene, (iii) 3,4-dimethyl pent-2-ene, (iv) 3,4-dimethylpent-1-ene. A. i and ii, B. ii and iii, C. iii and iv, D. i and iv.

16. Which of the following gives white precipitate with excess NH3 solution? (i) Pb^{2+}, (ii) Mg^{2+} (iii) Zn^{2+} A. i only, B. i and ii only, C. iii only D. i, ii and iii,

17. The following equations represent possible laboratory preparation methods of hydrogen gas (i) $Zn + 2HNO_3 \rightarrow Zn(NO_3)_2 + H_2$ (ii) $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$ (iii) $2Ag + 2HCl \rightarrow AgCl + H_2$ (iv) $Fe + 2HCl \rightarrow FeCl_2 + H_2$ (v) $Cu + H_2SO_4 \rightarrow CuSO_4 + H_2$ Which of these methods is/are feasible? A. i and ii, B. i and iii, C. ii and iv. D. i, iii and v

18. In which of the following ways is tetraoxosulphate (VI) acid acting when warmed with copper metal to give to sulphur (IV) oxide gas? (i) An oxidizing agent (ii) A reducing agent (iii) An acid (iv) A dehydrating agent. A. iv only B. ii only C. i only D. i and iii only

19. The following is a list of some attackers of organic substrates during organic reactions. (i) Br_2 (ii) H_3O^+ (iii) CN^-(iv) BF_3 and (v) NH_3 Electrophilic reagents among these attackers are A. ii, iii and iv B. i, ii and iv C. i, iii and iv D. iii and V only.

20. For the organic molecules: (i) C_4H_{10} (ii) C_4H_6 (iii) C_4H_8, (iv) C_6H_6 (v) C_7H_8, the double bond equivalents (DBEs) are respectively A. 0,1,2,4,4 B. 0,4,4,1,2 C. 0,2,1,4,4 D. 0,1,4,2,4.

21. 2.8g iron filings is heated while a stream of dry chlorine gas is passed over it until the necessary reaction is complete. Determine the weight of the product formed. [Fe 56; Cl=35.5]. A. 16.3g. B. 12.2g. C. 81g. D. 4.lg

22. In the preparation of ethyne by the action of water on calcium carbide, the gas is washed with X in order to remove Y. What are X and Y respectively? A. $CuSO_4$/dil.H_2SO_4 and PH_3 B. $CuSO_4$/dil.H_2SO_4 and SO_2, C. $FeSO_4$/conc.H_2SO_4 and SO_2, D. $FeSO_4$/conc.H_2SO_4 and PH_3

23. Vanadium (V) oxide is an important catalyst in the industrial manufacture of (i) oxygen, (ii) sodium hydrogen

trioxocarbonate (IV), (iii) tetraoxosulphate (VI) acid, (iv) ammonia. A. iii only, B. i and ii, C. ii and iii, D. iv only

24. Which of the following will give positive iodoform test? (i) ethanol (ii) propan-2-one (iii) ethanal A. i and ii only B. ii and iii only C. i, ii and iii D. i and iii only
25. Which of the following of the following corresponds to the absolute electronic configuration of copper in the ground state? A. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^9 4s^2$
B. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^1$
C. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^4 4s^2$
D. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$
26. Duralumin is an alloy made up of A. Aluminium, copper, manganese and magnesium. B. Aluminium, manganese, brass and iron C. Aluminium, tin, copper and lead D. Aluminium, copper, carbon and zinc.
27. Which of the following is a characteristic feature of transition elements? A. The outer s and p subshells are completely filled. B. The valence shell corresponding to principal quantum number, n, contains an (n – 1) subshell in which electrons are accommodated. C. The elements possess three partially filled subshells in their valence shells. D. The outer s and p subshells are incompletely tilled,
28. Hard water can be softened by the following methods; (i) Boiling, (ii) Distillation, (iii) Addition of $Ca(OH)_2$, (iv) Addition of Na_2CO_3, (v) Use of ion-exchange resins.
Which of these methods soften(s) temporarily hard water only? A. none B. all C. i and iii D. ii, iv and v.
29. A chloroform solution of a pure organic compound was spotted at, a distance 0.40cm from the base of a 10cm long chromatoplate. Upon elution, the solvent front got to a place 0.50cm from the top of the plate. If the compound moves halfway up the 10cm long plate, determine the R_F value of the compound. A. 0.526 B. 0.549 C. 0.484 D. 0.505
30. 2, 4-dimethylhexan-3-ene on ozonolysis gives A. 2-methylpropanal and butan-3-one B. 1-methylpropanone and 2-methylpropanal C. 2-methylpropanal and butan-2-one D. butanal and butan-2-one
31. Which of the following represents an industrial preparation of hydrogen? (i) $Zn_{(s)} + 2HCl_{(aq)} \rightarrow ZnCl_2 + H_{2(g)}$ (ii) $C_{(s)} + 2H_2O_{(g)} \rightarrow CO_{2(g)} + 2H_{2(g)}$ (iii) $2Na_{(s)} + 2H_2O(l) \rightarrow 2NaOH_{(aq)} + H_{2(g)}$ A. i, ii and iii B. ii only C. i and ii only D. i only
32. The main function of limestone in the industrial production of iron from haematite is to A. activate the process of iron production B. reduce haematite to iron and readily eliminate carbon (IV) oxide. C. removes the earthy impurities D. convert pig iron to wrought iron
33. If the complete combustion of 1 mole of an akanol is represented by the equation, $C_nH_{2n+1}OH + xH_2O \rightarrow yCO_2 + zH_2O$, which of the following expressions is/are correct? (i) x=n, (ii) y = 3n/2, (iii) x+y5n/2, (iv) y+z=2n+1 A. iii only B. i only C. ii wily D. iii and iv
34. Which of the following will not react with ammoniacal silver oxide (i) But-2-yne (ii) But-1-yne (iii) Butanal A. (i) and (ii) only B. (i) and (iii) only C. (ii) and (iii) only D. (i), (ii) and (iii)
35. Equal moles of an alkene and an alkanol, each containing 'n' carbon atoms in its molecule were separately combusted in excess oxygen. The volumes of steam produced by the compounds were in the ratio 2:3. What are the respective molecular formulae of the compounds?
A. C_3H_6, C_3H_7OH B. $C_5H_{10}, C_5H_{11}OH$,
C. C_2H_4, C_2H_5OH D. C_4H_8, C_4C_9OH
36. The numbers of tertiary and primary alkanols respectively with molecular

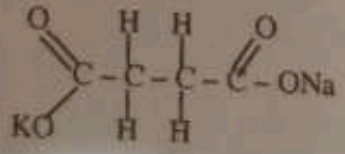
formula $C_5H_{12}O$ are A. 2,4 B. 4,1, C. 1,4 D. 4,2.

37. Some metals can only be extracted by (i) thermal treatment of their ore followed by some additives, (ii) preliminary purification, thermal treatment, reduction and then electrolysis (iii) electrolysis of their molten ore (iv) electrolysis of their molten ore after preliminary purification. Which of the above are used for the extraction of aluminium, iron and copper respectively? A. ii, iv and i, B. iv, i and ii. C. i, ii and iv D. ii, iv and i,
38. One mole of a hydrocarbon contains 6g of hydrogen. If the molar mass of the compound is 54 g/mol, what is the molecular formula of the hydrocarbon? [C = 12; Fl = 1]. A. C_4H_6 B. C_3H_6 C. C_6H_6 D. C_2H_6
39. Which of the following is not crystalline allotropes of carbon? (i) Diamond (ii) Coal (iii) Fullerenes (iv) Graphite A. i only B. i and iv only. C ii and iii only D. iv only
40. A compound with molecular formula $C_4H_{10}O$ gives no reaction with cold aqueous $KMnO_4$ solution but reacts with PCl_5, evolving HCl. What is the most likely structural formula of the compound? A. $CH_3OCH_2CH_2CH_3$ B. $CH_3C(CH_3)(OH)CH$ C. $CH_3CH(CH_3)OCH_3$ D. $CH_3CH(OH)CH_2CH_2CH_3$

2009/2010 SOLUTION
CHM 002 EXAMINATION

1i. **Lucas reagent** is a mixture of concentrated hydrochloric acid and zinc chloride. It is use to distinguish the three classes of alkanols-primary, secondary & tertiary.

ii. Fehling's solutions A and B is used to test for the presence of carbonyl group (-CHO). Fehling's solution A is a solution of $CuSO_4$. Fehling's solution B is a solution of NaOH containing Rochelle salt. Rochelle salt is potassium sodium-2, 3-dihydroxybutanedioate.



iii. Clemmensen (Not clemmenson) reagent is a mixture of amalgamated zinc and hydrochloric acid. Both Alkanals (Aldehydes) and alkanone (ketone) are reduce by Clemmenson reagent to the corresponding hydrocarbons.

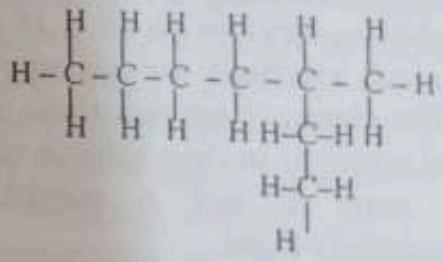
$$C_6H_5CHO \xrightarrow{N_2H_4} C_6H_5CH=N-NH_2 \xrightarrow{H^+Zn/Hg} \underset{\text{Toluene}}{C_6H_5CH_3}$$

iv. 2, 4-dinitrophenylhydrazine is a reagent use to characterize and identify alkanals and alkanones.

v. Tollen's reagent is a mixture of $AgNO_3$ and aqueous ammonia. That is ammoniacal aqueous solution of $AgNO_3$ (which is Ag_2O). Ammoniacal aqueous solution of $AgNO_3$ reacts with both alkanal and terminal alkyne (alkyne with their triple bond in the first carbon atom).

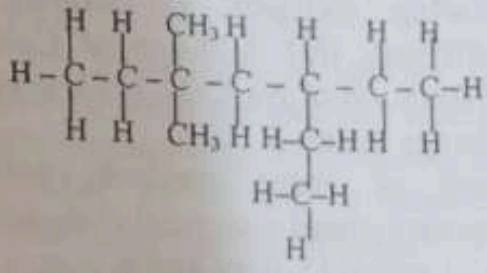
The correct option is C

2i.



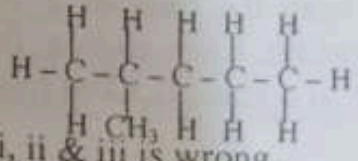
3-methylheptane (not 2-ethylpentene)

ii.



5-ethyl -2, 2-dimethyl hexane (not 5, 5-dimethyl -3-ethylhexane)

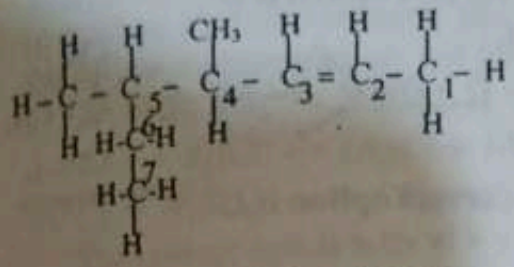
ii.



Hence i, ii & iii is wrong.

2-methylpentane (not 2-dimethylpentane)

The correct option is A

3. 

4. 5-dimethylhept-2-ene

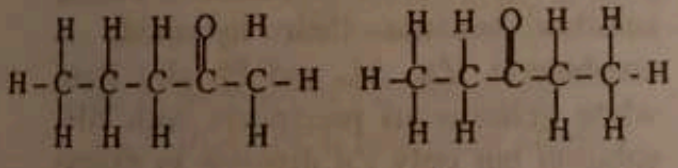
The correct option is D

5. In alkyl halide (i.e. Halogenoalkane), the halogen atom is the negative pole but the alkyl group is the positive pole.

(that is, $\overset{\sigma+}{R}-\overset{\sigma-}{Cl}$).If the alkyl group are held constant, then the greater the electronegativity of the halogen atom, the greater the bonding that exist within the alkylhalide consequently the greater the boiling points. The order of the electronegativity of the halogen is I < Br < Cl < F.

Since fluoride has the highest electronegativity, it implies that flouroethane will have the highest boiling point follows by chloroethane and last by bromoethane i.e. bromoethane < chloroethane < flouoroethane.

The correct option is B

5. 

Pentan-2-one Pentan-3-one

The correct option is A

6. Mass of the organic compound = 0.51g

Mass of CO_2 = 132g

Mass of H_2O = 0.63g

Mass of C in 1.32g of

$$CO_2 = \frac{12}{44} \times 1.32 = 0.36g$$

Mass of O = 0.57 – (0.36 +0.07) = 0.08g

C	:	H	:	O
$\frac{0.36}{12}$		$\frac{0.07}{1}$		$\frac{0.08}{16}$
0.03		0.07		0.005
6		14		1

The empirical formula is $C_6H_{14}O$

The correct option is B

7i. $2(C_6H_{10}O_5)_n + nH_2O \xrightarrow[Hydrolysis]{amylase/diastase} nC_{12}H_{22}O$

ii. $C_{12}H_{22}O_{11} + H_2O \xrightarrow[Hydrolysis]{maltase} 2C_6H_{12}O_6$

maltose glucose

iii. $C_6H_{12}O_6 \xrightarrow[decomposition]{zymase} 2C_2H_5OH + 2CO_2$

The correct option is D

8. Nucleophiles or Nucleophilic reagent is a reagent which attack electron deficient centre. The following are Nucleophiles.
   i. Electron rich molecules NH_3 PH_3, H_2O, alkenes, alkyne
   ii. Anions e.g. CN^-, OH^-, SCN^-
   iii. All Lewis base

   Hence NH_3 & $CH_3CH{=}CH_2$ are Nucleuophiles.

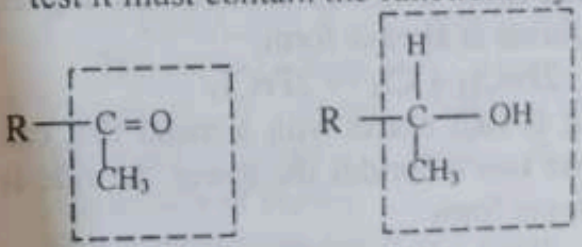
The correct option is C

9. Volatility $\propto \frac{\text{Degree of branching}}{\text{R.m.m or Hydrogen bonding}}$

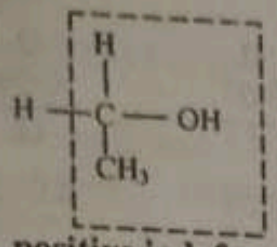
$CH_3CH_2CH_2COOH < CH_3CH_2CH_2CH_2OH < CH_3CH_2OCH_2CH_3 < CH_3(CH_2)CH_3 < CH_3CH(CH_3)CH_3$

The correct option is D

10. An alkaline solution of iodine (I_2/NaOH) is use for Iodoform test. For an organic compound to give a positive iodoform test it must contain the functionality.

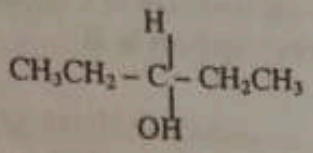


(i)



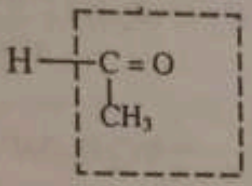
positive iodoform test

(ii)



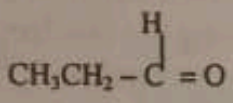
Negative iodoform test

(iii)



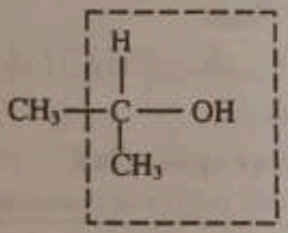
Positive iodoform test

(iv)



Negative iodoform test

(v)



Positive iodoform test

The correct option is A

11. If B_a^{2+} + x ⟶ white ppt then
$X \longrightarrow S^{2-}, SO_3^{2-}, SO_4^{2-}$ or CO_3^{2-}
The correct option is A

12. Whenever Cl_2 react with a metal that can form more than one chloride the higher chloride is always form.

$2FeCl_2 + Cl_2 \rightarrow 2FeCl_3$

But if HCl reacts with a metal that can form two chlorides the lower chloride is always form.

$2HCl + Fe \rightarrow FeCl_2 + H_2$

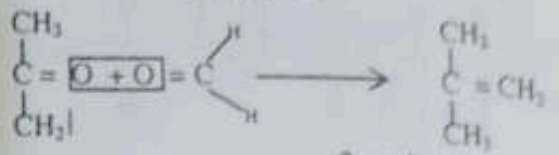
Hence the reactions that is not feasible (that is, the reaction that will not occur)

$6HCl + 2Fe \rightarrow 2FeCl_3 + 3H_2$

$Fe + Cl_2 \rightarrow FeCl_2$

The correct option is D

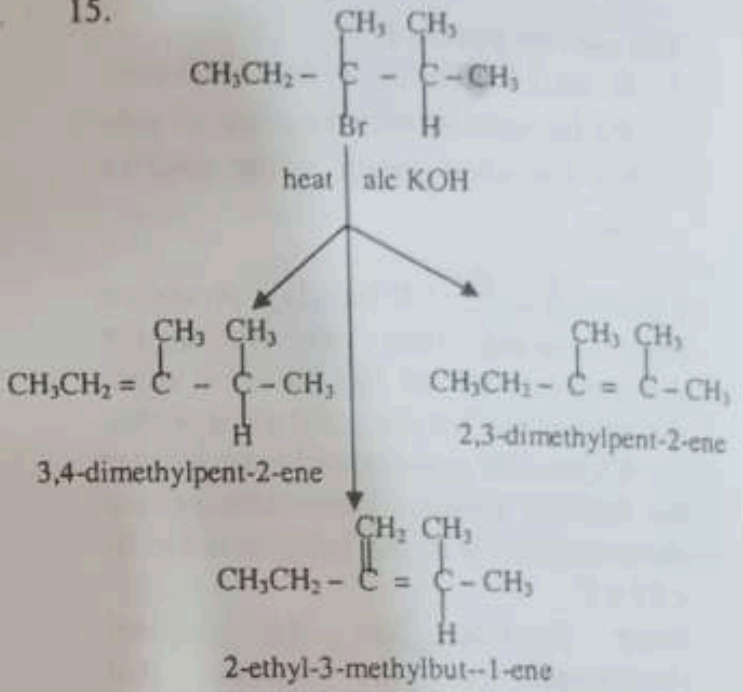
13.



The correct option is C 2-methylpropene

14. iii < v < iv < i < ii
The correct option is C

15.



From the list of compounds only 3,4-dimethylpent-1-ene is not form.
None of the option is correct

16. Zn, AL and Pb form a white gelateneous precipitate with dropwise solution of NaOH and dissolve in excess of NaOH solution because their hydroxide is amphoteric. Zn, AL and Pb also form white gelateneous precipitate with NH_3 solution but only Zn dissolve in excess of NH_3 solution.
Hence Mg^{2+} and Pb^{2+} will be insoluble in excess NH_3 solution.
The correct option is B

17. HNO_3 does not liberate H_2 when reacted with metals because the hydrogen liberated is oxidize to water. Since it is a strong oxidant.

Only metals that are higher than hydrogen in the activity series dissolve in acid to liberate hydrogen gas. Hence the following reactions are not feasible.

i. $Zn + 2HNO_3 \rightarrow Zn(NO_3)_2 + H_2$

ii. $2Ag + 2HCl \rightarrow 2AgCl + H_2$

iii. $Cu + H_2SO_4 \rightarrow CuSO_4 + H_2$

The correct option is D

18. $Cu + H_2SO_4 \xrightarrow{\Delta} CuO + SO_2 + H_2O$

oxidation, reduction

H_2SO_4 is an oxidant or oxidizing agent Cu is reductant or reducing agent.

Note that for Cu to react with H_2SO_4 heat must be apply and the acid must be in concentrated form. If H_2SO_4 is concentrated it can acts as an oxidant, sulphonating agent or drying agent.

The correct option is D

19. Electrophile or Electrophilic reagent is reagent which attack electron deficient centre e.g.

i. All electron deficient molecules $ALCl_3$, $BeCl_2$, BF_3

ii. All cations – Ca^{2+}, NH_4^+, Fe^{2+}, H_3O^+

iii. All Lewis acid

iv. All molecules that are easily polarized and attack electron cloud with their positive pole Br_2

The correct option is B

20. Double bond equivalent (DBE)

$$= \frac{2N_C - N_H - N_X + N_N + 2}{2}$$

N_C = Number of carbon atom

N_H = Number of hydrogen atom

N_X = Number of halogen atom

N_N = Number of nitrogen atom

(i) C_4H_{10}

$$\text{DBE} = \frac{2(4) - 10 - 0 + 0 + 2}{2}$$

$$= \frac{8 - 10 + 2}{2} = \frac{0}{2} = 0$$

(ii) C_4H_6

$$\text{DBE} = \frac{2(4) - 6 - 0 + 0 + 2}{2}$$

$$= \frac{8 - 6 + 2}{2} = \frac{4}{2} = 2$$

(iii) C_4H_8

$$\text{DBE} = \frac{2(4) - 8 - 0 + 0 + 2}{2}$$

$$= \frac{8 - 8 + 2}{2} = \frac{2}{2} = 1$$

(iv) C_6H_6

$$\text{DBE} = \frac{2(6) - 6 - 0 + 0 + 2}{2}$$

$$= \frac{12 - 6 + 2}{2} = \frac{8}{2} = 4$$

(v) C_7H_8

$$\text{DBE} = \frac{2(7) - 8 - 0 + 0 + 2}{2}$$

$$= \frac{14 - 8 + 2}{2} = \frac{8}{2} = 4$$

The correct option is C

21. $2Fe + 3Cl_2 \rightarrow 2FeCl_3$

$$\cap_{Fe} = \frac{28}{56} = 0.05$$

$$\cap_{FeCl_3} = \frac{2mole\ of\ FeCl_3}{2mole\ of\ Fe} \times 0.05mol$$

$of\ Fe = 0.05mol$

$M_{FeCl_3} = \cap_{FeCl_3} \times R.m.m$

$= 0.05 \times 162.5$

$= 8.1255$

The correct option is C

22. $CaC_2 + 2H_2O \rightarrow C_2H_2 + Ca(OH)_2$

The ethyne (C_2H_2) form is washed with acidify $CuSO_4$ ($i.e.\ CuSO_4/dil\ H_2SO_4$) to remove phosphine ($PH_3$). Hence $X \rightarrow CuSO_4/dil\ H_2SO_4$ and $Y \rightarrow PH_3$

The correct option is A

23. Vanadium V oxide (V_2O_5) is an important catalyst used in the preparation of H_2SO_4.

The correct option is A

24. Ethanol, propanone (not propan-2-one) and ethanal give positive iodoform test.

The correct option is C.

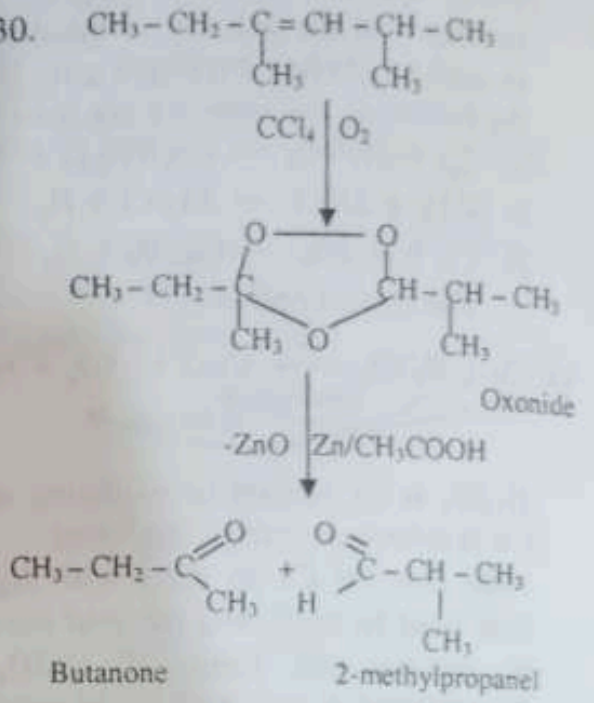
25. $_{29}CU \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10}$
Note that the 4s-orbital must take one electron whenever the 3d-orbital require one electron to be half or full filled. This is because of the stability of orbital.
The correct option is B.

26. Duralumin is an alloy made of 95% Al, 3%, Cu, 1%Mg, and 1% Mn.
The correct option is A.

27. In transition element the valence shall correspond to the principal quantum number (n), containing (n-1) sub-shell in which electrons are accommodated. That is, the d-orbital is partial filled.
The correct option is B.

28. Temporary hard water are remove by boiling, distillation, addition $Ca(OH)_2$, addition of Na_2CO_3 and the use of ion exchange resin.While permanent hard water is remove by distillation, addition of Na_2CO_3 and the use of non-exchange resin. Hence addition of Na_2CO_3, distillation and the use of ion-exchange resin will remove both temporary and permanent hard water.
The correct option is B.

29. Distance travels by substance (y)
$= 10cm - (0.4cm + 0.5cm)$
$= 10cm - 0.9cm$
$= 9.10cm$
Distance travels by substance (x)
$= \frac{10cm}{2} - 0.4cm$
$= 5cm - 0.4cm = 4.60cm$
$Rf = \frac{x}{y} = \frac{4.6}{9.1} = 0.505$
The correct option is D

30. 

Note that there is no compound called butan-2-one or propan-2-one. The correct name is butanone and propanone because both do not form positioned isomers.
The correct option is C.

31. H_2 is prepare industrially by the reaction of coke and water.
$C_{(s)} + 2H_2O \rightarrow CO_2 + 2H_{2(g)}$
The correct option is B.

32. The main function of limestone in the industrial production of iron from haematite is to remove earthy impurities.
$CaCO_{3(g)} \rightarrow CaO_{(s)} + CO_2$
$CaO + SiO_2 \rightarrow CaSiO_3$
Sand Slag
The correct option is C.

33. $C_nH_{2n+1}OH + \left(\frac{3n}{2}\right)O_2 \rightarrow nCO_2 + (n+1)H_2O$
$\rightarrow x = \frac{3n}{2}, y = n \;\&\; z = n+1$
$y + z = 2n + 1, \quad x + y = \frac{3n}{2} + \frac{n}{1}$
$= \frac{3n + 2n}{2} = \frac{5n}{2}$
The correct option is D

34. Ammoniacal silver oxide or aqueous Ammoniacal $AgNO_3$ is called Tollen's reagent. Tollen's reagent reacts with terminal alkyne and alkanal. Hence but-1-ene and butanal will react with Ammoniacal silver oxide.
The correct option is C.

35. $C_nH_{2n+1}OH + \left(\frac{3n}{2}\right)O_2 \rightarrow nCO_2 + (n+1)H_2O$

$C_nH_{2n} + \frac{3n}{2}O_2 \rightarrow nCO_2 + nH_2O$

$\frac{nH_2O \text{ from alkene}}{nH_2O \text{ from alkanol}} = \frac{2}{3}$

$\frac{n}{n+1} = \frac{2}{3}$

$3n = (2(n+1)$

$3n = 2n + 2$

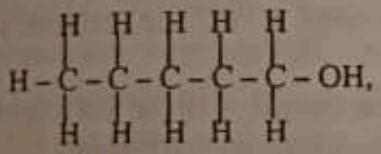
$n = 2$

$C_nH_{2n} = C_2H_4$

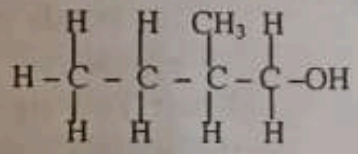
$C_nH_{2n+1}OH = C_2H_5OH$

The correct option is C

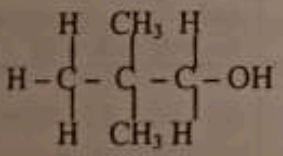
36. **Primary alkanol**



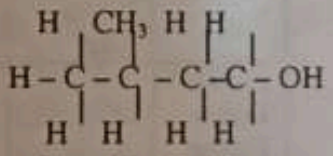
Pentan-1-oL



2-methylbuta-1-oL

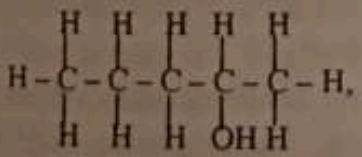


2,2-dimethylpropan-1-oL

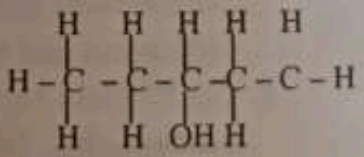


3-methylbutan-1-oL

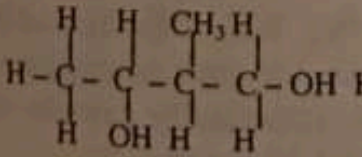
Secondary alkanols



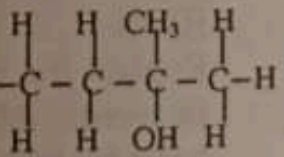
pentan-2-oL



pentan-3-oL

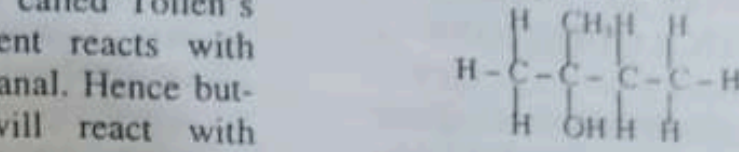


3-methylbutan-2-ol



2-methylbutan-2-ol

Tertiary alkanols



2-methylbutan-2-ol

The correct option is C

37. (a) The extraction of Al follows the sequences: Preliminary purification → electrolysis of molten ore.
(b) The extraction of Fe follows the sequence: thermal treatment of their ore → some additives.
(c) The extraction of Cu follows the sequences: preliminary purification → thermal treatment → reduction → electrolysis.
The correct option is B.

38. $\cap H_2 = \frac{6g}{1g/mol} = 6mole$

$C_xH_y = C_xH_6$

R.m.m of $C_xH_6 = 54$

$12x + 6 = 54$

$12x = 54 - 6$

$12x = 48$

$x = 4$

$C_xH_6 = C_4H_6$

The correct option is A

39. The crystalline allotropes of carbon are diamond, graphite and fullerenes.
The correct option is A

40. Alkanols and Alkanoic acids give white fume of HCl when reacted with PCl_5 or $SOCl_2$. The reagent, cold aqueous $KMnO_4$ is used to oxidize alkanols. However, tertiary alkanols does not react with. It implies that the organic compound in question is tertiary alkannols e.g. $CH_3C(CH_3)(OH)CH_3$.
The correct option is B.

CHAPTER EIGHT
ORGANIC PRACTICE QUESTIONS

1. (a) What was the old definition of organic chemistry? (b) (i) Whose work led to the collapse of this definition? (ii) How did the collapse happen?
   (c) Give two reasons why carbon is unique in its ways (d) discuss the characteristics of organic compounds.
2. (a) What do you understand by the term "functional group" in organic chemistry?
   (b) List, with illustrative examples, the characteristics of the homologous series.
3. (a) Draw the structures for each of the following names and comment on the correctness of each name.
   (i) 4-chioropentane (ii) 7-bromo-5-chloro-3-methloctane (iii) butan-2-one
4. Name each of the following structures by the IUPAC system
   (i) $CH_3CH_2\underset{\underset{CH_2}{\|}}{C}CH_2CH_3$
   (ii) $CH_3CH_2C(CH_3)_3$
5. (a) What do you understand by the term "sharp" as applied melting point of a solid organic compound.
   (b) Samples of two solid substances each of which melts between 119 and 121^{0}C were subjected to mixed melting point determination. Which of the following melting points the mixture may or may not have?
   Comment on the identities or otherwise of the two compounds A and
   (i) 119-121^{0}C (ii) 110-120^{0}C (iii) 123-125^{0}C
   (c) A constant boiling point is a necessary but not sufficient criterion for the purity of a liquid substance.
   What do you understand by this statement?
6. (a) What do you understand by the term R_f value as applied to chromatography.
   (b) A solution of a substance was spotted at the distance, 0.5cm, from the base of chromatoplate. Upon elution, the solvent front got to a place 0.5cm from the: top of component moves half-way up the 20cm long plate, determine R_f value of the component. (c)Explain the meaning of the following terms as used in chromatography (i) mobile phase (ii) stationary phase (iii) elution
7. (a) Define the term "hybridization" as applied to carbon (b) Assuming the normal bond angle at sp^3, sp^2 and sp hybridized carbon-atom,illustrate formula for each of the following structures.
   (i) $CR_3C{\equiv}CH$ (ii) $CH_3CH{=}CH_2$ (iii) $CH_3CH = CHCH_3$
   (c) Which orbitals overlap in organic compounds to give?
   (i) σ (Sigma) and (ii) π (pie) bonds
   (d) Copy and complete the following tables which concern sigma (a) and pie (it) bonds present in ethane, ethane and ethyne.

Note: Two sigma bonds will be different if the orbitals overlapping are different.

	Sigma (a) bonds		
compd x	Type of Sigma bond	No of Pie bond	Overlapping orbitals and their orientation towards each other
Ethane Ethene Ethyne			

   Please repeat the above table but put pie (π) bonds as heading
   (e) Which is stronger? Sigma (σ) or pie (π) bond and why?
8. (a) Explain in one sentence only, what is meant by (i) a Nucleophiles (ii) an Electrophiles (b) Classify the following as Nucleophiles or Electrophiles
   (i) H_2O (ii) Br_2 (iii) BF_3 (iv) NH_3
   Explain the basis for your classification in words. Also, structurally explain the basis for your classification.

9. (a) How would you show the presence of (i) carbon and (ii) hydrogen in a given sample of organic compound.
(b) How would you estimate the percentage of (i) carbon (ii) hydrogen and (iii) oxygen in a given sample of a compound that contains carbon, hydrogen and oxygen only?
(c) 5.1g of an organic compound containing carbon, hydrogen and oxygen on combustion yielded 13.2g of carbon (IV) oxide and 6.3g of water. Calculate the empirical formula of the compound. If the molecular weight is 102, determine the molecular formula of the compound.

10. (a) $16cm^3$ of a gaseous hydrocarbon were mixed with $90cm^3$ of oxygen. After explosion and cooling, the volume was $66cm^3$. It was reduced to $34cm^3$ of residual oxygen by absorption by KOH solution. What is the molecular formula of the hydrocarbon?
(b) Write balanced equations for the complete combustion, in oxygen of the compounds: (i) an Alkane and (ii) an Alkyne each of which contains n-carbon atoms in its molecule. Equal volumes of the two hydrocarbons were separately completely combusted in oxygen. The volumes of steam produced in (i) and (ii) were in the ratio 2:1. Determine the value of "n" and hence the formulae of the Alkane and Alkyne.
NB. All measurements were carried out at 120°C.

11. (a) What do you understand by the term "isomerism"? Illustrate your answer with examples.
(b) Draw and name all the isomers of (i) C_4H_8O (ii) C_4H_8
(c) From the following list of compounds select pairs of compounds that exhibit.
(i) Functional group isomerism (ii) Chain isomerism (iii) positional isomerism.
$CH_3CH_2CH=CH_2$; $CH_3CH_2CH_2CH_2OH$
$CH_3CH=CHCH_3$; $CH_3CH_2CH_2CH_3$
$CH_3CH_2CH(OH)CH_3$; $CH_3CH_2CH(CH_3)CH_2OH$
(d) From the list of compounds in (c) select a compound in each case that can be used to illustrate stereoisomerism and then draw the stereoisomer.

12. Obtain the isomeric primary, secondary and tertiary amines from the molecular formula $C_4H_{11}N$ and name each by the IUPAC system.

13. Deduce the number of alkoxyalkane with the molecular formula $C_4H_{10}O$.

14. (a) How many (i) monochloropropanes and (ii) dichloropropanes are available
(b) Deduce the number of trichloropropanes that can be obtained from each dichloropropane.
(c) Identify which of the dichloropropanes is optically active.

15. (a) Each of three isomeric pentenes X, Y and Z can be hydrogenated to give 2-methylbutane. What can you infer concerning the structure of X, Y and Z?
(b) An alkene upon ozonolysis yields only one product. What do you infer concerning the structure of the alkene?

16. (a) Arrange the following in order of increasing volatility. Explain how you arrive at your answer
(i) $CH_3CH_2C(CH_3)_2CH_2CH_3$
(ii) $CH_3(CH_2)_2CH_3$
(iii) $CH_3CH(CH_3)C(CH_3)_2CH_3$
(iv) $CH_3CH(CH_3)CH_3$
(b) Arrange the following compounds in their order of increasing boiling point.
(i) $CH_3CH_2CH_2CH_3$
(ii) $CH_3(CH_2)_2COOH$
(iii) $CH_3CH(CH_3)CH_3$.
Give reasons for your answer.

17. Given three cylinders known to contain ethane, Ethene and ethyne but with their labels fallen off, discuss how you would set out to label them. You should back

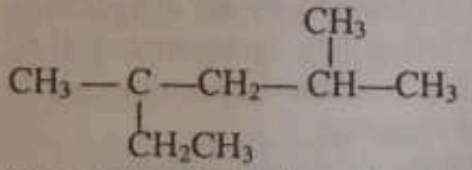
up your discussions with relevant equations.

18. A given organic hydrocarbon decolorizes bromine in CCl_4 and adds on one mole of hydrogen per mole of hydrocarbon to produce the correspondi ng Alkane. Ozonolysis produced Ethanal and 3-methy1butan-2-one. Deduce the structure of the hydrocarbon.
19. You are given a gaseous mixture of Ethane and Ethene. Describe how you can obtain a pure sample of each of the components.
20. Compare and contrast the reactions of (i) Ethene (ii) ethyne with (a) bromine vapour. (b) H_2SO_4 and (c) acidified $KMnO_4$
21. Write equations to show the conversion of ethanol to chloromethane using (a) HCl and (b) PCl_5
22. Propose a scheme for the conversion of propan-l-ol to propan-2-ol
23. Write equations to show how and under what conditions
    (i) NaOH will react with 1-bromopropane. (ii) NaCN will react with bromoethane (iii) ethanol will react with conc H_2SO_4
24. Write out the structure of all carboxylic acids and derivatives with the molecular formula $C_6H_{12}O_2$.Pick out two particular isomers that are derivatives of carboxylic acids and show how they can be distinguished, one from the other.
25. Write equations to show how and under what conditions the following compound will react.
    (a) 1-aminopropane and nitrous acid (b) 2-aminopropane and ethanoic anhydride
26. How many cm^3 of 0.15M HCl are required to react with 0.25g of 1-aminobutane.
27. Write equations to show how and under what conditions ethanoic acid can be converted to
    (i) $CH_2ClCOOH$ (ii) CH_3COCl
28. Write equations for the reaction between ethanoylchloride and (a) water (b) methanol (c) ammonia
29. (a) What is an amino acid?
    (b) Describe how amino acids link to form proteins.
30. (a) What is a fatty acid?
    (b) Give an example of a triglyceride that is made up of three octadecanoic acid molecules.
31. Give the structure of aminoethanoic acid (i) as a solid (ii) in acid medium (iii) in neutral pH (iv) in alkaline solution.
32. (a) What is meant by the isoelectric point of an amino acid (b) In alkaline medium, an amino acid contains two basic groups. $-NH_2$ and COO^-. Which of these groups is more basic? Hence which of them will be preferentially protonated when an alkali is added to the solution? What will be the product at isoelectric point. (c) In acid medium, an amino acid contains two acidic groups: $-N^+H_3$ and –COOH. Which of these groups is more acidic? Hence, which of them will give up a proton when an alkali is added to the solution?
    What will be the product at the isoelectric point?
33. Distinguish between the following terms as used in polymer chemistry.
    (a)Addition and condensation polymerization (b) Thermoplastic and thermosetting polymers (c) Co-polymer and homopolymer.
34. Give two uses for each of the following carbohydrates (a) Glucose (b) sucrose (c) starch (d) Cellulose
35. (a) Give the general classification of carbohydrates (b) How can you confirm that glucose has five hydroxyl groups in its molecule. (c) What reaction can you use to justify the fact that glucose, fructose sucrose, starch and cellulose are all carbohydrates?

36. Discuss the preparations of (a) Ethene and (b) ethyne in the laboratory. You should include clearly well- labeled diagrams showing how fairly pure samples can be obtained.
37. You are given a reasonable quantity of potatoes tubers.
Describe how you can obtain ethanol from them. You should include how a fairly pure sample of ethanol can subsequently be obtained.
38. Calculate the weight of bromine that will saturate 6g of 2-methylbuta-1,3-diene. [Br=80; H=1; O=16].
39. $CH_3CH_2CH_2OH \xrightarrow[X's\ CH_2SO_4]{180^0C} Y \xrightarrow{HBr} Z \xrightarrow[reflux]{NaOH\ (aq)} K$
Supply the structures of Y, Z and K
40. Calculate the octane rating of a fuel whose performance is the same as that of a mixture of 55g of 2,2,4-trimethylpentane and 45g of n-heptane.
41. With the aid of structure only, explain why (i) BF_3 (ii) Br_2 (iii) NH_3 is either Electrophiles or Nucleophiles.
42. Name the compound formed when the two end alkyl groups of methyl propanoate are interchanged.
43. Arrange the following compounds in order of decreasing boiling points using their Roman figures.
(i) $CH_3(CH_2)_3CH_3$ (ii) $CH_3C(CH_3)_3$ (iii) $CH_3(CH_2)_4CH_3$
(iv) $CH_3CH_2CH(CH_3)_2$
44. Write equation(s) for the reaction(s) obtained when but-l-yne is bubbled into dilute tetraoxosulphate (VI) acid at 60°C in the presence of mercury (II) tetraoxosulphate (VI).
45. The fermentation of starch to ethanol involves the following stages:
Starch I maltose II glucose III ethanol
(a) Which enzymes are respectively involved in stages 1, II and III (b) Name, the types of reaction involved in stages I, II and III
46. A sample of a substance contains C and H only burns in excess oxygen to yield 8.8g of CO_2 and 3.6g of H_2O. Calculate the empirical formula of the compound.
47. Which of the following compounds will react with Ammoniacal silver oxide? Write equation for any reaction taking place. (i) But-1-yne (ii) but-2-yne (iii) butanal (iv) butanone.
48. An organic compound X gives steamy white fumes with PCl_5 and also gives a positive idoform test. What functionality in X is responsible for both behaviours?
49. What is the function of sulphur during vulcanization of rubber?
50. Give the IUPAC name for $CH_3OCOCH_2CH_3$.
51. What is the monomer for PVC?
52. What is the common component of all alkanoates.
53. Name the gaseous hydrocarbon(s) that can be produced from metal carbide(s).
54. What impurity/impurities is/are present in any of the hydrocarbon(s) in question 53?
55. How is/are the impurity/impurities in question 54 removed?
56. What are the chemical constituents of sodalime used in the preparation of methane?
57. How many sigma and pie bonds are present in one molecule of methylbenzene?
58. What organic product is formed when chromic acid is drop wisely added to ethanol boiling under reflux.
59. What organic product is formed when ethanol is drop wisely added to heated chromic acid?
60. Ethene is prepared by the dehydration of ethanol using hot, concentrated H_2SO_4. Name the possible impurities and how they are removed.
61. Consider the following structures
(i) $CH_3CH_2CH_2CH_2OH$
(ii) $CH_3CH_2CH(OH)CH_3$

(iii) $CH_3CH(CH_3)CH_2OH$
(iv) $CH_3CH_2CH_2O.CH_3$
Use the respective Roman figures in answering the following questions.
(a) Which of the compounds is a positional isomer with (i)
(b) Which of the compounds is a functional group isomer with (i)
(c) Which of the compounds is a chain isomer with (I)
(d) Which of the compounds can exhibit optical isomerism? Show these optical isomers structurally.

62. How many isomeric alkoxyalkane an be obtained from $C_4H_{10}O$. Draw their structures.
63. Obtain the equations for a two-stage reaction between ethyne and HBr.
64. Arrange the following compounds in their order of increasing R_f values.
(a) $PhCH_2CH_2Ph$
(b) $PhCH(OH)CH_2Ph$
(c) $PhCH(OH)CH(OH)Ph$
(d) $PhCOCH_2Ph$
65. The spots of coloursless organic compounds are usually made visible by inserting the plates into a tank containing iodine crystals. Mention three properties of iodine that make its use possible.
66. $CH_3O.COCH_2CH_3 \xrightarrow[\text{Reflux}]{\text{dil HCl}} X+Y$
Draw the structures for X and Y
67. Give the formulae of halogenated Alkanes that are respectively used as (a) anaesthetic (b) germicide (c) solvent.
68. Write equations for the following conversions. (a) Ethyne to Propyne (b) Ethyne to but-2-yne.
69. Deduce the IUPAC name for



70. One mole of a hydrocarbon contains 6g of hydrogen. If the molecular weight of the hydrocarbon is 54, determine the formula of the hydrocarbon.
71. (a) Organic reactions are slow why is this so (b) Organic compounds are volatile. Why is this so.
(c) What are the consequences of the slowness of organic reactions and the volatility of organic compounds on the conduct of organic reactions?
72. Isomerism is the existence of two or more compounds with the same molecular formula but different physical and / or chemical properties. With the aid of pertinent examples, explain the implication of "and/or" in the definition
73. An unknown organic compound A, has the molecular formula $C_5H_{12}O$
(a) To what family/families of compounds can A belong?
(b) A gives steamy white flumes upon treatment with PCl_5. What does this tell you about the functional group present in A?
(c) Upon heating with excess conc H_2SO_4, A was converted to B, C_5H_{10} upon ozonolysis produce Ethanal and propanone. Deduce the structure of B
(d) Draw and name two possible structures for A
(e) If A gives a positive Iodoform test, which of the probable structures in (d) is more probable.
(f) Draw the structure for the ozonide B.
74. Write equation(s) for the reaction(s) that will convert ethanoic acid to aminoethanoic acid.
75. Write equation(s) for the reaction(s) that will convert Propanal to 2-aminobutanoic acid
76. Write equations to show how and under what conditions aminoethanoic acid will react with (a) dilute HCl (b) dilute NaOH (c) PCl_5 (d) HNO_2 (e) CH_3COCl.

SOLUTION TO ORGANIC PRACTICE QUESTIONS

1a. Organic chemistry is the chemistry of compounds that are manufacture in living cell.

1b. Frendrich Wohler.

1c

- its exceptional ability to catenate
- It's ease of combining with Oxygen and hydrogen
- Its ability to form a double or triple bond

Note that **catenation** is the process by which atoms of an element joint together through covelent bonding to form straight, branch or ring chain.carbon and sulphur can catenate

1d **characteristics of organic compounds**

(i) They exist as gases or solid of low melting point. This is due to the weak intermolecular force that exist within them.

(ii) Liquid organic compound are highly volatile. Volatility is the ability of a substance to exist as a vapour due to the volatility of organic compound, their reactions is usually carried out under reflux. Reflux means condensation in vertical position.

(iii) They have low rate of reaction due to the reluctance in breaking carbon to carbon covalent bond. As a result energy is usually supply in the form of heat or catalyst to organic reaction.

iv. They are covalent in nature

v. They are flammable

vi. They are thermally unstable

vii. They are non-conductor of heat and electricity.

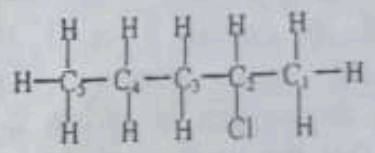
viii. They are insoluble in polar solvent (e.g. H_2O) except if they contain polar group such as –OH, -COOH, -NH_2 etc.

2a. **Functional group** is an atom or group of atoms which determine the chemistry of a given homologous series. It is important because it help to determine the homologous series of an organic compound.

2b. **Characteristics of a homologous series.**

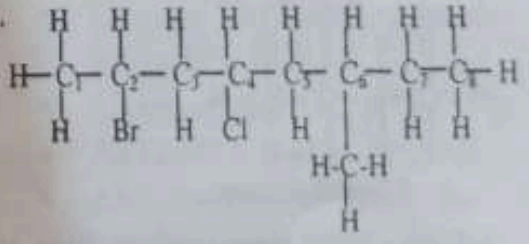
- They have a general Molecular formula e.g. C_nH_{2n+2} for the Alkanes
- They have the same chemical properties
- Their physical properties differ as the number of carbon increase per molecule
- Each member differs from one another by a CH_2 group
- Each member of the series can be prepare by a general method

3a. (i)



- Number the carbon atom as shown above to give the lowest number to the branched chain.
- The longest chain contain 5 carbon atoms, hence the parent Alkane is pentane.
- There is a chlorine atom attached to carbon 2. Hence the substituent name is 2-chloro.
- The IUPAC nomenclature is 2-chloropentane. Hence the correct name is 2-chloropentane not 4-chloropentane.

ii.

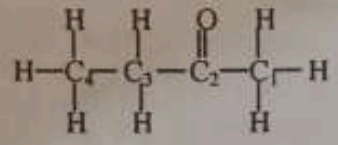


- Number the carbon atom as shown above to give the lowest number to the branched chains.

- The longest chain contains eight carbon atoms. Hence the parent alkene is octane.
- There is a methyl group, chloro atom and bromine atom attached to carbon 6, 4 and 2 respectively. Hence the substituent name is 2-bromo-4-chloro-6-methyl.
- The IUPAC nomenclature is 2-bromo-4-chloro-6-methyloctane.

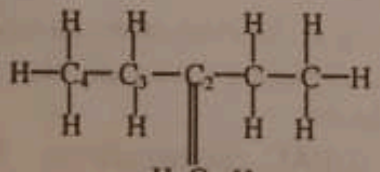
Hence the correct name is 2-bromo-4-chloro-6-methl octane not 7-bromo-5-chloro-3-methyloctane.

iii.



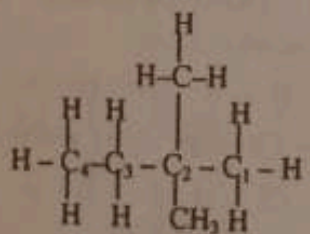
The oxygen atom can only be attached to carbon 2 or 3 if the compound must remain Alkanone placing the oxygen in carbon 2 or 3 shows that the position of the oxygen will be second if the compound is numbered appropriately. Hence the 2 is not required in the name. The name is just butanone. Hence the correct name is butanone not butan-2-one.

4. (i)



2-ethylbut-1-ene

(ii)



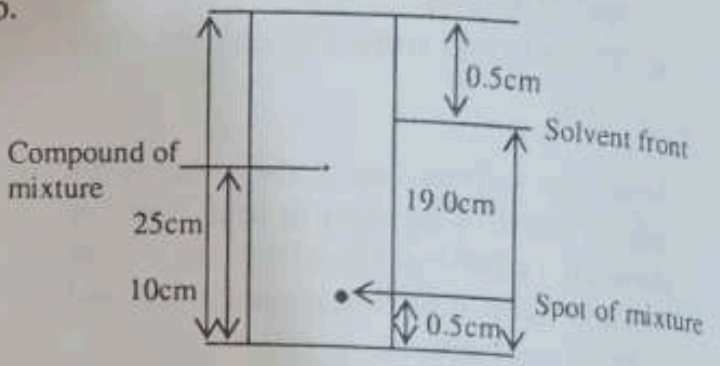
2,2-methylbutane

5. All pure solid substances melting at a narrow range of temperature. This narrow range of temperature at which a substance melt is referred to as sharp melting point.

6. R_f value is the ratio of the distance more by solute to distance move by solvent. R_f value is inversely proportional to intermolecular force. i.e. the greater the intermolecular force existing with a solvent the lower it R_f value.

$$R_f = \frac{\text{distance moved by solute}}{\text{distance moved by solvent}}$$

b.



⇒ Distance moved by component of mixture = 10-0.5 = 9.5cm^3

Distance moved by solvent = 20-0.5-0.5 = 19.0cm

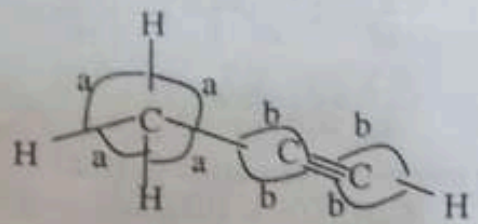
$R_f = 9.5/19.0 = 0.5$

Note that **R_f** is also define as the ratio of the time that a substance spends in the stationary phase to the time that it spends in the mobile phase.It is always less than one

Chromatography is a separation technique which is base on difference in solubility of the component of the mixture to be separated. The mixture is dissolved in a gas or liquid called the mobile phase, and the components are separated as this phase move over a solid (or viscous liquid)called the stationary phase. The movement of the mobile phase over the stationary phase is called elution.

7a. **Hybridization** in term of carbon is the mixing or blending of the 2s and 2p orbitals of carbon to form hybrid orbitals.

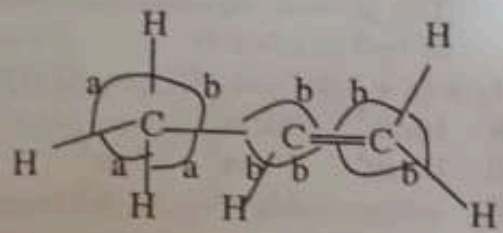
7b.



a = 109.46°
b = 180°

ii.

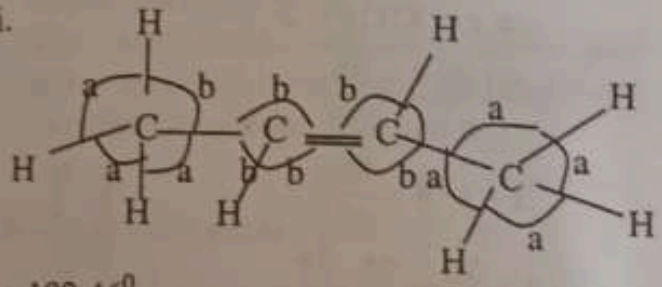
a



a = 109.46°
b = 120°

iii.

a



a = 109.46°
b = 120°

C. **Sigma (σ) bond** is a type of covalent bond that arises through end to end orbital overlap and has most electron density along the bond axis. Sigma bonds are formed between.

i. Two hybrid orbitals e.g. Sp^3-Sp^3, Sp^3-Sp^2, Sp^3-Sp etc.
ii. An hybrid orbital and s-orbital e.g. Sp^3-S, Sp^3-S, Sp^3-Sp etc.
iii. An hybrid orbital and p-orbital e.g. Sp^3-p, Sp^2-p, Sp-p etc.
iv. Two p-orbitals that are linearly oriented.

Pie (π) bond is a type of covalent bond formed by sideways overlap of two atomic orbitals that has two regions of electron density, one above and below the internuclear axis. Pie bond is form between two p-orbitals that are laterally (side-by-side) oriented.

Compd	Type of sigma bonds	No sigma bond	Overlapping orbital	Orientation toward each other
ethane ethene ethyne	Sp^3-sp^3& sp^3-s Sp^2-sp^2& sp^2-s Sp-sp& sp-s	7 5 3	Sp^3-sp^3& sp^3-s Sp^2-sp^2& sp^2-s Sp-sp& sp-s	Linear Linear Linear

Compd	Type of pie bonds	No pie bond	Overlapping orbital	Orientation toward each other
ethane ethene ethyne	- P-P - P-P	- 1 2	- P-P P-P	- Lateral Lateral

Sigma bond is stronger than pie bond because of the degree of overlapping

8a.(i) **A Nucleophiles** is a reagent which attack electron deficient centre. It is also known as nucleophilic reagent. The following are Nucleophiles.

- Electron rich molecules e.g. H_2O, NH_3, PH_3 etc.
- Anions e.g. CN^-, OH^-, SCN^-, Cl^- etc.
- All Lewis base e.g. NH_3
- Molecules that are easily polarized and attack electron deficient centre with it negative pole e.g. Rmgx (i.e. Grignard reagent).

(ii) **An Electrophiles** is a reagent which attach electron rich centre. It is also known as electrophilic reagent.

The following are Electrophiles.

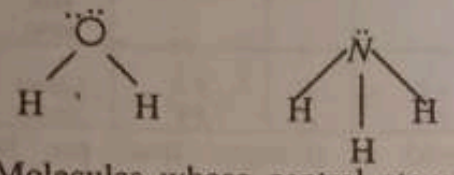
- Electron deficient molecules e.g. $AlCl_3$, BF_3, BeF_2 etc.
- All cations e.g. Ca^{2+}, NH_4^+, Mg^{2+} etc.
- All Lewis acids e.g. BF_3, $AlCl_3$
- All molecules that are easily polarized and attack electron cloud with their positive pole e.g. bromine

$\delta+$ $\partial-$
Br – Br

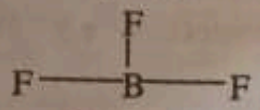
Nucleophile	Electrophile
NH_3, H_2O	Br_2, BF_3

From the definition of Nucleophiles and Electrophiles we have already explained the basis of classifying a molecule as Nucleophiles or Electrophiles.

Molecules that have lone-pair of electron in their central atom in their Lewis structures are known as electron rich molecules. Electron rich molecules are Nucleophiles.



Molecules whose central atom has less than eight electrons in their Lewis structures are known as electron deficient molecules. Such molecular are Electrophiles.



Also molecules that are easily polarized on approaching electron cloud such that they attack the electron cloud with their positive poles are also Electrophiles e.g. bromine.

$\delta+ \quad \partial-$

Br – Br

9a. Aready solved

9b. Aready solved

9c. Mass of organic compound = 5.10g

Mass of CO_2 = 13.20g

Mass of H_2O = 6.30g

Mass of C in 13.20g of CO_2 =

$$\frac{12 g/mol}{44 g/mol} \times 13.20 g = 3.60 g$$

Mass of H in 6.30g of H_2O =

$$\frac{2 g/mol}{18 g/mol} \times 6.30 g = 0.70 g$$

Mass of oxygen = 5.1 – (3.6+0.7) = 0.80g .

C	:	H	:	O
$\frac{3.60}{12}$	:	$\frac{0.70}{1}$	:	$\frac{0.80}{16}$
0.3	:	0.7	:	0.05
6	:	14	:	1

The empirical formula is $C_6H_{14}O$

$(C_6H_{14}O)n = 102g/mol$

$[6(12g/mol)+14(1g/mol)+1(16g/mol)]n = 102g/mol$

$[72g/mol + 14g/mol + 16g/mol]n = 102g/mol$

$102ng/mol = 102g/mol$

$102n = 102$

$n = 102/102 = 1$

The molecular formula is $C_6H_{14}O$

10. The general equation of combustion of hydrocarbon is

$C_xH_y + (x + y/4)O_2 \rightarrow xCO_2 + y/2\ H_2O$

VBR	$16cm^3$	$90cm^3$	-	-
VOR	$16cm^3$	$36cm^3$	$32cm^3$	-
VAR	-	$34cm^3$	$32cm^3$	-

$\Rightarrow$ from the stoichiometry of the reaction

$$\frac{1}{16} = \frac{x}{32}$$

$$\Rightarrow x = 32/16 = 2$$

$$\frac{x + y/4}{x} = \frac{56}{32}$$

$$2 + y/4 = \frac{56}{32} \times 2$$

$$x + y/4 = \frac{56}{32} = \frac{28}{8} = \frac{7}{2}$$

$$2 + y/4 = \frac{7}{2}$$

$$y/4 = \frac{7}{2} - \frac{2}{1} = \frac{7-4}{2} = 3/2$$

$$y = \frac{3}{2} \times 4 = 6$$

N.B. VBR – volume before reaction

VOR – volume of reaction and

VAR – volume after reaction

$C_xH_y = C_2H_6$

b.

(i) $C_nH_{2n+2} + \left(\frac{3n+1}{2}\right)O_2 \rightarrow nco_2 + (n+1)H_2O$

(ii) $C_nH_{2n} + \left(\frac{3n}{2}\right)O_2 \rightarrow nco_2 + nH_2O$

(iii) $C_nH_{2n-2} + \left(\frac{3n-1}{2}\right)O_2 \rightarrow nco_2 + (n-1)H_2O$

$$\Rightarrow \frac{\text{vol of steam for alkane}}{\text{vol of steam for alkyne}} = \frac{n+1}{n-1} = \frac{2}{1}$$

$n + 1 = 2(n-1)$

$n + 1 = 2n - 2$

$1+2 = 2n-n$

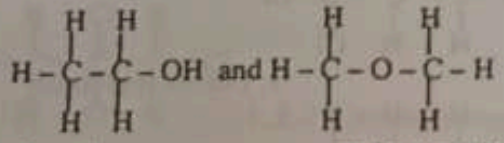
$n = 3$

$\Rightarrow$ $C_nH_{2n+2} = C_3H_8$

$C_nH_{2n-2} = C_3H_4$

11. **Isomerism** is the phenomenon where two or more compound with the same molecular formula known as the isomers (or isomeride) have different physical and/or chemical properties.

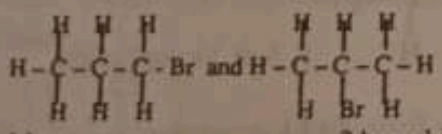
The "and" in the definition means that some isomers have their physical and chemical properties different e.g.



ethanol and methoxymethane

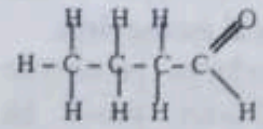
Such isomers are usually in different homologous series.

The "or" in the definition means that certain isomers have different physical properties but the same chemical properties. Such isomers are usually in the same homologous series e.g.

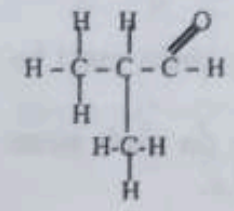


1-bromopropane and 2-bromobutane

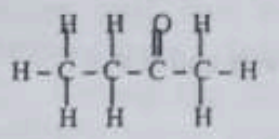
b. The compound C_4H_8O satisfies the general formula $C_nH_{2n+1}CHO$. Hence it is an Alkanal it will also satisfy the general formula of the Alkanone some Alkanal and Alkanone are functional isomers.



butanal

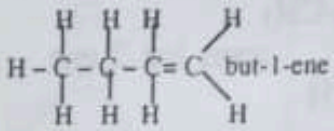


2-methylpropanal

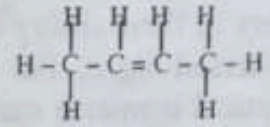


butanone

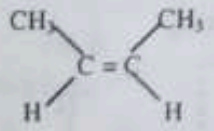
ii. The compound C_4H_8 satisfy the general formula C_nH_{2n}. Hence it is an alkene.



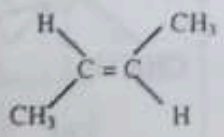
but-1-ene



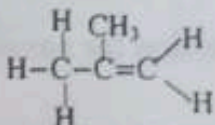
but-2-ene



cis-but-2-ene



Trans-but-2-ene



2-methylpropene

11c. i. None

ii. $CH_3CH_2CH_2CH_2OH$ & $CH_2CH(CH_3)CH_2OH$

iii. $CH_3CH_2CH_2CH_2OH$ & $CH_2CH_2CH(OH)CH_3$;

$CH_3CH_2CH = CH_2$ &

$CH_3CH = CHCH_3$

11d. **Stereoisomerism** is the phenomenon whereby two or more compound with the

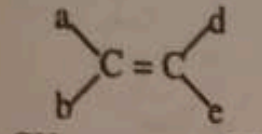
same molecular formula differs in their configuration in space.

Stereoisomerism is of two types which are **geometric** and **optical isomerism.**

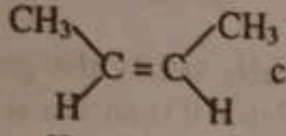
For a molecular to undergo geometric isomerism two conditions must be satisfied.

i. A double bond or ring chain must be present.

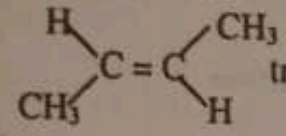
ii. The substituent group on each atom must not be the same i.e.



$a \neq b$ and $d \neq e$

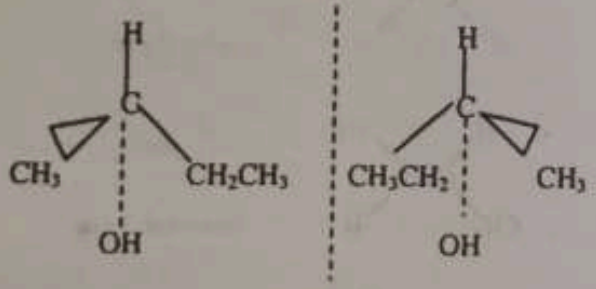


cis-but-2-ene



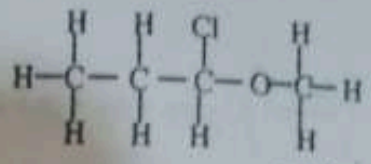
trans-but-2-ene

Optical isomers differs in their ability to rotate the plane polarized light. For a molecular to be an optical isomer it must have a **chiral centre** i.e. a carbon atom with four different group.

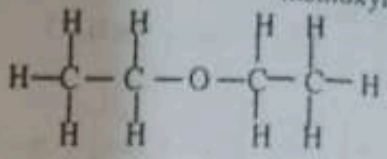


12.See tutorial question for answer

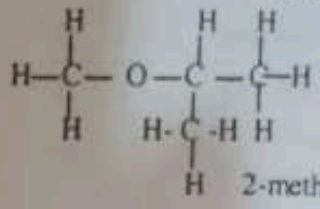
13.



methoxymethane

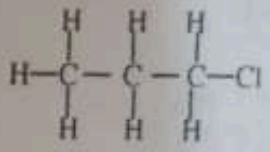


ethoxyethane

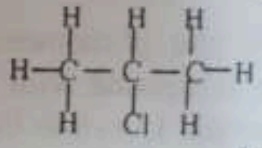


2-methoxypropane

14.



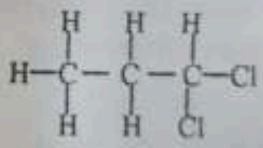
1-chloropropane



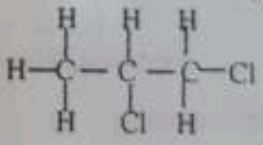
2-chloropropane

Hence there are only two monochloropropane.

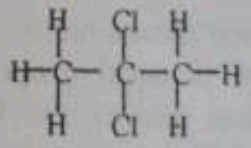
ii.



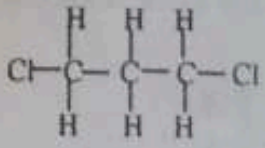
1, 1-dichloropropane



1, 2-dichloropropone



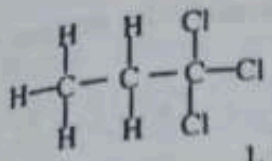
2,2-dichloropropane



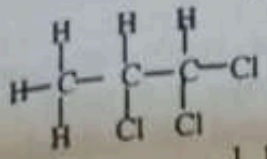
1, 3-dichloropropane

Hence there are four dichloropropane.

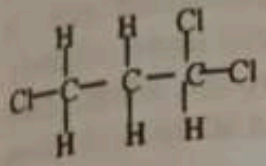
b. The number of trichloropropane that can be obtain from 1,1-dichloropropane are show below;



1, 1, 1-dichloropropane



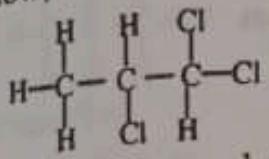
1, 1, 2-dichloropropone



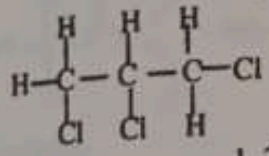
1,1, 3-dichloropropane

Hence three trichloropropane can be obtain from 1,1-dichloropropane.

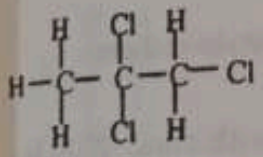
The number of trichloropropane that can be obtained from 1,2-dichloropropane are show below;



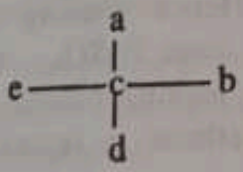
1, 1, 2-trichloropropane



1, 2, 3-trichloropropone

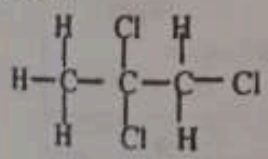


1, 2, 2-trimethylpropane



Hence the trichloropropane can be obtain from 1,2-dichloropropane.

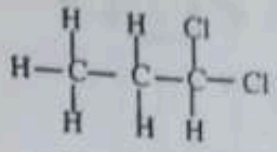
The number of trichloropropane that can be obtain from 2,2-dichloropropane are show below;



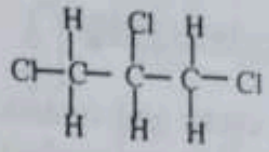
1, 2, 2-trichloropropane

Hence only one trichloropropane can be obtain from 2,2-dichloropropane.

The number of trichloropropane that can be obtained form 1,3-dichloropropane are show below;



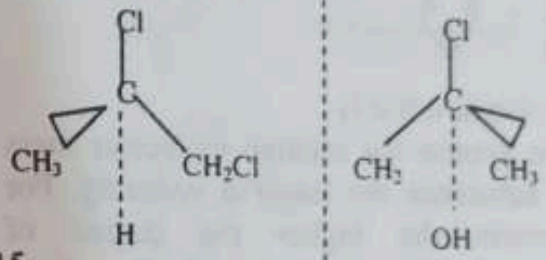
1, 1, 3-trichloropropane



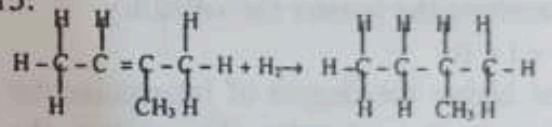
1,2,3-trichloropropane

Hence only two trichloropropane can be obtained from 1,3-dichloropropane.

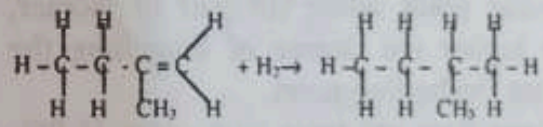
C. Among the dichloropropane, the only optically active one is 1,2-dichloropropane because it is the only dichloropropane with a chiral centre.



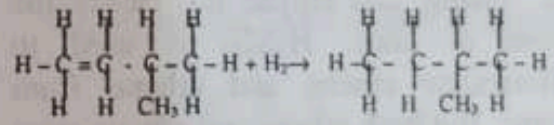
15.



2-methylbut-2-ene



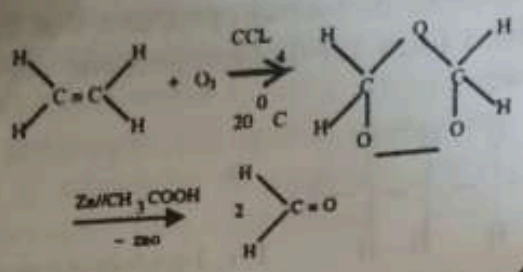
2-methylbut-1-ene

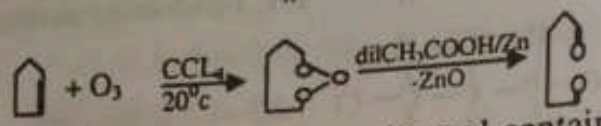


3-methylbut-1-ene

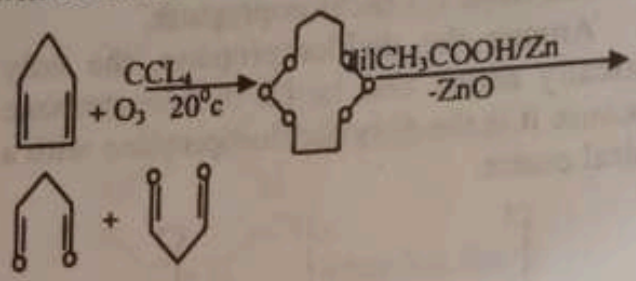
Hence X, Y and Z are 2-methylbut-2-ene, 2-methylbut-1-ene and 3-methybut-1-ene.

15b. An alkene that give one product in ozonolysis is either symmetric (i.e. it can be divided into two equal halves) or it contains a ring chain with only one double bond.





Note that if the alkene is cyclic and contain two double bond then more than one product will be formed.



16. i < iii < ii < iv

The greater the relative molecular mass of substance the lesser it volatility. For isomers the higher the degree of branching the greater the volatility.

b. iii < i < ii

The higher the degree of intermolecular force in a molecular the greater the boiling point while for pair of isomer, the higher the degree of branching the lesser the boiling point.

17. Ethane does not react with conc. H_2SO_4 but ethene and ethyne do. Hence the action of conc. H_2SO_4 is used to differentiate ethene and ethyne from ethane. But both ethene and ethyne react with conc. H_2SO_4 as show below.

$$C_2H_4 + H_2O \xrightarrow{\text{Conc } H_2SO_4} C_2H_5OH$$

$$C_2H_2 + H_2O \xrightarrow[HgSO_4]{\text{Conc. } H_2SO_4} H-C=C(OH)-H$$

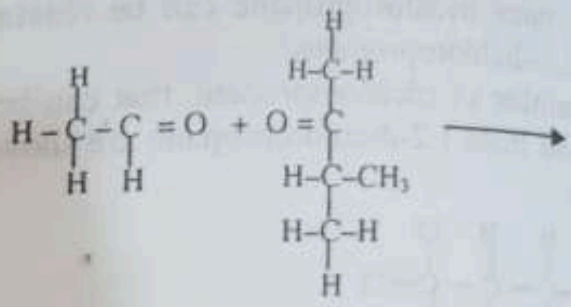
enol

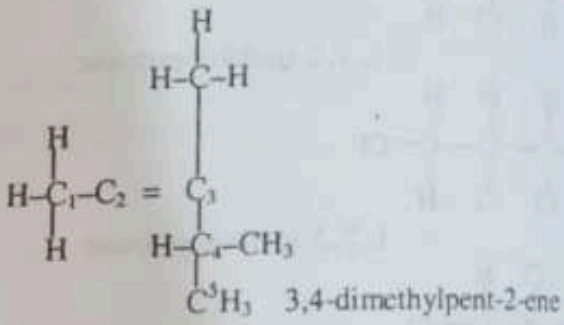
Ethyne react with Ammoniacal solution of copper I chloride or silver nitrate but ethane does not. Hence the action of these reagents on ethyne is used to identify the reagent that is ethyne.

$$CH \equiv CH + 2Cu^{2+} \xrightarrow[H_2O]{NH_3} Cu-C \equiv C-Cu + 2H^+$$

Hence the reagent bottle can now be labeled appropriately.

18. An organic compound which decolorizes bromine water is unsaturated (i.e. it contain double or triple bond). Unsaturated hydrocarbons which take one mole of reagent in addition reaction contain a double.





3,4-dimethylpent-2-ene

19. Ethane does not react with conc. H_2SO_4 but ethene does. Hence passing the mixture through conc.H_2SO_4 will absorbed the ethene leaving behind the ethane. Hence the ethene is separated from the ethane.

20.

	Ethene	Ethyne
1.	$C_2H_4 + Br_2 \rightarrow CH_2BrCH_2Br$	$C_2H_2 + Br_2 \rightarrow CHBrCHBr$
2.	$C_2H_4 + H_2O \xrightarrow{conc\,H_2SO_4} CH_3CH_2OH$	$C_2H_2 + H_2O \xrightarrow[HgSO_4]{conc\,H_2SO_4} H-C=C(OH)-H$
3.	$C_2H_4 \xrightarrow{KMnO_4} CH_2COOH$	$C_2H_2 \xrightarrow{KMnO_4} 2HCOOH$

Hence Ethene and ethyne decolorize reddish colour of bromine vapour.

21. $CH_3CH_2OH + HCl \rightarrow CH_3CH_2Cl + H_2O$

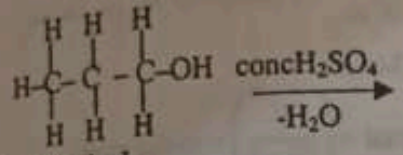
$CH_3CH_2OH + PCl_3 \rightarrow CH_3CH_2Cl + POCl_3 + HCl$

$3CH_3CH_2OH + PCl_3 \rightarrow 3CH_3CH_2Cl + H_3PO_3$

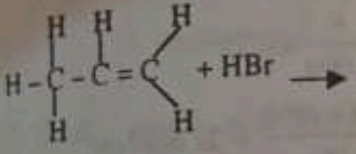
$CH_3CH_2OH + SOCl_2 \rightarrow CH_3CH_2Cl + SO_2 + HCl$

Note that we decided to show the behaviour of Alkanol with PCl_3 and $SOCl_2$ to increase your wealth of knowledge. Besides the above reaction is a confirmatory test for the presence of –OH group. Note that Alkanoic acid also bear in a similar way. Any compound with a –COOH or –OH group will give a white fume (HCl) with $SOCl_2$ and PCl_5.

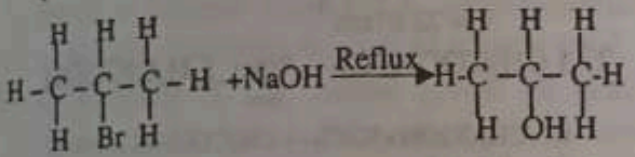
22.



Propan-1-oL



Propene



2-bromoPropane propan-2-ol

The conversion of propan-1-ol to propan-2-ol involve the following reactios

(i)Dehydration

(ii)Dehydrohalogenation and

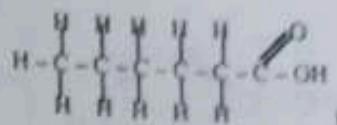
(iii)Hydrolysis

23. i. $CH_3CH_2CH_2Br + NaOH \xrightarrow{Reflux} CH_3CH_2CH_2OH + NaBr$

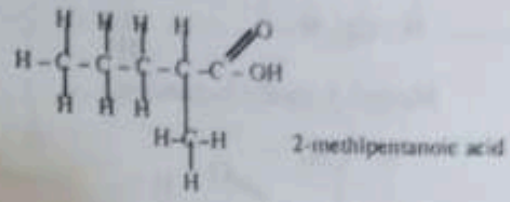
(ii). $CH_3CH_2Br + NaCN \xrightarrow{aqalcohol} CH_3CH_2CN + NaBr$

(iii) $CH_3CH_2OH \xrightarrow[180^0C]{Conc\ H_2SO_4} CH_2 = CH_2$

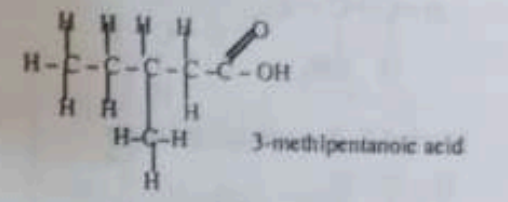
24.



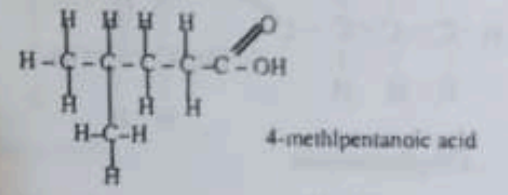
hexanoic acid



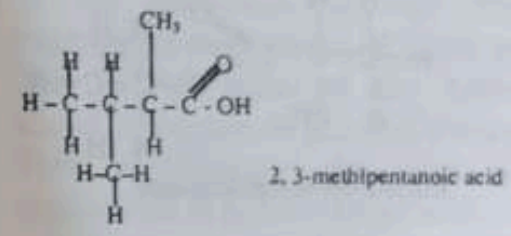
2-methlpentanoic acid



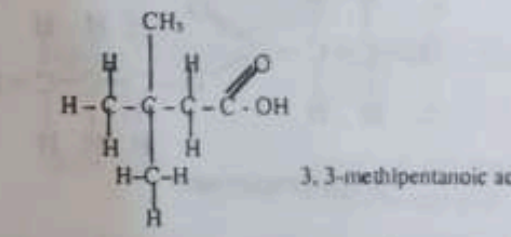
3-methlpentanoic acid



4-methlpentanoic acid

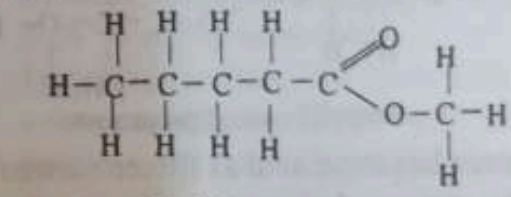


2, 3-methlpentanoic acid

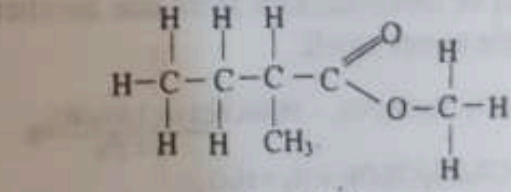


3, 3-methlpentanoic acid

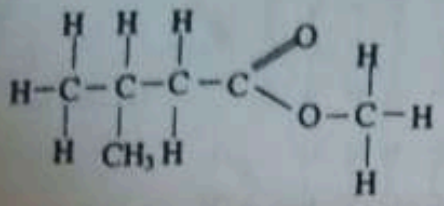
Esters are functional isomer of carboxylic acid.



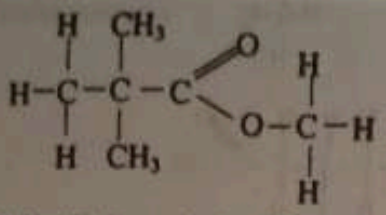
Methylpropanoate



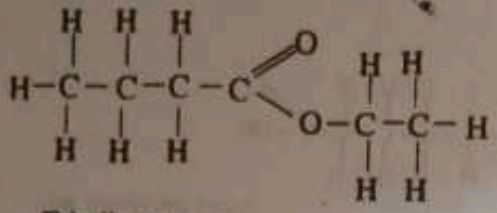
Methyl-2-methylbutanoate



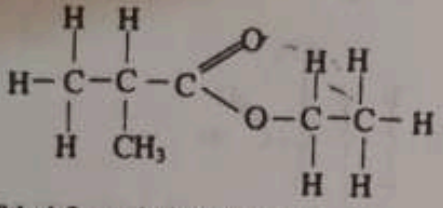
Methyl-3-methylbutanoate



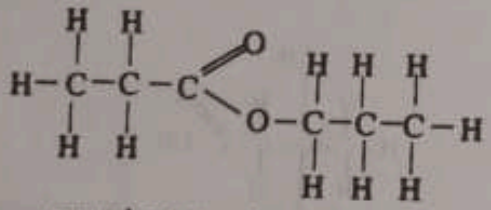
Methyl-2, 2-methylpropanoate



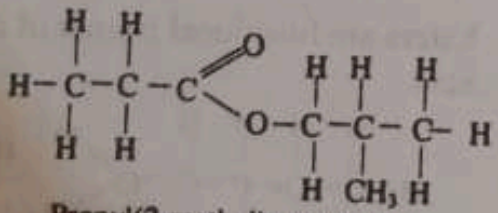
Ethylbutanoate



Ethyl-2-methylpropanoate



propylpropanoate



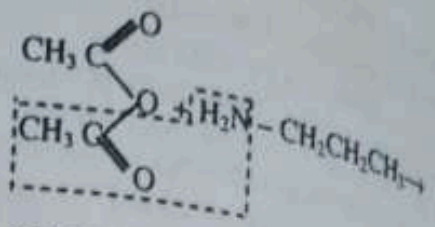
Propyl(2-methyl)propanoate

Hence hexanoic acid as fifteen isomers. The various derivative of hexanoic acid can be differentiated from one another by their sweet smell.

25.

i. $CH_3CH_2CH_2NH_2 + HONO \xrightarrow[0-5^0c]{dil\ HCL/NaNO_2} CH_3CH_2CH_2OH + N_2 + H_2O$

ii.



$CH_3CONH_2 + CH_3COOCH_2CH_2CH_3$

26.

$CH_3CH_2CH_2CH_2NH_2 + HCl \rightarrow CH_3CH_2CH_2CH_2NH_3Cl$

No of mole of $CH_3CH_2CH_2CH_2NH_2$ = $\frac{\text{Reacting mass}}{\text{molar mass}} = \frac{0.25g}{73g/mol} = 0.0034mol$

No of mole of HCl = $\frac{1\ mole\ of\ HCl}{1\ mole\ of\ CH_3CH_2CH_2CH_2NH_2} \times 0.0034mol\ of\ CH_3CH_2CH_2CH_2NH_2$

$= 0.0034mol$

$\cap_{HCl} = 0.0034mol = \left(\frac{V}{1000}\right) \times \text{molar conc}$

$0.0034 = \frac{V}{1000} \times 0.15$

$V = \frac{0.0034 \times 1000}{0.15} = 22.6667cm^3$

$V = 22.67cm^3$

27.i $CH_3COOH + Cl_2 \xrightarrow[heat]{Reflux} CH_2ClCOOH$

ii. $CH_3COOH + SOCl_2 \rightarrow CH_3COCl + SO_2 + HCl$

dry acid

Note that PCl_5 can be used in the place of $SOCl_2$

28(a)

$CH_3C(=O)Cl + H\text{-}OH \rightarrow CH_3COOH + HCl$

(b)

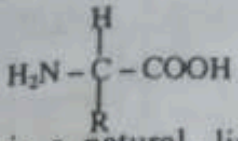
$CH_3C(=O)Cl + CH_3O\text{-}H \rightarrow CH_3COOCH_3 + HCl$

(c)

$CH_3C(=O)Cl + H\text{-}NH_2 \rightarrow CH_3CONH_2 + HCl$

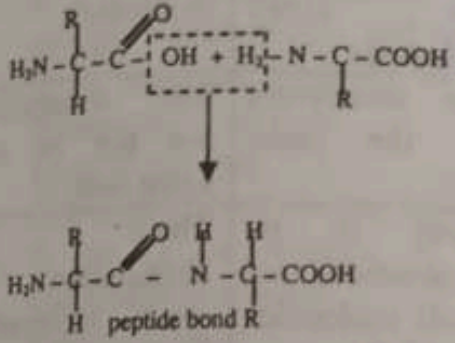
29. **Amino acid is a bifunctional compound** which contains both the carboxylic and amino group within its molecules. An amino acid in which the amine group ($-NH_2$) and the carboxylic group (-COOH) is attached to the same carbon is known as α-amino acid. α-

amino acid has the general structural formula of:



b. **Protein** is a natural, linear polymer (of amino acids) composed of any of about20 types of amino acid monomers linked together by peptide bonds.

The amino acids which combine to form proteins are joined together by a peptide bonds. In each peptide bond formation, a water molecules is loss. e.g.



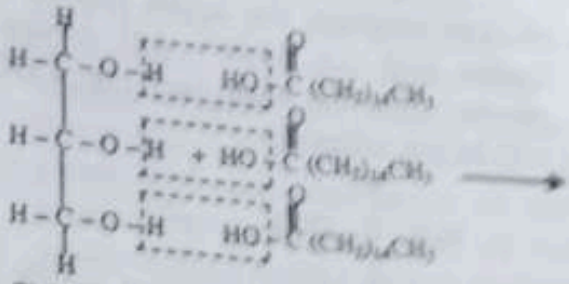
30. **Fatty acids** are carboxylic acid with a long hydrocarbon chain that is derived from a natural source e.g. octadecanoic acid which is also known as stearic acid.

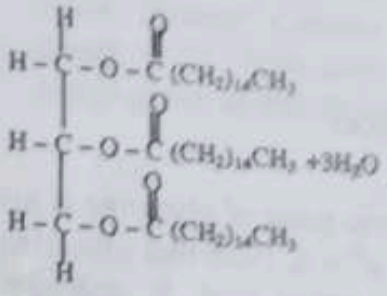
b. **Glyceride** is the name given to both facts and oils. Fats and oils are esterification products of fatty acid and glycerol (propan-1, 2, 3-triol).

Fats are Alkanoate of saturated fatty acids which are solid at room temperature. While oils are mainly Alkanoate of unsaturated fatty acids which are liquid at room temperature.

Note also that both fats and oils are called LIPIDS.

Octadecanoic acid has the molecular formula $CH_3(CH_2)_{14}COOH$ while glycerol have the molecular formula $CH_2OHCHOHCH_2OH$.

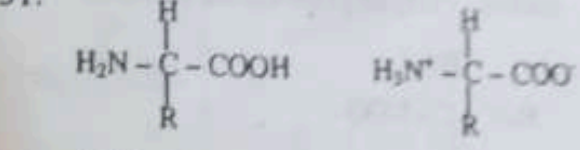

Glycerol


Triglyceride

In the formation of one mole of triglyceride three moles of water are loss. The IUPAC name of the triglyceride above is propan-1, 2,3-trioctadecanoate. This is because the acid in the triglyceride is octadecanoic acid.

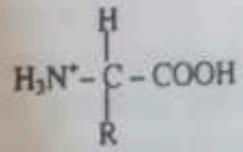
31.

Solid state

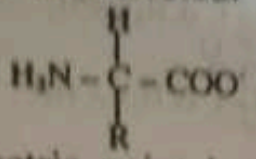

aqueous solutions (in neutral p^H)

Note that amino acid in aqueous has the structure shown above. In aqueous solution, COO^- is acting as a base while H_3N^+ is acting as an acid.

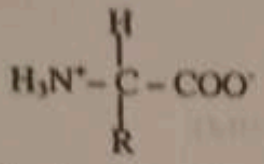
In acidic medium, the basic part of the amino acid (i.e. COO^-) will accept a proton from the acid but the acidic path (i.e. H_3N^+) is not affect.


Acidic medium

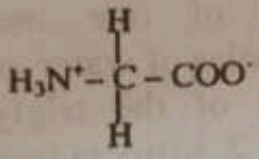
In alkaline medium, the acidic part of the amino acid (i.e. H_3N^+) will donate a proton while the basic part (i.e. COO^-) will be not affected.



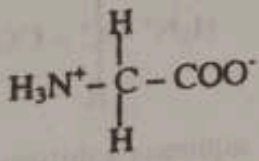
32. Isoelectric point is the pH at which an amino acid exists completely as dipolar ions i.e.



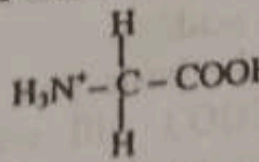
The isoelectric point of glycerine is just a little above $p^H = 6$. Note that glycerine is on simplest amino acid. It structure is shown below;



b. $-NH_2$ is more basic than COO^- (i.e. $-NH_2 > -COO^-$). Hence when an acid is added $-NH_2$ is protonated to form



c. -COOH is a stronger acid than $-\overset{+}{N}H_2$ (i.e. $-COOH > -N^{+H}{}_3$). Hence –COOH will give up a proton when an acid is added to form



33.

Addition polymerization	Condensation polymerization
It is the phenomenon whereby two or more compound of the same unit called the monomers link together to form the polymer without elimination of any small molecules.	It is the phenomenon where two or more compounds of different unit called the monomers link together to form the polymer with the elimination of a small molecule.
The monomers are the same unit.	The monomers are not of the same unit.
There is no elimination of small molecules like H_2O.	There is elimination of small molecules like water.
Examples are polyethene pvc, polytstrrene etc.	Examples are nylon, SBR (styrene-butachene rubber) butyl rubber, neoprene etc.

b.

Thermoplastic polymers	Thermosetting polymers
These are polymers which can be softened or melt when heated, hence they can be remolded.	These are polymers that cannot be remolded or softened when heated, hence they cannot be remolded.
Examples are polyethene polypropene, polystyrene, pvc etc.	Examples are phenolic material and amino-methenal.

c.

Homopolymers	Co-polymer
Homopolymers are polymers of the same monomeric units	Co-polymers are polymers of different monomeric units.
Examples are polyethene, pvc, polystyrene.	Examples are nylon, SBR, Neoprene.

34a. **Uses of glucose**

i. It is used in the manufacturing of jam and sweets.

ii. It is used as intermediate supply of energy to seek people and sportsmen.

iii. It is used as additive to aid the fermentation of wine

b. **Uses of sucrose**

i. It is used for sweetening food

ii. It serves as source of glucose, fructose and ethanol.

c. **Uses of starch**

i. It is used in laundry to stiffen clothes

ii. It is used to make taste and adhesive.

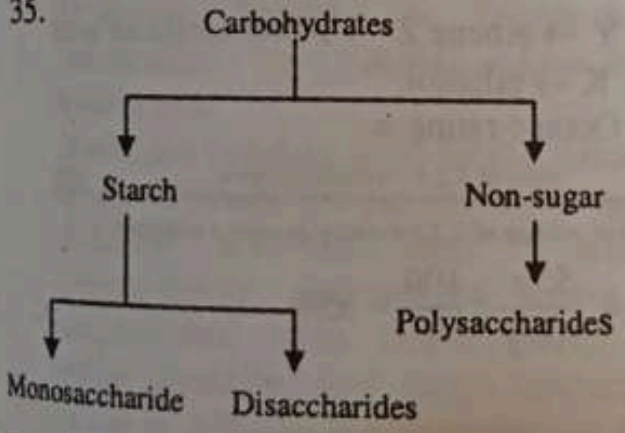
iii. It is used in the manufacture of glucose and ethanol.

d. **Uses of cellulose**

i. It is used in the production of artificial silk and cellophane.

ii. It is used in the manufacture of explosives and gun cotton.

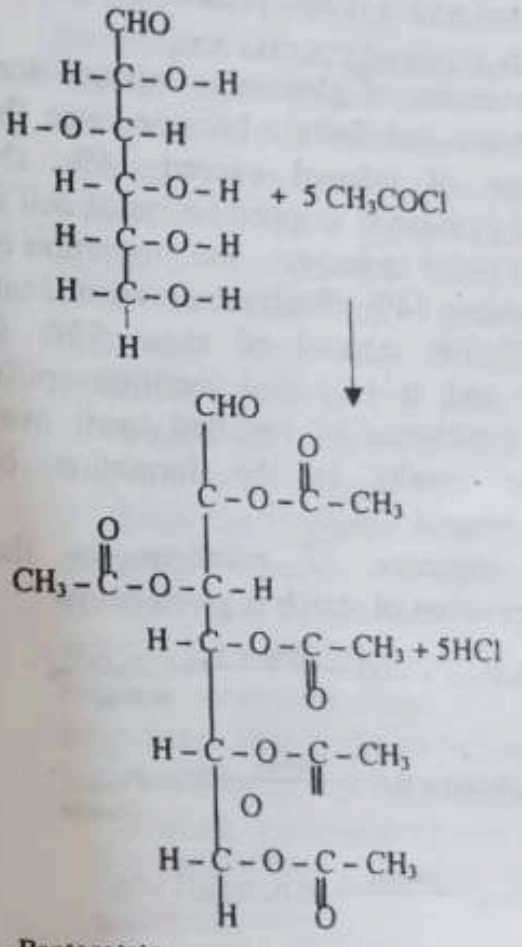
35.



b. **Acetylation** is a reaction in which any acetyl group (CH_3CO) is introduce into a compound as a result of the reaction of the compound with an acetylating agent such as CH_3COCl, $(CH_3CO)_2O$ etc.

Acetylation is used to determine the number of hydroxyl group (-OH) in a compound. Compound with one –OH group with take one mole of acetyl group. The number of mole of acetyl group (CH_3CO) take my a molecules shows the number of –OH group in that compound.

Since glucose contains five hydroxyl group (-OH)will take five moles of acetyl group as shown below.



Pentacetate

c. Hydrolysis, Acetylation

36. Please refer to any readable chemistry textbook for the diagram of the preparation of ethene.Preparation of ethene is already dealt with in this book

37. The potatoes tubers are crush and the starch in them is extracted. The extracted starch is first heated with water and germinating barley, which provides the

enzyme amylase. This enzyme converts the starch into maltose.

$$2(C_6H_{10}O_5)n + nH_2O \xrightarrow{\text{a mylase}} \underset{\text{maltose}}{nG_2H_{22}O_{11}}$$

The product is then cooled and fermented with yeast for several days, where the maltose is converted to glucose by the enzyme maltose.

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{\text{maltase}} \underset{\text{glucose}}{2\,C_6H_{12}O_6}$$

The glucose is then converted to ethanol and carbon iv oxide by the enzyme zymase which is also present in yeast.

$$C_{12}H_{22}O_6 \xrightarrow{\text{zymase}} 2\,C_2H_5OH + 2CO_2$$

The conversion of glucose to ethanol does not continue indefinitely because once the percentage of ethanol exceed 14%, the action of zymase is stopped i.e. yeast cell is killed. In order to increase the proportion of ethanol above 14%, distillation is carried out on distillation ethanol of about 95% is obtained and it is called rectified spirit. Further distillation of rectified spirit over quicklime results in the formation of absolute ethanol.

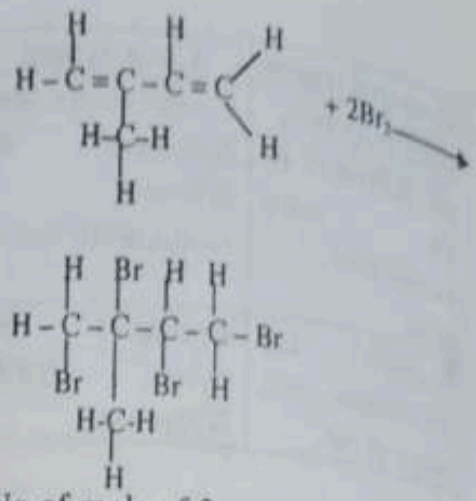
The sequence of reactions in the fermentation of starch is given below

$$2(C_6H_{10}O_5)_{n(s)} + nH_2O \xrightarrow{\text{diastase}} \underset{\text{maltose}}{n\,C_{12}H_{22}O_{11(aq)}}$$

$$C_{12}H_{22}O_{11}(aq) + H_2O \xrightarrow{\text{maltase}} \underset{\text{Glucose}}{2C_6H_{12}O_{6(aq)}}$$

$$C_6H_{12}O_{6(aq)} \xrightarrow{\text{zymase}} \underset{\text{Ethanol}}{2C_2H_5OH(aq) + 2CO_2}$$

38.



No of mole of 2-methylbuta-1, 3-diene $= \frac{\text{Reacting mass}}{\text{molar mass}} = \frac{60}{68\text{g/mol}}$

$= 0.0882\text{mol}$

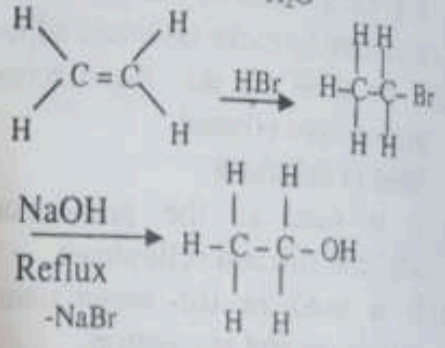
No of mole of bromine

$= 2 \times 0.0882 = 0.1765\text{mole}$

Mass of bromine

$= 0.1765 \times 160 = 28.2353\text{g}$

39. $CH_3CH_2OH \xrightarrow[\text{excess conc } H_2SO_4,\ -H_2O]{180^0C}$



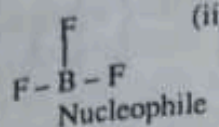
Y → ethene Z → 1-bromoethene and K → ethanol.

40. Octane rating =

$$\frac{\text{mass of 2,2,4 - trimethylpentene}}{\text{mass of mixture of 2,2,4 trimethylpentene + n heptane}} \times \frac{100}{1}$$

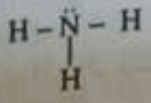
$$= \frac{55g}{100g} \times \frac{100}{1} = 55\%$$

41. Electrophile

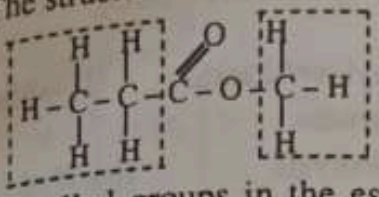
(i) 

Nucleophile

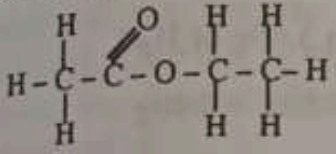
(ii) $\overset{\partial+}{Br} - \overset{\partial-}{Br}$



42. The structure of methylpropanoate is



The alkyl groups in the ester are shown above by marked line. When the alkyl groups are interchange the compound obtained is shown below;



The compound above is ethyl ethanoate.

43. The major factors that determine the boiling point or volatility of an organic compound are listed and explained below.

(a) **Intermolecular forces.** The greater the intermolecular forces that exist when an organic compound the greater the boiling point but the lesser the volatility. The intermolecular forces that exist with an organic compound are in the order.

Hydrogen bonding > Dipole-dipole interaction > dipole-induce-dipole interaction.

Hydrogen bonding exist in the Alkanoic acids, Alkanols, amines etc. it stronger in Alkanoic acid and least in amines. Dipole-dipole interactions occur in alkylhalides, ether (alkoxyalkane) etc while dipole-induced dipole interactions occur in Alkanes.If intermolecular force is the same, then organic compounds will be classify on the basis of relative molecular mass

(b) **Relative molecular mass:** The greater the relative molecular mass of an organic compound in the same homologous series the greater the boiling point the less the volatility. If relative molecular mass is the same, then organic compounds will be classify on the basis of degree of branching

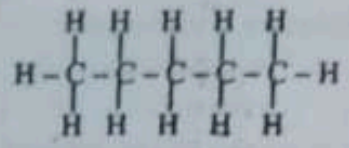
(c) **Degree of branching**: The greater the degree of branching the lesser the boiling points but the greater the volatility.

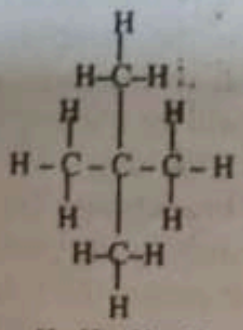
Hence in classifying an organic compound base on boiling point or volatility, the first thing to consider is the intermolecular force. If the intermolecular forces are not the same the compound is classified base on the type of intermolecular forces that exist within them. But if intermolecular force is the same then the compounds are classified base on their relative molecular mass. But if the relative molecular mass is the same then the compound are classified base on their degree of branching.

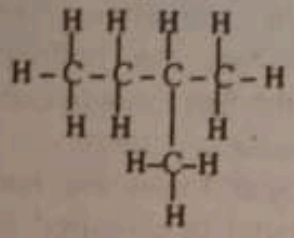
Since the intermolecular force in the compound is the same, because the entire compound is in the same homologous series, the classification is base on relative molecular mass and degree of branching. This is shown below;

i. The compound with the highest relative molecular mass (i.e. $CH_3(CH_2)_4 CH_3$) will have the highest boiling point.

ii. $CH_3(CH_2)_3CH_3CH_3C(CH_3)_3$ and $CH_3 CH_2CH(CH_3)$ are isomers, (i.e. their relative molecular mass is the same) hence they are classified base on degree of branching. The degree of branching means the number of branched chain each of the compounds contains. To obtain it draw the structure of the compound as shown below;

A. 

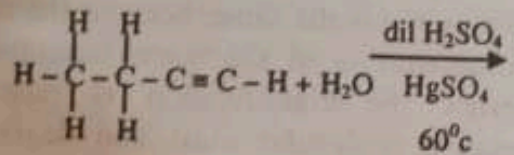
B. 

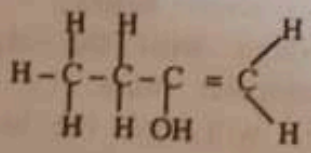
C. 

Hence the degrees of branching in A, B & C are 0, 2 & 1 respectively. So A will have the highest boiling point followed by C least by B.

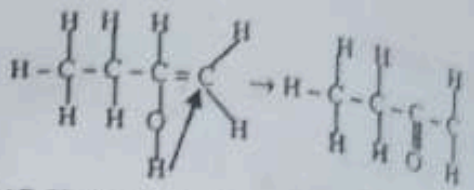
Hence the order of boiling point of the compound is shown below;

$CH_3(CH_2)_4CH_3 > CH_3(CH_2)_3CH_3 > CH_3CH_2CH(CH_3)_2 > CH_3C(CH_3)_3$.

44. 



The compound formed contains the –OH group and the double bond. Hence it called ENOL. Enol are unstable, they undergo rearrangement to form either Alkanal or Alkanone. In the re-arrangement of enol, the hydrogen atom attached to the –OH group is relative to join the other carbon bearing the double bond and the double bond moves to the oxygen atom.



45. $2(C_6H_{10}O_5)n + nH_2O \xrightarrow{\text{amylase}} nC_{12}H_{22}O_{11}$ maltose

$C_{12}H_{22}O_{11} + H_2O \xrightarrow{\text{maltase}} 2C_6H_{12}O_6$ Glucose

$C_6H_{12}O_6 \xrightarrow{\text{zymase}} 2C_2H_5OH + 2CO_2$

Hence

a. I→Amylase/diastase II→Maltase
III→zymase

b. I→hydrolysis II→Hydrolysis
III→Decomposition

46. Mass of C in 8.80g of CO_2

$$= \frac{12}{44} \times 8.80g = 2.40g$$

Mass of H in 3.60g of H_2O

$$= \frac{2}{18} \times 3.60g = 0.40g$$

C	:	H
$\frac{2.4}{12}$	:	$\frac{0.4}{1}$
0.2	:	0.4
1	:	2

The empirical formula of the hydrocarbon is CH_2

47. Ammoniacal silver oxide is called Tollen's reagent. It is used to differentiate Alkanal from Alkanone and terminal Alkyne from non-terminal Alkyne. The reaction of Ammoniacal silver oxide $[Ag(NH_2)^+_2]$ with Alkanal is shown below;

$CH_3CHO + 2Ag(NH_2)_2^+ + 3OH^- \rightarrow 2Ag + CH_3COO^- + 4NH_3 + 2H_2O$

Silver mirror

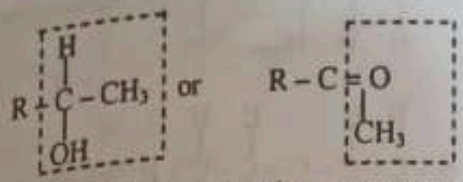
Hence Ammoniacal silver oxide will react with butanal and but-1-yne. Note that it is Ammoniacal silver nitrate that will react with terminal Alkyne.

48. An organic compound that gives a steamy white fume with PCl_5 or $SOCl_2$ is either an Alkanoic acid or Alkanol.

$ROH + PCl_5 \rightarrow RCl + POCl_3 + HCl$ (White fume)

$RCOOH + PCl_5 \rightarrow CH_3COCl + POCl_3 + HCl$ (White fume)

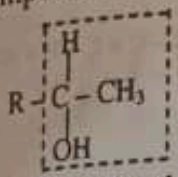
A compound that gives a positive Iodoform test contains the functionality.



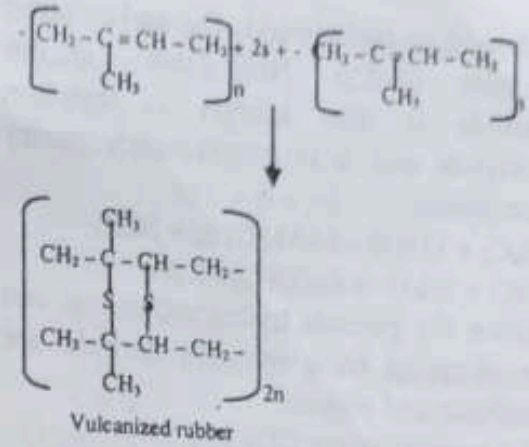
Where R is either an hydrogen atom,alkyl group or aryl group

Note that ethanoic acid does not undergo Iodoform test because it has a false carbonyl group due to resonance.

Hence the functionality present in the compound is



48. **Vulcanization** is the process of heating sulphur with rubber under pressure in order to toughen it. It was discovered by Charles Goodyear. The sulphur adds to the double bond by breaking then to form carbon-carbon and carbon-sulphur cross link covalent bonds.



Vulcanized rubber

Hence the function of sulphur in vulcanization of rubber is that, it converts the double bonds in the rubber to single bond thereby toughening it.

50. The general formula of esters or Alkanoate can be written in the form $RCOOR^1$ or $R^1O.COR$. In any ways it is written,R^1O represent the Alkanol part while –COR represent the acid part. The Alkanol part must be name first,follow by the acid part.Both part are name base on the number of carbon atom they contained. In $CH_3O.COCH_2CH_3$. The Alkanol part is CH_3O – (i.e. methyl group) white the Alkanoic acid part is – $COCH_2CH_3$ (i.e. propyl group) hence the IUPAC nomenclature is methylpropanoate.

51. **PVC** means polyvinyl chloride. It is a polymer of chloroethene (vinyl chloride) formed by the polymerization of vinyl chloride. Hence the monomeric unit (or the monomer) of polyvinylchloride (PVC) is chloroethene (or vinyl chloride).It uses are given below;
    i. It is used in making plastic bottles for chemical and oil
    ii. It is used in making rain coat and caps &
    iii. It is used in making plastics pipes.

52. All Alkanoate are made up of two component which is the Alkanol component represented by –RCO-

53. Metallic carbides are binary compounds that contain a metal and carbon e.g.

Aluminium carbide (AL_4C_3) and calcium carbide (CaC_2). Note that calcium carbide is also known as calcium acetylide and it is a non-stoichiometry compound

$Al_4C_3 + 12H_2O \rightarrow 4AL(OH)_3 + 3CH_4$

$CaC_2 + 2H_2O \rightarrow Ca(OH)_2 + C_2H_2$

Hence the gaseous hydrocarbon that can be obtained from metallic carbide are methane and ethyne.

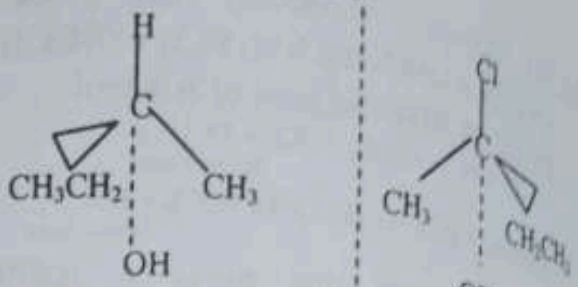
54. The impurities are CO_2 and SO_2
55. By washing with cold Alkaline solution
56. $Ca(OH)_2 + NaOH \rightarrow$ sodalime
57. Already scores.
58. $CH_3CH_2OH \xrightarrow[\text{warm}]{K_2Cr_2O_7/H^+} CH_3CHO$
59. $CH_3CH_2OH \xrightarrow[\text{warm}]{K_2Cr_2O_7/H^+} CH_3COOH$
60. The impurity in the preparation of ethane is SO_2 and CO_2 which are removed by washing with hot concentration NaOH solution.
61. a. In positional isomers, the longest chain is not altered but the position occupied by the functional group or branched chain is altered. Hence $CH_3CH_2CH(OH)CH_3$ is a position of isomer of $CH_3CH_2CH_2CH_2OH$.

b. Alkanol/Ether; Alkanoic acid/Ester and Alkanal/Alkanone are functional isomers. Hence $CH_3CH_2CH_2.O.CH_3$ (ether) is a functional isomers of $CH_3CH_2CH_2CH_2OH$ and $CH_3CH_2CH(OH)CH_3$

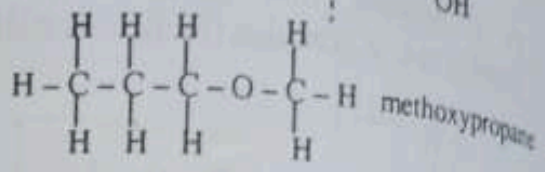
c. In chain isomers the position of the functional group remain the same but the longest carbon chain is re-arranged. Hence $CH_3CH(CH_3)CH_2OH$ is chain isomers of $CH_3CH_2CH_2CH_2OH$.

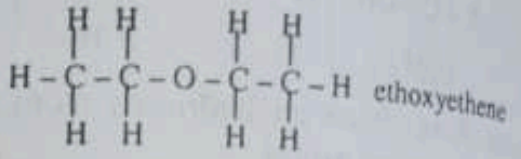
d. For a compound to exhibit optical isomerism it must have a chiral centre i.e. a carbon atom surrounded by four different groups e.g.

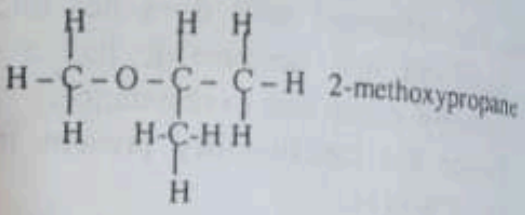
$CH_3CH_2CH(OH)CH_3$.



62.







63. $H-C\equiv C-H + HBr \rightarrow H-\underset{Br}{C}=\underset{H}{C}-H + HBr$

$\rightarrow Br-\underset{H}{\overset{Br}{C}}-\underset{H}{\overset{H}{C}}-H$

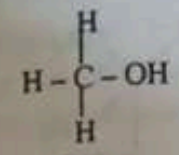
64. R_f value decrease with increase in intermolecular forces. The higher the degree of hydrogen bonding the higher the intermolecular force.

$PhCH(OH)CH(OH)Ph > PhCH(OH)CH_2Ph > PhCOCH_2Ph > PhCH_2CH_2Ph$

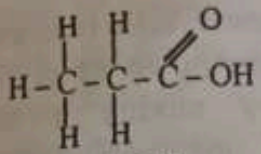
65. i. It form a loose bond
ii. It easily sublime
iii. It is coloured reddish brown
iv. It has empty d-orbitals

66. $CH_3.O.COCH_2CH_3 + H_2O \xrightarrow[\text{dil HCl}]{\text{reflux}}$

$CH_3OH + CH_3CH_2COOH$

X → 

Methanol

Y → 

Propanoic acid

Note that methanol is also known as carbinol or wood spirit.

67. i. Trichloromethene is use as anaethetic
ii. Trichloromethane is used as germicide
iii. Tetachloromethane is used as a solvent.

68.a $H-C\equiv C-H + Na \xrightarrow{Liq.NH_3}$

$H-C\equiv C-Na + \frac{1}{2}H_2$

$H-C\equiv C-Na + CH_3I \longrightarrow$

$H-C\equiv C-CH_3 + NaI$

propyne

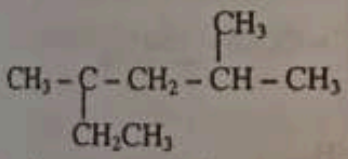
b. $H-C\equiv C-H + 2Na \xrightarrow{Liq.NH_3}$

$Na-C\equiv C-Na + H_2$

$Na-C\equiv C-Na + 2CH_3I \longrightarrow$

$CH_3-C\equiv C-CH_3 + 2NaI$

but-2-yne

69a. 

b. The longest chain contains 6 carbon atoms. Hence the parent Alkane is hexane.

ii. There are two methyl group attached to carbon 2 and 4. Hence the substituent name is 2, 4-dimethyl.

iii. The IUPAC nomenclature is 2,4-dimethylhexane.

71. $\cap_H = \frac{\text{Reacting mass}}{\text{molar mass}} = \frac{6g}{1g/mol} = 6mol$

Let the hydrocarbon be represented as C_xH_y but $y = 6$.

$\Rightarrow C_xH_y = C_xH_6$

R.m.m. of $C_xH_6 = 54$

$12x + 6 = 54$

$12x = 54 - 6 = 48$

$x = 48/12 = 4$

$C_xH_6 = C_4H_6$

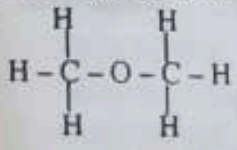
$\therefore$ The formula of the hydrocarbon is C_4H_6

a. Organic reaction is slow due to the reluctances in breaking covalent carbon to carbon covelent bond.

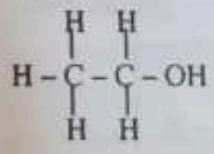
b. Organic compound are volatile because of the weak intermolecular force that exist within them.

c. The consequence of the slowness of organic reaction is that energy must be supply in the form of catalyst or heat. The consequence of the volatility of organic compound is that organic reaction is usually refluxed. Reflux means condensation in vertical position.

72. Isomers with different physical and chemical properties are in different homologous series.

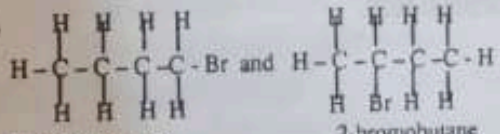
 and

methoxymethene



ethanol

Isomers with different physical or chemical properties are in the series homologous series.

e.g. 

1-bromopropane 2-bromobutane

73a. Since the organic compound contains only one oxygen atom; it can either be an Alkanol, ether, Alkanal or Alkanone. If it

satisfy the formula $C_nH_{2n+1}OH$. It is either an Alkanol or ether but if it satisfy the formula $C_nH_{2n+1}CHO$ is either an Alkanal or Alkanone.

$C_5H_{12}O$ satisfy the general formula $C_nH_{2n+1}OH$. Hence the compound belongs to the Alkanol or ether homologous series.

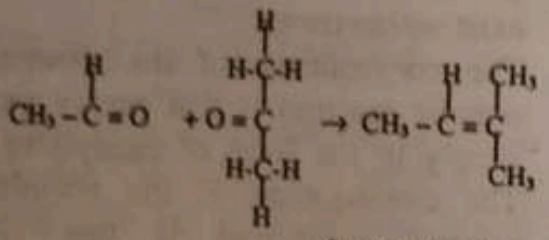
b. Alkanol gives a steamy white fume with PCl_5. hence A is an Alkanol.

$CH_3(CH_2)_3CH_2OH + PCl_5 \rightarrow$

$CH_3(CH_2)_3CH_2Cl + POCl_3 + HCl$

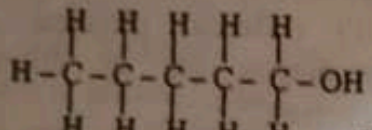
The functional group present in the compound is –OH.

c.

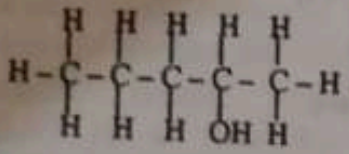


2-methylbut-2-ene

d.

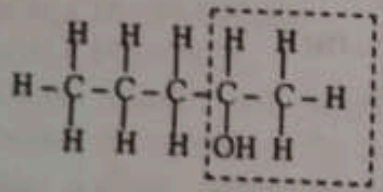


pentan-1-oL



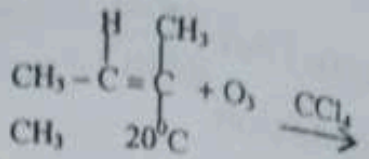
pentan-2-oL

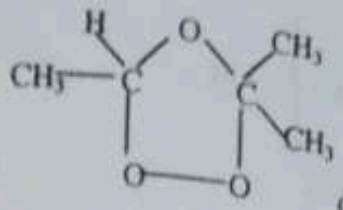
e.



An Alkanol with the marked functionality will give a positive Iodoform test.

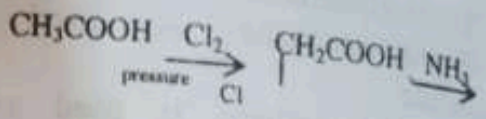
f.

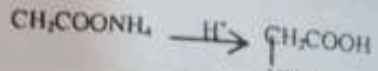




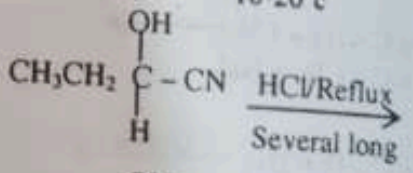
ozonide

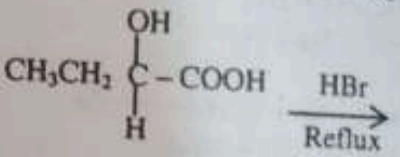
74. Amino ethanoic acid (i.e. amino acetic acid) is also known as glycerine. It is prepared by mixing a concentrated solution of mono-chloroethanoic acid ($ClCH_2COOH$) with concentrated ammonia solution and the mixture is to stand for 24hrs or by heat the mixture under pressure.

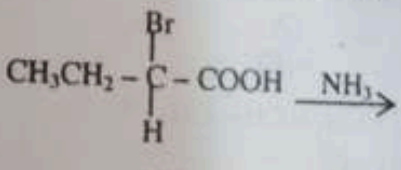


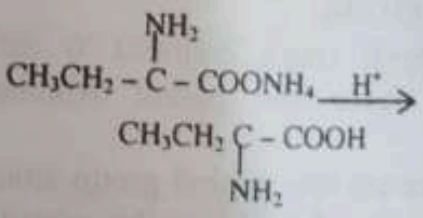


75. $CH_3CH_2CHO \xrightarrow[10\text{-}20^oc]{KCN/dil\ H_2SO_4}$









2-aminobutanoic acid

76.a. $H_2NCH_2COOH + NaOH \rightarrow H_2NCH_2COONa + H_2O$

b. $H_2NCH_2COOH + HCl \rightarrow ClH_3NCH_2COOH$

c. $H_2NCH_2COOH + HNO_2 \rightarrow HOCH_2COOH + N_2 + H_2O$

$CH_3COCl + H_2NCH_2COOH \rightarrow CH_3CONHCH_2COOH + HCl$

INORGANIC QUESTION

(1) Explain why metals form few compounds with hydrogen.

(2) With the aid of balanced equations, show the behaviour of each of the following with sodium hydroxide solution.
(a) Zinc (b) Aluminium (c) Silicon.
In each case, give the names of the products formed.

(3) Discuss the industrial preparation of hydrogen by the action of steam on coke.

(4) With the aid of equations, discuss the preparation of oxygen from each of the following compounds.
(a) Sodium trioxonitrate (V)
(b) Potassium trioxochlorate (V)
(c) Lead (II) trioxonitrate(V).
You should indicate any catalyst used as well as any special method of obtaining pure oxygen from the product(s) of the reaction.

(5) Classify the following oxides as (a) Basic oxides (b) Acidic oxides (c) Amphoteric oxides (d) Neutral oxides.
Where possible, give and equation to support your classification.
(i) Aluminium oxide (ii) copper (II) oxide (iii) nitrogen (II) oxide (iv) sulphur (IV) oxide.

(6) when air, which contains Nitrogen, carbon (IV) oxide, water vapour and rare gases is passed through alkaline pyrogallol, what products will be left in the residual gas.

(7) A solid substances is burned in oxygen. The gaseous product is successively passed through (a) Limewater, which turned milky (b) white anhydrous copper (II)tetraoxosulphate (VI) which turns blue.
What can you definitely conclude as being present in the gaseous products?

(8) Give account of the chemical value of the solvent properties of water.

(9) Water is said to be hard when it contains calcium ions from calcium tetraoxosulphate (IV). You are expected to trace the origin of these ions in any natural water.

(10) Discuss the various methods for removing hardness in water. Where possible, you should back up your discussions with chemical equations. Indicate which of these methods will remove both temporary and permanent hardness in water.

(11) Give and account of (i) advantages and (ii) disadvantage of (a) Soft water (b) hard water.

(12) Mention the use of (a) alum (b) chlorine (c) lime (d) iodine (e) Fluoride
In the treatment of water for town supply.

(13) Write equations for the preparations of chlorine from conc. HCl by oxidizing with (a) MnO_2 and (b)$KMnO_4$
Which of the two methods is more convenient, why?

(14) What do you observe when a mixture of solid sodium chloride, solid MnO_2 and conc. H_2SO_4 is heated in a test tube. Give the equation(s) leading to this observation.

(15) Give the equation for the bleaching action of chlorine.

(16) What do you observe when chlorine is pass into an aqueous solution of potassium iodide. Give the equation leading to this observation.

(17) Write equation(s) to show how and under what conditions chlorine will react with sodium hydroxide.

(18) In the flame test for metal ions, the solid substance is usually mixed with conc. HCl before the test is carried out. Why is this step necessary?

(19) Give the usual dry and wet tests and observations for ionic chlorides.

(20) Give the different allotropes of carbon together with their uses.

(21) Give the equations for the production of
(a) Water gas and (b) Producer gas

(22) Quote and equation in each case to show (a) reducing and (b) oxidizing property of sulphur (IV) oxide.

(23) (a) Give the necessary equations for the bleaching action of SO_2.(b)Explain why straw bleaches by SO_2 return to its original colour on exposure to the atmosphere

(24) (a) Discuss the industrial preparation of H_2SO_4.
(b) Explain why SO_3 is not usually absorbed by water during this synthesis.

(25) What do you observe when hydrogen sulphide is pass into conc.H_2SO_4. Give and equation for the reaction taking place.

(26) How would you test for sulphide in the laboratory?

(27) Nitrogen can be prepared by heating a mixture of aqueous solutions of $NaNO_2$ and NH_4Cl. Give the necessary equation(s) for the formation of nitrogen from this equation.

(28) Write an equation for the preparation of ammonia in the laboratory. What do you use as a drying agent for the gas? Why cannot you use common drying agents like c.H_2SO_4 or fused $CaCl_2$?

(29) Write the necessary equation for each of the following operations.
(a) Burning of ammonia in oxygen
(b) Reaction of NH_3 with excess air in the presence of platinum catalyst.
(c) Reaction of excess NH_3 with chlorine.
(d) Reaction between ammonia and heated CuO

(30) Give the equations involved in the catalytic oxidation of NH_3 to NO_2 and HNO_3.

(31) (a) Write the necessary equations for the laboratory preparation of HNO_3.
(b) Comment or explain each of the following.
(i) All glass apparatus must be used during the preparation
(ii) Upon cooling, the HNO_3 obtained is coloured yellow.

(32) Give the equation for the oxidizing ability of HNO_3 on
(i) Carbon (ii) Copper (iii) H_2S

(33) Give four uses of HNO_3.

(34) (a) Give the (i) dry and (ii) wet test for NO_3^-.
(b) Indicate all observations during the test.
(c) Explain why the addition of copper turnings produces intensified fumes.

(35) Give all the necessary equations for the production of the brown ring in the brown ring test for NO_3^-.

(36) Write equation(s) to show how N_2O can be prepared in the laboratory. Indicate any necessary precaution that is taken during the preparation.

(37) (a) Name the ore from which aluminium is extracted.
(b) What preliminary tidy up is carried out before the extraction?
(c) Briefly discuss the extraction.

(38) Give the characteristics of the transition metals.

(39) List three consequences of the green "house" effect.

SOLUTION TO INORGANIC PRACTICE QUESTIONS

1. Metals form few compounds with hydrogen because hydrogen forms compounds mostly readily by covalency or in acids by loss of electrons. Neither of these two is well suited to metals.

2(a) $Zn + 2NaOH + 2H_2O \rightarrow Na_2Zn(OH)_4 + H_2$
Sodium tetra hydroxozincate (II)

(b) $2Al + 2NaOH + 6H_2O \rightarrow 2NaAl(OH)_4 + 3H_2$
Sodium tetra hydroxoaluminate (III)

(c) $Si + 2NaOH + H_2O \rightarrow Na_2SiO_3 + 2H_2$
Sodium trioxosilicate (IV)

3. The industrial preparation of hydrogen by the action of steam on coke is known as Bosch process/reaction.

$H_2O_{(g)} + C_{(s)} \rightarrow CO_{(g)} + H_{2(g)}$

$H_2O_{(g)} + CO_{(s)} \rightarrow CO_{2(g)} + H_{2(g)}$

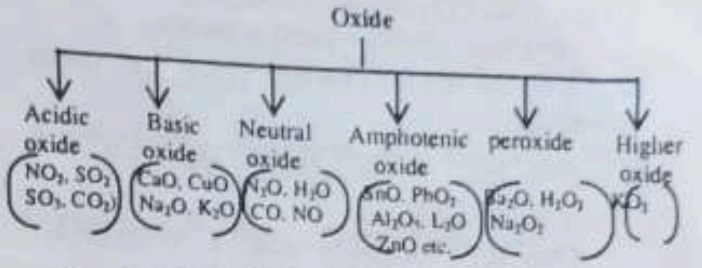
Under pressure the CO_2 formed is dissolved in water or absorb by hot concentrated KOH or NaOH leaving behind pure hydrogen gas.

Note that a mixture of $CO_{(g)}$ and $H_{2(g)}$ is known as water gas.Therefore water gas is gas that contain CO and H_2in the ratio of 1:1.Water gas is often confuse with synthesis gas.The reason is that both water gas and synthesis gas are made of CO and H_2.Synthesis gas is a gas that is made up of CO and H_2 in the ratio of 1:3 when steam is pass through methane

4. Preparation of O_2
   a. From $NaNO_3$
   $2NaNO_3 \xrightarrow{\Delta} 2NaNO_2 + O_2$
   b. From $KClO_3$
   $2KClO_3 \xrightarrow[\Delta]{MnO_2} 2KCl + 3O_2$
   c. From $Pb(NO_3)_2$
   $2Pb(NO_3)_2 \xrightarrow{\Delta} 2PbO + 4NO_3 + O_2$

The gaseous products NO_2 and O_2 are passed through a u-tube cooled in ice. The NO_2 (b.p. 21^0C) condenses, so that O_2 can be collected as the only gaseous products.

5.



   a. Basic oxides: Copper (II) oxide
   b. Acidic oxides: SO_2
   c. Amphoteric: Aluminium oxide
   d. Neutral oxides: Nitrogen (II) oxide.

6. Akaline and pyrogallol (Benzene-1,2,3-triol) are two distinct compound.
   Akaline absorb CO_2 and Pyrogallol(Benzene-1,2,3-triol) absorb O_2.Hence Akaline pyrogallol absorb CO_2 and O_2.The residual gas will be nitrogen, water vapour and the noble gases.

7. CO_2 turns limewater milky
   H_2O turns white anhydrous($CuSO_4$ blue)
   The gaseous product contains CO_2 and H_2O

8. Water is a universal solvent because it is polar.As a result, all polar substances dissolve in it.

9. Origin of $CaSO_4$
   It is present because many rocks and soils contain hydrated $CaSO_4$ which is slightly soluble in water.
   Origin of $Ca(HCO_3)_2$
   It is present, because water which contains CO_2 is capable of very slowly dissolving $CaCO_3$ in soils over which it flows.
   $CaCO_3 + H_2O + CO_2 \rightarrow Ca(HCO_3)_2$

10. Removal of hardness of water
    i. Boiling/heating (only temporary hardness of water)
    $Ca(HCO_3)_2 \rightarrow CaCO_3 + H_2O + CO_2$
    ii. Addition of calculated quantity of $Ca(OH)_2$ (only temporary hardness of water).
    $Ca(HCO_3)_2 + Ca(OH)_2 \rightarrow 2CaCO_3 + 2H_2O$
    iii. Distillation (removes both)
    (iv) Addition of Na_2CO_3

$CaSO_4 + Na_2CO_3 \rightarrow CaCO_3 + Na_2SO_4$

$Ca(HCO_3)_2 + Na_2CO_3 \rightarrow CaCO_3 + 2NaHCO_3$

v. Use of ion-exchange resin (removes both)

$(Na^+)_2Y^{2-} + Ca^{2+}(HCO^-_3)_2 \rightarrow Ca^{2+}Y^{2-} + 2NaHCO_3$

$(Na^+)_2Y^{2-} + CaSO_4 \rightarrow Ca^{2+}Y^{2-} + NaHSO_4$

11. Already solved

12. a. Alum: coagulation of impurities
    b. Chlorine: killing of germs
    c. Lime: P^H correction
    d. Iodine: Prevent goitre
    e. Fluorine: Prevent tooth decay

13. a. $MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$
    b. $2KMnO_4 + 16HCl \rightarrow 2KCl + 2MnCl_2 + 8H_2O + 5Cl_2$

    The preparation of Cl_2 from $KMnO_4$ is more convenient because it takes place in the cold and needs no heating.

14. $2NaCl + MnO_2 + 2H_2SO_4 \rightarrow Na_2SO_4 + MnSO_4 + 2H_2O + Cl_2$

    Observation: Hydrogen chloride gas is produced and it's oxidized immediately by MnO_2

    Greenish-yellow gas with a choking, irritating and unpleasant smell is observed.

15. Bleaching action of Cl_2

    Cl_2 reacts with H_2O forming oxochlorate (1) acid.

    $Cl_2 + H_2O \rightarrow HOCl + HCl$

    $Dye + HOCl \rightarrow HCl + (dye + O)$

    colourless

16. $Cl_2 + 2KI \rightarrow 2KCl + I_2$

    Observation: a violent colour of I_2 is observed indicating that Iodine has been displaced from its salt by chlorine

17. Cold/dilute NaOH

    $Cl_2 + 2NaOH \rightarrow NaCl + NaClO + H_2O$

    Hot/conc NaOH

    $3Cl_2 + 6NaOH \rightarrow NaCl + NaClO_3 + H_2O$

18. The solid substance is mixed with conc. HCl before flame test to suppress the interference or prevent the interaction of other ions during the test. This to make the test to be more specific, more accurate and error free.

19. (a) Dry tests for ionic chlorides

    (i) $Cl^- + conc.\ H_2SO_4 \rightarrow HCl_{(g)}$

    Colourless
    Irritating fumes
    Turns blue
    litmus red

    (ii) $Cl^- + conc.\ H_2SO_4$ and $MnO_2 \rightarrow Cl_2$

    greenish yellow, bleaches damp litmus paper

    (b) Wet tests for ionic Cl^-

    (i) Acidify the Cl^- with HNO_3

    (ii) $Cl^- + AgNO_3 \rightarrow AgCl_{(s)}$

20. Allotropes of C

    1. **Diamond**: manufacture of glass cutters
    2. **Graphite**: good conductor of electricity
    3. **Wood charcoal**: as fuel and absorbent for gases
    4. **Animal charcoal**: used for decolorizing sugar.
    5. **Lamp black**: making printer's ink

21. (a) Water gas and Producer gas

$$C + H_2O \longrightarrow \underbrace{CO + H_2O}_{\text{Water gas}}$$

Producer gas

$$C + \underbrace{O_2 + 4N_2}_{\text{air}} \rightarrow CO_2 + 4N_2$$

$$+ C$$

$$\underbrace{2CO + 4N_2}_{\text{Producer gas}}$$

22. SO_2

    1. Reducing property

    $2MnO_4^- + 6H^+ + 5SO_3^{2-} \rightarrow 2Mn^{2+} + 3H_2O + 5SO_4^{2-}$ because

    ii. Oxidizing property

    $SO_2 + 2H_2S \rightarrow 2H_2O + 3S$

23. a. Bleaching action of SO_2

    $SO_2 + H_2O \rightarrow H_2SO_3$

    $H_2SO_3 + Dye \rightarrow H_2SO_4 + bleached\ dye$

    Coloured colourless

    b. Straw that's bleached by SO_2 usually goes back to the original colours upon exposure to air. Because the

bleaching action of SO_2 is by reduction. Upon exposure to air they are oxidized back to their original colours by atmospheric oxygen.

24. Industrial preparation of H_2SO_4

Contact process

a. Sulphur is burned in a stream of air to obtain SO_2

$S + O_2 \rightarrow SO_2$

b. SO_2 is purified and made to react with excess air (dried by passage through conc. H_2SO_4) at a temperature range $450 - 500^0C$ over V_2O_5 catalyst to produce SO_3.

c. SO_3 is absorbed into conc. H_2SO_4 to form Oleum $H_2S_2O_7$

d. Oleum is diluted with water to produce H_2SO_4

i. $S + O_2 \rightarrow SO_2$

ii. $2SO_2 + O_2 \xrightarrow{V_2O_5} 2SO_3$

iii. $SO_3 + H_2SO_4 \rightarrow H_2S_2O_7$

iv. $H_2S_2O_7 + H_2O \rightarrow 2H_2SO_4$

Precaution:

a. The H_2SO_2 formed is not dissolve directly in water because the reaction is violently exothermic.

b. SO_3 reacts vigorously with water, evolving a large amount of heat and forming H_2SO_4. The SO_3 reacts with water vapour and causes the formation of a dense mist of H_2SO_4 droplets which are difficult to condense and pass out of the absorber into the atmosphere.

25. A yellow deposit of S will be observed together with the liberation of a colourless, irritating and choking smell gas (SO_2) which turns blue litmus paper red.

$H_2S + H_2SO_4 \rightarrow SO_2 + 2H_2O + S_{(s)}$

26. Test for S^{2-}

i. Add dilute HCl or H_2SO_4 to the solution

ii. Colourless gas with rotten egg smell is evolved

iii. Add $(CH_3COO)_2Pb$ paper turns dark brown.

iv. Add $KMnO_4$ paper → turned brownish black.

27. $NaNO_2 + NH_4Cl \rightarrow NH_4NO_2 + NaCl$

$NH_4NO_2 \rightarrow N_2 + 2H_2O$

28. $Ca(OH)_2 + 2NH_4Cl \rightarrow CaCl_2 + 2H_2O + 2NH_3$

The drying agent used is quickline (CaO)

Conc H_2SO_4& $CaCl_2$ are not used because NH_3 reacts with them.

$H_2SO_4 + 2NH_3 \rightarrow (NH_4)_2SO_4$

$CaCl_2 + 4NH_3 \rightarrow CaCl_2.4NH_3$.

29. a. $4NH_3 + 3O_2 \xrightarrow[\text{Limited air}]{} 6H_2 + 2N_2$

b. $4NH_3 + 5O_2 \xrightarrow[\text{excess air}]{} 6H_2O + 4NO$

$4NO + 2O_2 \rightarrow 4NO_2$

$4NH_3 + 7O_2 \xrightarrow[\text{excess air}]{} 6H_2O + 4NO_2$

c. $2NH_3 + 3Cl_2 \rightarrow 6HCl + N_2$ (Excess)

$6HCl + 6NH_3 \rightarrow 6NH_4Cl$

But if the Cl_2 is in excess Ncl_3 will be form

$NH_3 + 3Cl_2 \rightarrow 3HCl + NCl_3$ (Excess)

d. $2NH_3 + 3CuO \rightarrow 3Cu + 3H_2O$

30. a. $4NH_3 + 5O_2 \xrightarrow[catalyst]{pt\ /\ Rhodium} 4NO + 6H_2O$

b. $2NO + O_2 \rightarrow 2NO_2$

c. $4NO_2 + O_2 + 2H_2O \rightarrow 4HNO_3$

31. a. Laboratory preparation of HNO_3

$H_2SO_4 + KNO_3 \rightarrow KHSO_4 + HNO_3$

bi. All glass apparatus must be used because trioxonitrate (V) acid vapour attacks rubber or cork.

ii. Upon cooling, the HNO_3 produced is coloured yellow because of slight decomposition of HNO_3

$4HNO_3 \rightarrow 2H_2O + 4NO_2 + O_2$

NO_2 dissolves in HNO_3 to give the yellow colour.

32. i. $C + 4HNO_3 \rightarrow CO_2 + 2H_2O + 4NO_2$

ii. $3Cu + 8HNO_3 \xrightarrow[\text{dilute}]{} 3Cu(NO_3)_2 + 4H_2O + 2NO$

$Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2H_2O + 2NO_2$
conc.

iii. $H_2S + 2HNO_3 \rightarrow S + 2H_2O + 2NO_2$

33. uses of HNO_3
   i. as fertilizers & dyes
   ii. manufacture of explosives e.g. trinitrotoluene.
   iii. as nitrating agent for the introduction of the nitro group.
   iv. as rocket fuel.

34. ai. Dry test for NO_3^-
   i. conc. H_2SO_4 + dry solid
   ii. Heat to a high temperature

b. Observation: more volatile HNO_3 is liberated brown fumes are seen.

24. aii. The "Brown Ring" test is a confirmatory test for trioxonitrate V ion NO_3^-. In this test, a freshly prepared iron II tetraoxosulphate VI, $FeSO_4$ solution [$FeSO_4$ must be freshly prepared to prevent it oxidation into $Fe_2(SO_4)_3$] is added to about $1cm^3$ of the solution. The test tube bearing the solution is then slant/or place in a slanting position) and a few drops of concentrated H_2SO_4 is then added along the side of the test tube. The formulation of a brown ring of $FeSO_4.NO$ complex between the junction of the acid and solution confirm the presence of NO_3^-. The formulation of the brown ring is shown below.

(vi) Acidify the nitrate solution with conc. H_2SO_4

$$2Zn(NO_3)_2 + 2H_2SO_4 \rightarrow 2ZnSO_4 + 4HNO_3$$

(vii) The freshly prepared $FeSO_4$ combine with the conc H_2SO_4

$$4FeSO_4 + 2H_2SO_4 \rightarrow 2Fe_2(SO_4)_3 + 2H_2$$

(viii) The HNO_3 form decomposed to form NO

$$4HNO_3 \rightarrow 2H_2O + 3O_2 + 4NO$$

(ix) The NO form combine with both $Fe_2(SO_4)_3$ and H_2

$$Fe_2(SO_4)_3 + 2H_2 + 4NO \rightarrow 4[Fe(H_2O)_5NO]SO_4 + H_2SO_4$$

(x) The dissociation $[Fe(H_2O)_5NO]SO_4$ to $FeSO_4.NO$ form

$$[Fe(H_2O)_5NO]SO_4 \rightarrow FeSO_4.NO + 5H_2O$$

The $FeSO_4.NO$ is responsible for the brown ring.

So the order of the reaction of the brown ring test is that HNO_3 to form NO and then the formation of the brown ring, $FeSO_4.NO$

c. Addition of Cu burnings, intensified brown fumes because Cu reacts with HNO_3 to produce more NO_2

$Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$

35. $NO_3^- + H_2SO_4 \rightarrow HNO_3 + HSO_4^-$

$6FeSO_4 + 2HNO_3 + 3H_2SO_4 \rightarrow 3Fe_2(SO_4)_3 + 4H_2O + 2NO$

$FeSO_4 + NO \rightarrow FeSO_4.NO$

36. $(NH_4)_2SO_4 + 2KNO_3 \rightarrow 2NH_4NO_3 + K_2SO_4$

$NH_4NO_3 \rightarrow N_2O + 2H_2O$

Precaution: NH_4NO_3 can explode on too much heating because it is thermally unstable.

37. a. Al is extracted from Bauxite
   b. The impurities must be removed before reducing the oxide because their presence could make the electrolytic reduction difficult.
   c. Extraction of Al
   i. Purification of bauxite

$Al_2O_3 + 2NaOH \rightarrow 2NaAlO_2 + H_2O$

$Al_2O_3 + 2NaOH + 3H_2O \rightarrow 2NaAl(OH)_4$

$NaAl(OH)_4 \rightarrow Al(OH)_3 + NaOH$

$2Al(OH)_3 \rightarrow Al_2O_3 + 3H_2O$

   ii. Electrolysis(Al_2O_3)

Cathode: $Al^{3+} + 3e^- \rightarrow Al_{(s)}$

Anode: $O^{2-} + 2e^- \rightarrow O$

$O + O \rightarrow O_2$

$4Al^{3+} + 6O^{2-} \rightarrow 4Al_{(s)} + 3O_2$

38. Characteristics of transitional metals.
   i. Complex ions formation e.g. $[Co(H_2O)_6]^{2+}$
   ii. coloured ions formation due to up paired d-electrons e.g. $FeCl_3$ – yellow
   iii. As catalyst because they can change their oxidation states.
   $2KClO_3 \xrightarrow[heat]{MnO_2} 2KCl + 3O_2$
   iv. Variable oxidation states e.g. Fe^{2+} & Fe^{3+}

39. Consequences of green house effect is global warming.The consequence of global warming are:
   i. It causes ice caps to melt
   ii. It brings about increase in land temperature and shortage of freshwater to grow crops.
   iii. It encourages spread of deserts.
   iv. It upsets our ecosystem & human lives.

TUTORIAL PERIOD 1

(Topics: Introduction to Organic Chemistry)

3a. Write the essential steps in an experimental method, which is used to determine the percentage by mass of carbon, and hydrogen in an organic compound. Indicate the necessary measurements and show How the percentage composition is calculated from these measurements: -

b. The molecular mass of an organic compound containing carbon, hydrogen and nitrogen was found to be 59. On combustion, 0.13g of the compound gave 0.29g of CO_2 and 0.18g of H_2O. 0.145g of the compound on suitable treatment gave 27.44cc of N_2 measured at S.T.P. Deduce the possible structures of the compound.

4a. 16cc of a gaseous hydrocarbon were mixed with 90cc of O_2. After explosion and cooling, the volume was 66cc. It was reduced to 34cc of residual O_2 by absorption by KOH solution. What is the molecular formula of the hydrocarbon?

Note that cc means centimetre cube(cm^3)

(b) Write balanced equations for the complete combustion in oxygen of the compounds:

(i) An Alkane (ii) an Alkyne each of which contain n-carbon atoms in their molecule. Equal volume of the two hydrocarbons were separately and completely combusted in oxygen. The volumes of steam produced in (i) and (ii) were in the ratio 2:1. Determine the value of "n"and hence the formulae for the Alkane and the Alkyne.

N.B: (All measurements were carried out at 120°C)

SOLUTION TO TUTORIAL PERIOD 1

3a. A known weight of the organic compound is combusted. The production of combustion is passed through a weighed tube containing $CaCl_2$ and then through a weighed tube containing concentrated solution of KOH. The KOH solution absorbs CO_2 while the $CaCl_2$ absorbs H_2O present in the combustion product. The differences in the weights of the tubes containing $CaCl_2$ and KOH give the weights of H_2O and CO_2 respectively present in the products of combustion.

CALCULATIONS

Let the weight of organic compound sample be xg

Let the weight of H_2O be yg and CO_2 be zg

weight of carbon in zg of CO_2 = 12/44 x z = 3z/11g

% of carbon in sample = $\left(\frac{3z}{11} \div x\right) \times 100 = \frac{27.27z}{x}\%$

Weight of hydrogen in sample = 2/188 x y = 2y/18 = y/9g

% of hydrogen in sample $= \left(\frac{y}{9} \div x\right) \times 100 = \frac{11.11y}{x}\%$

b. Molecular weight = 59 = M.W.

Mass of sample combusted, x = 0.13g

Mass of CO_2 produced, z = 0.29g

Mass of H_2O produced, y = 0.18g

$$\% \text{ of C} = \frac{3}{11} \times \frac{0.029g}{0.13g} \times 100\% = 60.84\%$$

$$\% \text{ of H} = \frac{1}{9} \times \frac{0.18g}{0.13g} \times 100\% = 15.38\%$$

0.145g of compound gave 27.44cc of N_2 at S.T.P (Note cc ≡ cm^3 and S.T.P ≡ 0^0c and 1 atom)

At S.T.P 22400cc of N_2 =1mole of N_2 gas = 28g of N_2

∴ 27.44cc of N_2 at STP =

$$\frac{28g}{22400cc} \times 27.44cc \text{ of } N_2$$

$= 0.0343g$ of N_2

% of nitrogen in sample =

$$\frac{0.0343g}{0.145g} \times 100\% = 23.66\%$$

Element	C	H	N_2
% composition	60.84	15.38	23.66
Atomic masses	12	1	28
Atomic ratios	5.07	15.38	0.845
	6	18.20	1
	6	18	1

The empirical formula is $C_6H_{18}N_2$. This reduces to C_3H_9N

$n(C_3H_{10}N) = 59$

$(3nx12) + (10nx1) + (nx28) = 59$

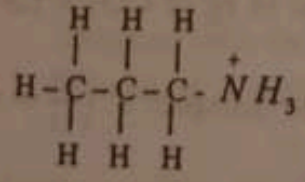
$36n + 10n + 14n = 59$

$59n = 5g$

$n = 59/59 = 1$

∴ The molecular formula is C_3H_9N

Possible structure is



4a. Assuming Avogadro's law and Gay-Lussac's law are both obeyed.

Equation for the reaction

$C_xH_y + (x + y/4)O_2 \longrightarrow xCO_2 + \frac{y}{2}H_2O$

Before reaction	16moles	90moles	-
After reaction	-	34moles	32moles (66-34)

From the balanced equation above

1 mole of C_xH_y gas gives x moles of CO_2 gas

∴ 16moles will give 16x moles of CO_2 gas

∴ 16x = 32, x = 32/16, x = 2

1 mole of C_xH_y gas requires $(2x+y/2)$ of O_2 gas

16 moles will require $16(2x+y/2)$ mole of CO_2

∴ $16(x + y/4) = 90-34 = 56$

$16x + 4y = 56$

$16(2) + 4y = 56$

$32 + 4y = 56$

$4y = 56-32 = 24$

$y = 24/4 = 6$

∴ The molecular formula of the compound is C_2H_6 (ethane)

bi. For alkane

$C_nH_{2n+2} + (3/2n + ½)\ O_2 \rightarrow nCO_2 + (n+1)H_2O$ or

$C_nH_{2n+2} + \left(\frac{3n+1}{2}\right)O_2 \rightarrow nCO_2 + (n+1)\ H_2O$

ii. For alkyne

$C_nH_{2n-2} + \left(\frac{3n+1}{2}\right)O_2 \rightarrow nCO_2 + (n+1)\ H_2O$

Using the Avogadro's law that equal volume of gases at the same T and P contains the same number of molecules.

$$\frac{(n+1)}{(n-1)} = \frac{2}{1} \Rightarrow 2(n-1) = n+1 \Rightarrow 2n-2=n+1$$

$2n - n = 1+2 = 3$, $n = 3$

The formula for the Alkane is $CH_3CH_2CH_3$ or C_3H_8 and for the Alkyne $CH \equiv CHCH_3$ or C_3H_4

TUTORIAL PERIOD 2

(Topics: Chemistry of Alkanes, Alkenes, Alkynes, types of reactions, Isomerism)

1a. What do you understand by the term isomerism? Illustrate your answer with examples.

b. Draw and name all the isomers of: (i) $C_4H_8O_7$ (ii) C_4H_8

c. Which of these following compounds would you except to exist as cis- and trans- isomers? Draw and name these isomers.

i. $CHCl=C=C=CH_2$
ii. $ClCH = CHCl$
iii. $CH_3C{\equiv}CCH_3$
iv. $C_2H_5C(CH_3)=CHCH_3$
v. $CH_3CH=CHCH_3$
vi. $HOOCCH=CHCOOH$

2a. How and under what conditions will propane react with chlorine? Discuss the mechanism of monochlorination of propane, showing all the steps in the reaction.

b. Three isomeric pentenes, X, Y and Z can be hydrogenated to yield 2-methylbutane. Addition of chlorine to Y gives1,2-dichloro-3-methylbutane, whereas 1,2-dichloro-2-methylbutane is obtained from the reaction of Z with chlorine. Write the structure formulae of the two dichloro derivatives and hence deduce the structural formulae of the three pentenes.

3. In the study of the chlorination of propane, four products A, B, C and D of formula $C_3H_6Cl_2$ were isolated. What are their possible structures? On further chlorination, A gives two trichloro products while C can be obtained in an optically active form. Deduce the structure of A, B, C and D.

4a. From the following list of compounds;

$CH_3CH=CHCH_3$, $CH_3CH_2CH_2CH_2OH$,
$CH_3CH_2OHCH_3$, $CH_3CH_2CH=CH_2$,
$CH_3CH_2CH(OH)CH_3$ $CH_3CH(CH_3)CH_2OH$

Select pairs of compounds that exhibit
(i) Functional group isomerism
(ii) Chain isomerism
(iii) Positional isomerism

b. From the list in. (a) select a compound in each case that can used to illustrate stereoisomerism.Draw the stereoisomers

5. Write the IUPAC names for:

(a) $CH_2=CHCH(CH_3)_2$

(b) $CH_3\text{-}CH_2\text{-}CH_2C(C_2H_5)_2$ with $CH=CH_2$ attached to the C

(c) $CH_3\text{-}C(CH_3)(CH(CH_3)\text{-}CH_3)\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}OH$
(printed as: CH₃ above; CH₃-C-CH₂-CH₂-CH₂-OH; H₃C-CH-CH₃ below)

(d) $CH_3\text{-}CH_2\text{-}CH_2\text{-}CH_3$

(e) $CH_3\text{-}CH_2CH=CHCH_3$

(f) $Cl\text{-}CH=CH\text{-}C\text{-}CH=CH\text{-}Cl$ with $=O$ on the central C

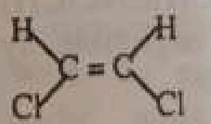
6. Write the structure of:
(i) 3-ethyl-2,5-dimethylhex-2-ene
(ii) 3-amino-2-chlorobutane
(iii) hex-5-ene-1-yne
(iv) 4 t-butyl-5-isopropyldecane
(v) 3-bromo-5-chloropent-3-ene-2-ol
(vi) 3-ethyl-2,5-dimethylhex-2-ene
(vii) 2-methoxy-3-heptanone
(viii) 2-ketopropanoic acid

SOLUTION TO TUTORIAL PERIOD 2

For 1a and 1b check solution to practice questions.

1c.i no cis-trans isomerism for $CHCl = C = C = CH_2$

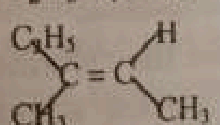
ii.

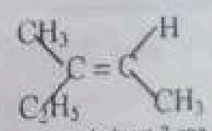

Cis-1,2-dichloroethane


trans-1-2-dichloroethane

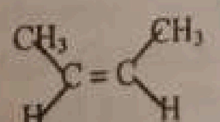
iii. $CH_3C{\equiv}CCH_3$ no Cis and trans isomerism

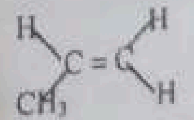
iv. $C_2H_5C(CH_3) = CHCH_3$

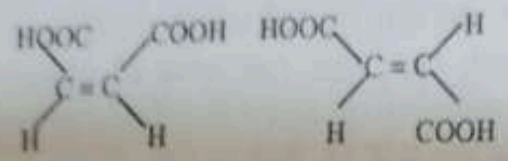

Cis-3-methylpent-2-ene


trans-3-methylpent-2-ene

v.

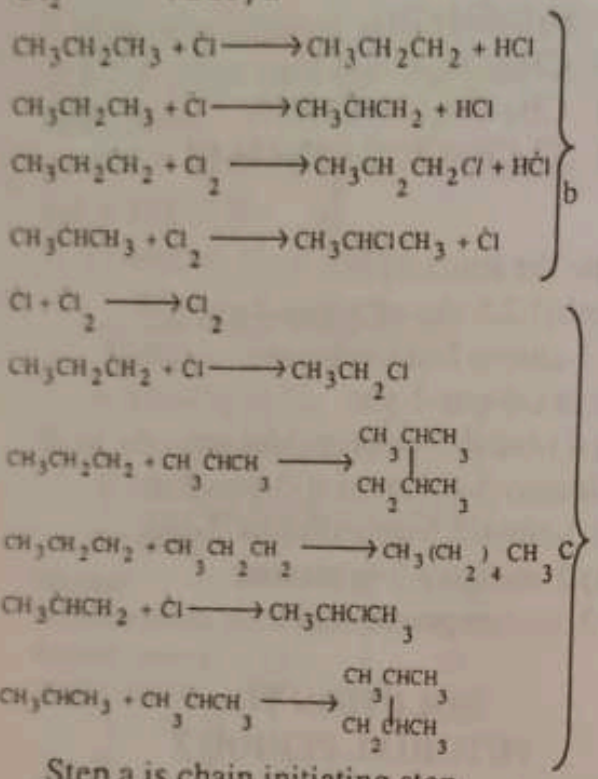

Cis-but-2-ene


trans-but-2-ene

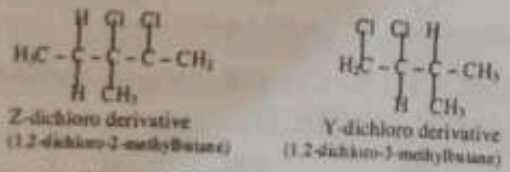
vi. 

Cis-butenedioic acid trans-butenedioic acid

2a. Propane will react with chlorine by substitution in the presence of light (uv light) or at very high temperature (250^0c - 300^0c) through free radical mechanism.



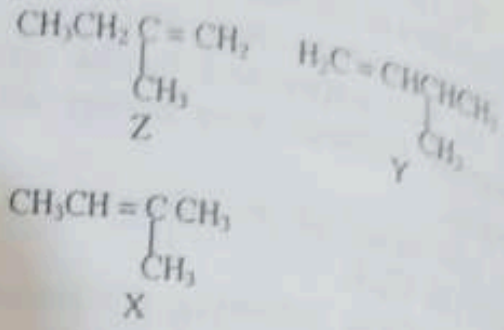
Step a is chain initiating step
Step b is chain propagating step
Step c is chain terminating step
The major products are;
$CH_3CH_2CH_2Cl$(45%) and $CH_3CHClCH_3$ (55%), the remaining are negligible by products.

b. 

Z-dichloro derivative
(1,2-dichloro-2-methylbutane)

Y-dichloro derivative
(1,2-dichloro-3-methylbutane)

to get Y and Z, just remove the chlorine atoms between adjacent carbon atoms and introduce a double bond.

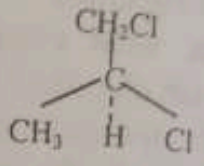


Z Y

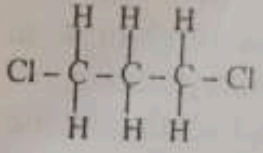
X

Possible structure of A,B,C,D are $CH_3CH_2CHCl_2$,$CH_3CHClCH_2Cl$, $CH_3CCl_2CH_3$ and $ClH_2CCH_2CH_2Cl$
For C to be optically active it must have a chiral carbon centre, ∴ C is $CH_3CHClCH_2Cl$

or



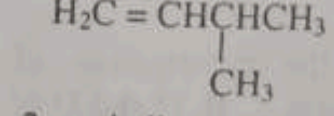
For A to form 2 trichloropropanes, A must be $ClH_2C\,CH_2CH_2Cl$ or



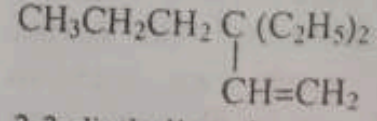
Fore more explanation refer to page 102

4a. Already solve. Refer to page 101

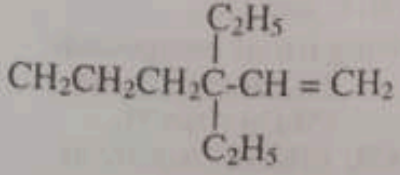
5a. IUPAC name for $CH_2 = CHCH(CH_3)_2$

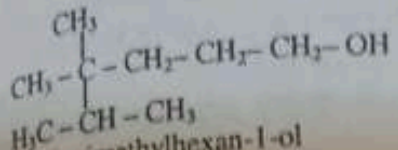


3-methylbut-1-ene

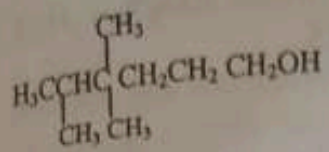
b. 

3,3-diethylhex-1-ene



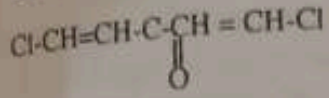
c. 

4,4,5-trimethylhexan-1-ol



$CH_3CH_2CH_2CH_3$ - butane or n-butane

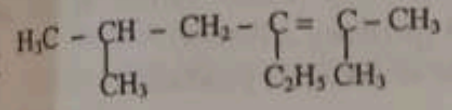
d. $CH_3CH_2CH{=}CHCH_3$ - pent-2-ene

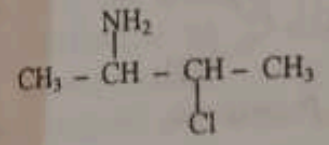
e. 

f.

1,5-dichloropentane-3-one-1,4-diene

6. Structure of 3-ethyl-2,3-dimethylhex-2-ene

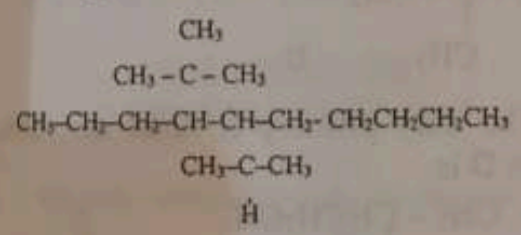
i. 



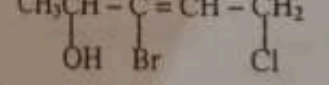
ii. hex-5-ene-1-yne

$HC{\equiv}C\text{-}CH_2CH_2\text{-}CH{=}CH_2$

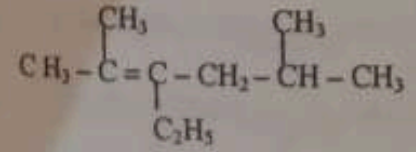
viii. 4 t-butyl-5-isopropyldecane



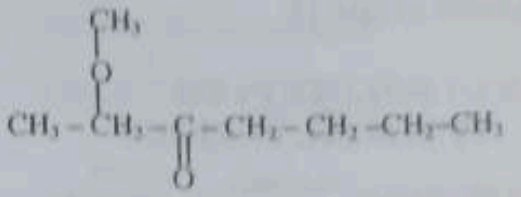
ix. 3-bromo-5-chloropent-3-ene-2-oL



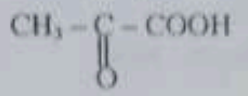
x. 3-ethyl-2,5-dimethylhex-2-ene



xi. 2-methyoxy-3-heptanone



xii. 2-ketopropanoic acid



TUTORIAL PERIOD 3

TYPES OF ORGANIC REACTIONS (II)

1. Write equations to show bow and under what conditions
   (i) NaOH will react with ethyl bromide.
   (ii) NaCN will react ethyl bromide
   (iii)AgCN will react with ethyl bromide
   (iv)Ethanol will react with conc. H_2SO_4
2a. Write stepwise equations to show how and under what conditions, propyne will react with water.

b. In the addition of hydrogen bromide (HBr) to 2-methyl-pent-2-ene, write an equation to show the structures and names of likely products and indicate the major product.

3. Write equations to show how and under what conditions:
   (i) NaOH will react with ethyl bromide,
   (ii) AgCN will react with ethyl bromide,

4a What do you understand by the term "Grignard Reagent"?

b. Write an equation to show how and under what conditions a Grignard reagent can be prepared.

c. Discuss the various synthetic reactions of Grignard reagents.

5. An unknown organic liquid A, $C_4H_{10}O$, upon treatment with PCl_5 gave steamy white fumes. Mild oxidation of A with chromic acid yielded compound B C_4H_8O, which could be further oxidized to C $C_4H_8O_2$. On dehydration with conc. H_2SO_4, A

gave DC_4H_8. ozonolysis of which gave methanal and propanone. Deduce the structures of A to D.

SOLUTION TO TUTORIAL PERIOD 3

1i. $NaOH + CH_3CH_2Br \xrightarrow[-H_2O]{\text{ALCOHOL}} CH_2{=}CH_2 + NaBr$

ii. $NaCN + CH_3CH_2Br \xrightarrow[\text{ethylbromide}]{} \xrightarrow[\text{alcohol \& heat}]{\text{aqueous}} CH_3CH_2CN + NaBr$

$2AgCN + 2CH_3CH_2Br \xrightarrow[\text{ethylbromide}]{} \xrightarrow[\text{heat}]{\text{alcohol}} CH_3CH_2CN + CH_3CH_2NC + 2AgBr$

Note that the cyanide and isocyanides are formed together when alcoholic AgCN is used.

iv. $CH_3CH_2OH + \text{conc. } H_2SO_4\ 170\text{-}180^0 \rightarrow CH_2{=}CH_2$

Note that the concentrated H_2SO_4 acts majorly as a dehydrating agent.

In reaction (1) above, if aqueous NaOH is used the product will be ethanol and NaOH will act as catalyst (in the hydrolysis).

$CH_3CH_2Br + H_2O \xrightarrow{NaOH} CH_3CH_2OH + HBr$

2a. $CH_3C{\equiv}CH + H_2O \xrightarrow[\text{water dil. } H_2SO_4,\ 97^0c]{HgSO_4} CH_3C(OH){=}CH_2$

Propyne

$CH_3C(OH){=}CH_2 \xrightarrow{\text{arrangement}} CH_3C(=O)CH_3$

b. $CH_3C(CH_3){=}CHCH_2CH_3 + HBr \longrightarrow$

$CH_3C(Br)(CH_3)CH_2CH_2CH_3 + CH_3C(CH_3)(HBr)CHCH_2CH_3$

(major product) 2-bromo-2-methylpentane; 3-bromo-2methyl pentane

4a. Grignard reagents are organometallic compound in which magnesium is directly bonded to carbon. They have the general formula RMgX where R-alkyl group X-halogen.

b. Grignard reagents are prepared by allowing a solution of alkylhalide (haloalkane) in dry ether to stand over turnings of metallic magnesium.

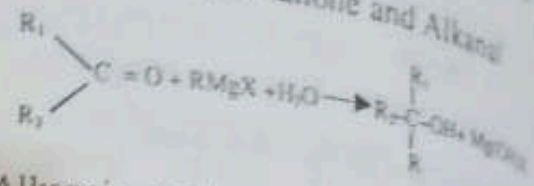
$RX + Mg \xrightarrow{\text{ether}} RMgX$

e.g. $CH_3CH_2Br + Mg \xrightarrow{\text{ether}} CH_3CH_2MgBr$

c. Grignard reagents can be used for syntheses of many organic compounds such as:

i. Alkanes from water: $RMgX + H_2O \rightarrow RH + Mg(OH)X$

ii. Alkanols from Alkanone and Alkanal



iii. Alkanoic acid using CO_2 and acidic medium

$RMgX + CO_2 \xrightarrow{H^+} RCOOH$ etc.

5. Since A can be oxidized successively using chromic acid and reacts with PCl_5 to give steamy white fumes A is an Alkanol (primary Alkanol).

From the ozonolysis products

$H_2C{=}O$ and $O{=}C(CH_3)_2$

Methanal Propanone

We can get D by removing the oxygen and joining the atoms. thus

$CH_3C(CH_3){=}CH_2$ D

∴ The only primary Alkanol derivable from D is

$A = CH_3CH(CH_2OH)CH_3$

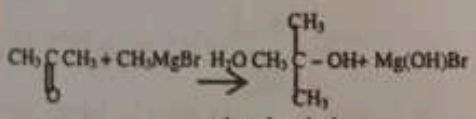
TUTORIAL PERIOD 4

(Topics: Chemistry of Alcohols, Ethers, Aldehydes, Ketones, Carboxylic acids etc)

1. Write equations for the preparation of each of the following compounds:
   a. t-butyl alcohol i.e. 2-methylpropan-2-ol
   b. 2-cyanopropan-2-ol
   c. butanol
   d. 3-pentanol
2. Propose a scheme for the conversation of propan-1-ol to 2-hydroxybutanoic acid.
3. i How and under what condition can you convert ethanol to ethyl halides using:
   (a) Halogen acids (b) phosphorus halides
   ii. Propose a scheme for the conversion o propan-1-ol to propan-2-ol
4. Compare and contrast the reaction of propanone and Propanal with: (a) hydroxylamine (b) 2,4-dinitrophenylhydrazine(c)Tollen's reagent.
5. a. Give the possible products of the dry distillation of a mixture of calcium methanoate and calcium ethanoate.
6. a. Complete and following:
   (i) $CH_3C{\equiv}CH + H_2O \xrightarrow{Hg^{2+}}$
   (ii) $CH_2{=}CH\text{-}CH_2\text{-}CH_3 + HBr? \longrightarrow$
   (iii) $BrCH_2CO_2H + SOCl_2 \longrightarrow$
   (iv) $CH_3CONH_2 + LiAlH_4 \longrightarrow$

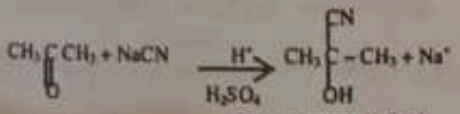
SOLUTION TO TUTORIAL PERIOD 4

1a.



t-butylacohol

b.



2-cyanopropan-2-ol

c. $CH_3CH_2CH_2CHO \xrightarrow[H^+]{LiAlH_4} CH_3CH_2CH_2CH_2OH$ (butanol)

d. $CH_3CH_2C(=O)CH_2CH_3 \xrightarrow[H^+]{LiAlH_4} CH_3CH_2CH(OH)CH_2CH_3$

3-pentanol

2.

Conversion of propan-1-ol to 2-hydroxylbutanoic acid

$$CH_3CH_2CH_2OH \xrightarrow[H_2SO_4]{K_2Cr_2O_7} CH_3CH_2CHO$$

Propan-1-ol

$$CH_3CH_2CHO \xrightarrow[\text{dil. } H_2SO_4,\ 10\text{-}20^{\circ}c]{KCN} CH_3CH_2C(O^-)H\text{-}CN$$

$$\xrightarrow[\text{reflux}]{\text{conc. HCl}} CH_3CH_2C(OH)HCOOH$$

2-hydroxybutanoic acid

3i.a By bubbling dry halogen acid gas through dry ethanol in the presence of zinc chloride catalyst until saturation is reached and the refluxing is done e.g.

$$CH_3CH_2OH + HCl \xrightarrow[\text{Catalyst, reflux}]{ZnCl_2} CH_3CH_2Cl + H_2O$$

b. Anhydrous ethanol is used in the cold e.g.

$CH_3CH_2OH + PCl_5 \rightarrow CH_3CH_2Cl + POCl_3 + HCl$

ii. Conversion of propan-1-ol to propan-2-ol

$$CH_3CH_2CH_2OH \xrightarrow[180]{\text{conc. } H_2SO_4} CH_3CH_2 = CH_2 + H_2O$$

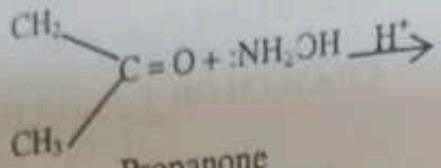
Propan-1-ol

$$CH_3CH = CH_2 + HBr \rightarrow CH_3CHBrCH_3$$

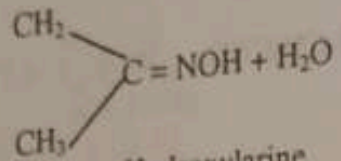
$$CH_3CHBrCH_3 + H_2O \xrightarrow{NaOH} CH_3C(OH)CH_3 + HBr$$

Propan-2-ol

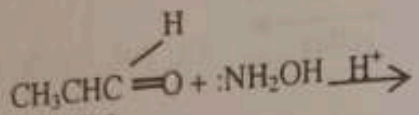
4a.



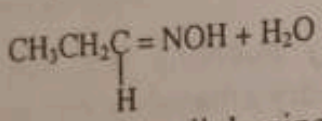
Propanone



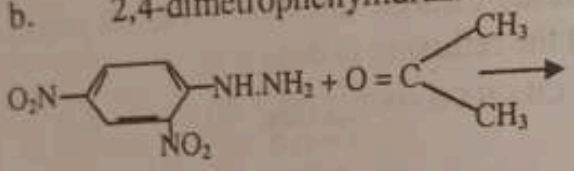
Hydroxylarine

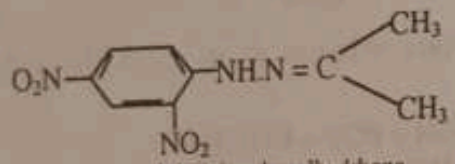


Propanal

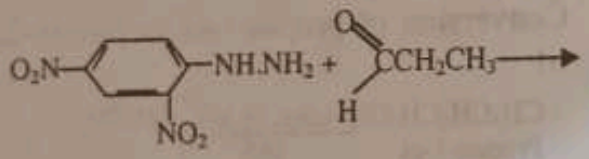


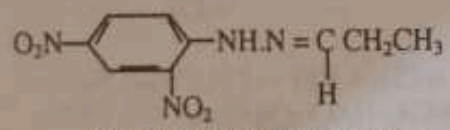
b. 2,4-dimetrophenylhdrazine





propanone-2,4-dinitrophynylhydrhone





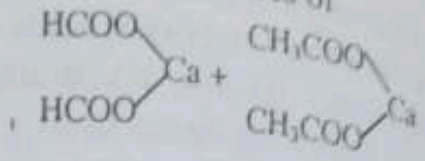
propanal-2,4-dinitrophynylhydrhone

c. Propanone does not react with Tollen's reagent while propanal does.

$CH_3CH_2CHO + 2Ag(NH_4)_2OH \rightarrow RCOONH_4 + 2Ag$

Tollen's reagent

5a. Possible products of



CH_3CHO, CH_3COCH_3, $HCHO$

For detail explanation refer to page 11

6a.

i. $CH_3C \equiv CH + H_2O \xrightarrow{Hg^{2+}} CH_3\overset{O}{\overset{\|}{C}}CH_3$

ii. $CH_2=CHCH_2CH_3 + HBr \rightarrow CH_3CHBrCH_2CH_3$

iii. $BrCH_2CO_2H + SOCl_2 \rightarrow BrCH_2COCl + SO_2 + HCl$

iv. $CH_3CONH_2 + LiAlH_4 \rightarrow CH_3CH_2NH_2$

TUTORIAL PERIOD 5

(Topics: Chemistry of Alcohols, Ethers, Aldehydes, Ketone, Carbozylic acids etc)

1a. Write equations to show how and under what conditions ethanoic acid can be converted to:(a)$CH_2C1COOH$ (b) CH_3COCl

b. How and under what condition can you convert ethanol to ethyl halides using: (i) halogen acids, (ii) phosphorus halides?

2a Name the alcohol(s) that can dehydrate to give 2-methylpropene.

b. Give the name(s) of the salt(s) which when dry distilled will give: (i) Pentan-2-one (ii) Pentanal (iii) Pentan-3-one. Also name other products that may be formed along with each compound. Where there are no other products, indicate so.

3. Compound A, has structural formula: $CH_3CO.O.CO.CH_2CH_3$

(i) Name this compound.

(ii) Give the name(s) of the products, when A is treated with propan-1-ol

(iii)In a usual synthesis, give the name of possible compound(s) that can combine to give A

4a. Arrange the following in order of increasing nucleophilicity:

(i) $CH_3CH_2NH_2$ (ii) $ClCH_2CH_2NH_2$ (iii) CH_3NH_2

b. Complete the following reactions by writing the structure of each of the organic products, D to H

i. $CH_3CH_2CH_2NO_2 \xrightarrow[\text{Ether}]{LiAlH_4} D$

ii. $CH_3(CH_2)_2CH_2NH_2 \xrightarrow{KOBr} E$

iii. $CH_3CH_2NH_2 + CH_3I \xrightarrow[\text{(excess)}]{} F$

iv. $CH_3CH_2\underset{\displaystyle CH_3}{\underset{|}{N}}H + (CH_3CO_2)O \longrightarrow G + CH_3COOH$

v. $CH_3CH_2\underset{\displaystyle CH_3}{\underset{|}{CH}}\text{-}N^+(CH_3)_3OH \longrightarrow H + (CH_3)_3N + H_2O$

c. Propose a reasonable scheme for the conversion of aminomethane to aminoethane. (Give all necessary reagents and experimental conditions).

5a. How many milliters of 0.15M HCl are required to react with 0.25g of n-butylamine?

b. Write equations to show how and under what conditions the following compounds will react:

i. 2-methylpropylamine and nitrous acid (HNO_2)

ii. Ethylamine and trichloromethane

iii. Diethylamide and acetic anhydride.

6a. Write the structural formulae of all carboxylic acids and derivatives with the molecular formula $C_6H_{12}O_2$. Pick out two particular isomers that are derivatives of a carboxylic acid and show how these can be distinguished from one another.

b. With the aid of equation, show how ethanoylchloride will react with:
(a) Water (b) methanol (c) ammonia (d) ethylamine.

7(i) Write the structures of all possible amines with for formula $C_5H_{13}N$ and name them by IUPAC system.

(ii) With the aid of equations, show how you one class of amine from another.

SOLUTION TO TUTORIAL PERIOD 5

1a.

$$CH_3COOH + \left\{\begin{matrix}PCl_5\\PCl_3\\SOCl_2\end{matrix}\right\} \rightarrow CH_3COCl$$

$$CH_3COOH + Cl_2 \xrightarrow[\text{light}]{\text{red phosphorus}} CH_2ClCOOH + HCl$$

b. Check period 8 question 3

2.

$$H_3C-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2OH$$ 2-methylpropan-1-ol

$$CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle OH}{\overset{|}{\underset{|}{C}}}}-CH_3$$ 2-methylpropan-2-ol

bi.$(CH_3CH_2CH_2COO)_2Ca$ and $(CH_3COO)_2Ca$

ii. $(HCOO)_2Ca$ and $(CH_3CH_2CH_2CH_2COO)_2Ca$

iii. $(CH_3CH_2COO)_2Ca$

3i. Ethanoic propanoic anhydride

ii. $CH_3CO.O.CO.CH_2CH_3 + CH_3CH_2CH_2OH \longrightarrow CH_3COOH + CH_3CH_2COOCH_2CH_2CH_3$

ethanoic acid — propyl propanoate

iii. ethanoyl chloride and sodium propanoate

$CH_3COCl + CH_3CH_2COONa \longrightarrow CH_3CO.O.COCH_2CH_3 + NaCl$

also propanoyl chloride and sodium ethanoate.

$CH_3CH_2COONa + CH_3COCl \longrightarrow CH_3CO.O.COCH_2CH_3 + NaCl$

4a. $ClCH_2CH_2NH_2 < CH_3NH_2 < CH_3CH_2NH_2$

bi. $D = CH_3CH_2CH_2NH_2$

ii. $CH_3(CH_2)_2-\underset{\underset{O}{\|}}{C}-NH_2 \xrightarrow{KOBr} CH_3CH_2CH_2NH_2$

E

iii. $CH_3CH_2NH_2 + \underset{\text{(excess)}}{CH_3I} \rightarrow CH_3CH_2N^+(CH_3)_3\,I^-$

F

Note that the reaction occur in steps

from secondary first, then tertiary amine and finally a quaternary amine. If the CH_3I is not in excess the product will be

$CH_3CH_2-\underset{\underset{H}{|}}{N}-CH_3$ (a secondary amine)

iv. $\underline{C} = CH_3CH_2-\underset{\underset{CH_3}{|}}{N}-\overset{\overset{O}{\|}}{C}-CH_3$

v. $\underline{H}$ is $CH_3CH=\underset{\underset{CH_3}{|}}{CH}$

for further explanation check (Hoffman elimination)

c. CH_3NH_2 (aminomethane) $\xrightarrow[0\text{-}5^\circ C]{HONO} CH_3OH \xrightarrow{PCl_5} CH_3Cl \xrightarrow[\text{aq. alcohol}]{NaCN} CH_3CN$

5a. molar mass of butylamine $(C_4H_9NH_2)$ = $(12 \times 4) + (11 \times 1) + 14$ = 73g/mol

$CH_3CH_2CH_2CH_2NH_2 + HCl \rightarrow CH_3(CH_2)_3N^+H_3Cl^-$

1mole of butylamine requires 1 mole HCl

$\therefore \cap_{HCl} = \cap_{Butylamine}$

$0.15M \times V = \frac{0.25g}{73g/mol}$

$V = \frac{0.25}{73} \times \frac{1}{0.15}$

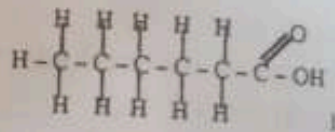
$V = 0.02283L = 22.83mL$

bi. $CH_3\underset{\underset{CH_3}{|}}{C}HCH_2NH_2 + HNO_2 \xrightarrow{0\text{-}5^\circ C} CH_3\underset{\underset{CH_3}{|}}{C}HCH_2OH + N_2 + H_2O$

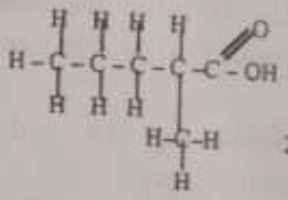
ii. $CH_3CH_2NH_2 + CHCl_3 \xrightarrow[KOH]{\text{alcoholic}} CH_3CH_2NC$

iii. $C_2H_5\underset{\underset{H}{|}}{N}C_2H_5 + (CH_3CO)_2O \longrightarrow CH_3CON(C_2H_5)CH_2CH_3$

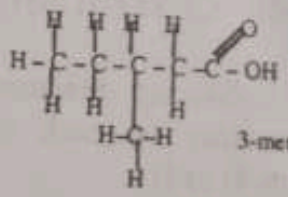
6a.



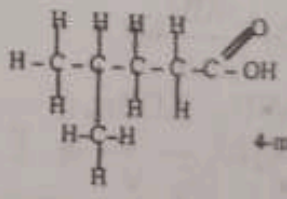
hexanoic acid



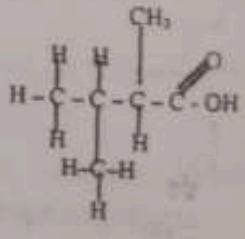
2-methlpentanoic acid



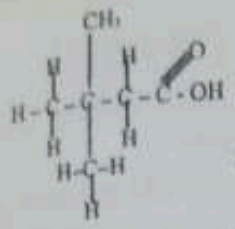
3-methlpentanoic acid



4-methlpentanoic acid

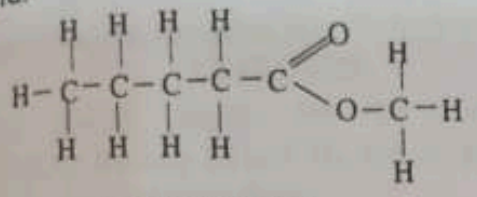


2, 3-methlpentanoic acid

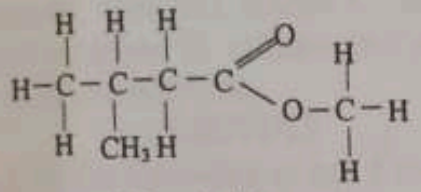


3, 3-methlpentanoic acid

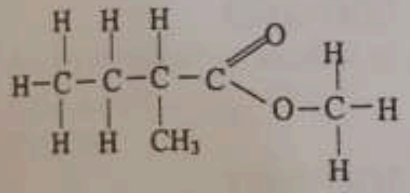
Esters are functional isomer of carboxylic acid.



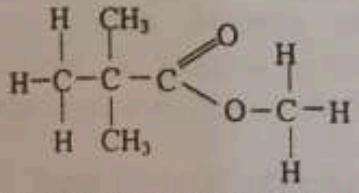
Methylpropanoate



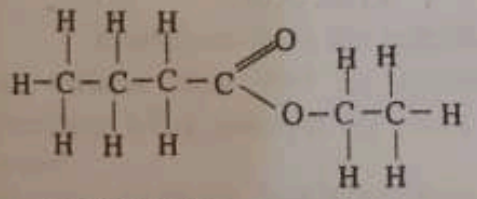
Methyl-3-methylbutanoate



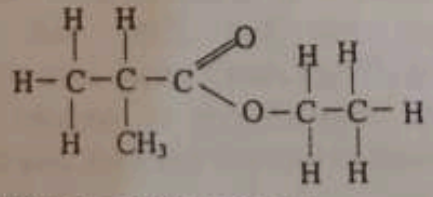
Methyl-2-methylbutanoate



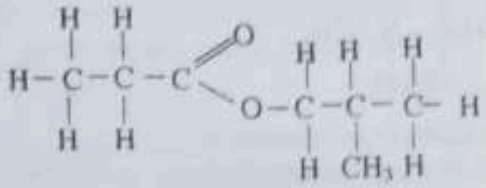
Methyl-2, 2-methylpropanoate



Ethylbutanoate



Ethyl-2-methylpropanoate



Propyl(2-methyl)propanoate

Hence hexanoic acid as fifteen isomers.

Comparing $CH_3(CH_2)_3COOCH_3$ and $HCOO(CH_2)_4CH_3$

On acidic hydrolysis;

$$CH_3(CH_2)_3COOCH_3 \xrightarrow[H_2O]{H^+} CH_3(CH_2)_3COOH + CH_3OH$$

While

$$HCOO(CH_2)_4CH_3 \xrightarrow[H_2O]{H^+} HCOOH + CH_3(CH_2)_4OH$$

b. $CH_3COCl + H_2O \rightarrow CH_3COOH + HCl$

Ethanoylchloride water

$CH_3COCl + CH_3OH \rightarrow CH_3COOCH_3 + HCl$

Methanol

$CH_3COCl + NH_3 \rightarrow CH_3CONH_2 + HCl$

ammonia

$CH_3COCl + CH_3CH_2NH_2 \rightarrow CH_3C(=O)-N(H)-CH_2CH_3$

ethylamine

or

$CH_3CONHCH_2CH_3$

7. Amines with formula $C_5H_{13}N$

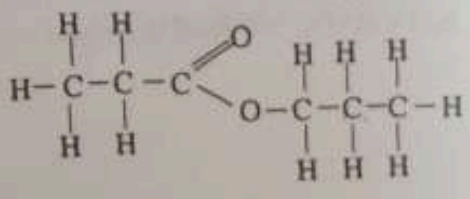
$CH_3(CH_2)_3CH_2NH_2$ - 1-aminopentane

$CH_3CH_2CH_2CH(NH_2)CH_3$ - 2-aminopentane

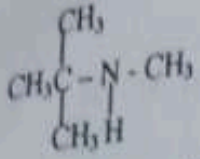
$CH_3CH_2CH(NH_2)CH_2CH_3$ - 3-aminopentane

$CH_3C(NH_2)(CH_3)CH_2CH_3$ - 2-amino – 2 – methyl pentane

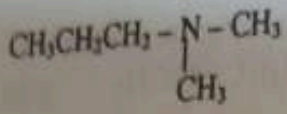
$CH_3CH(CH_3)CH(NH_2)CH_3$ - 2-amino – 3 – methyl pentane



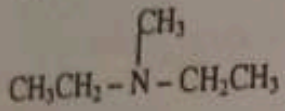
propylpropanoate



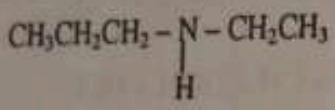
N-methyl t-butylamine or
1,1,N-trimethyl aminoethane



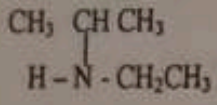
N,N-dimethyl aminopropane



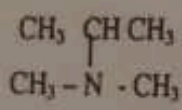
N-ethyl-N-methyl aminoethane



N-ethyl aminopropane



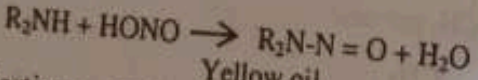
N-ethyl-2-aminopropane



N,N-dimthyl-2-aminopropane

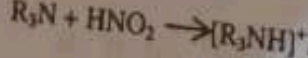
ii. The three classes of amines can be differentiated thus only primary amines give effervescence (liberate) N_2gas when reactedHNO_2

Secondary amines give nitroso-compounds which are pale yellow oils insoluble in water when react with HNO_2



Yellow oil

Tertiary amines merely dissolve in HONO (HNO_2) to give nitrite and no nitrogen gas is evolved.



CHAPTER NINE

PAST UTME ORGANIC QUESTIONS

UME/78/19

The reaction between an organic acid and an alcohol in the presence of an acid catalyst is known as:

A. saponification B. dehydration C. esterification D.hydrolysis D. hydration.

UME/78/20

The IUPAC names for the compounds CH_3COOH and $CH_2=CH_2$ are respectively:

A. acetic acid and ethane

B. ethanoic acid and ethene C. methanoic acid and ethylene D. ethanol and ethene E. acetic acid and ethylene.

UME/78/25

Which of the following is not a member of the homologous series of the paraffin (Alkanes)?

A. C_3H_8 B. C_5H_{12} C. C_7H_{16} D. $C_{15}H_{32}$ E. $C_{24}H_{46}$.

UME/78/27

An example of an alcohol is A. CCl_4 B. CH_3COOH C. $CHCl_3$ D. C_2H_6 E. CH_3OH.

UME/78/32

The most common type of chemical reaction which Alkanes undergo is A. substitution B. addition C. condensation D. polymerization E. double decomposition.

SOLUTION TO UME 1978

UME/78/19

Esterification is the reaction between an organic acid and an alcohol in the presence of a catalyst to form ester and water.

$$CH_3COOH + CH_3CH_2OH \underset{}{\overset{H^+}{\rightleftharpoons}} CH_3COOCH_2CH_3 + H_2O$$

The catalyst used is usually mineral acids like HCl but not H_2SO_4 in concentrated form. Conc. H_2SO_4 is not used as a catalyst in esterification because it dehydrates the ester formed to produce other products.

Esterification is similar to neutralization reaction however the difference between them is given in the table below:

	Esterification	Neutralization
1.	It is reversible	It is not reversible
2.	It is an endothermic process	It is an exothermic process
3.	It is very slow in nature	It is fast in nature
4.	It required a catalyst	It does not require catalyst
5.	The ester form has sweet small	The salt form does not have sweet small

Correct option is C

UME/78/20

The IUPAC name for CH_3COOH and $CH_2=CH_2$ are ethanoic acid and ethane respectively. Note that acetic acid and ethylene are the common named of CH_3COOH and $CH_2 = CH_2$ respectively.

Correct option is B

UME/78/25

The Alkanes (paraffin) have the general chemical formulae C_nH_{2n+2}.

n	3	5	7	15	24
CnH_{2n+2}	C_3H_8	C_5H_{12}	C_7H_{16}	$C_{15}H_{32}$	$C_{24}H_{50}$

Hence $C_{24}H_{48}$ is not a member of the alkene series.

Correct option is E

UME/78/27

The monohydric Alkanol are classes of organic compound with the general molecular formulae $C_nH_{2n+1}OH$ is ROH. When n = 1 we have CH_3OH.

Correct option is E.

UME/78/32

The Alkanes are classes of an organic compound which have low affinity for reaction. The only major reaction peculiar to the Alkane is substitution reaction.

Correct option is A.

UME 1979

UME/79/1

An organic compound X has the following properties:I. It is not miscible with water II. It has boiling point of 77°C III. It has sweet odour, IV. It is insoluble in sodium hydrogen carbonate solution V. It does not decolorize bromine water. X is therefore
A. methane B. ethanoic acid C. ethene D. ethyl ethanoate E. carbon tetrachloride.

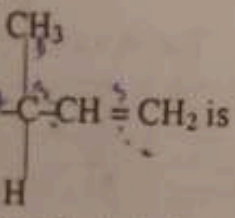
UME/79/2

Which are the correct IUPAC names for HCO_2CH_3 and $CH{\equiv}CH$.A.Methyl methanoate and ethane B. Methanoic acid and ethyne C. Ethylmethanoate and ethyne D.Methylmethanoate and ethyneE. Ethanoic acid and Ethene.

UME/79/3

Which of the following substances are all made by the process of polymerization? A. Nylon and soapB. Ethanoic acid, margarine and ethanol C. Nylon and artificial rubber D. Soap and butane E. Margarine and nylon.

UME/79/8

The IUPAC name for  is

A. 2-methylbut-3-ene B. 2-methylbut-4-ene C. 3-methylbut-2-ene D. 3-methylbut-1-ene. 3-methylpent-1-ene

UME/79/9

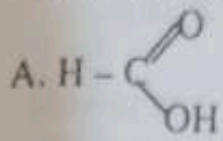
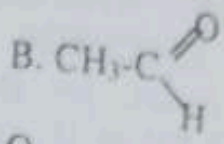
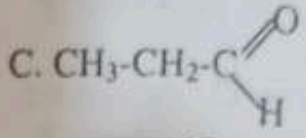
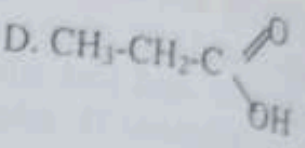
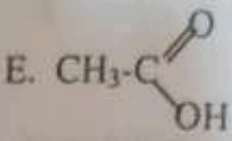
Methanoic acid mixes with water in all proportions and has about the same boiling point as water. Which of the following methods would you adopt to obtain pure water from a mixture of sand, water and Methanoic acid?
A. Fractional distillation B. Filtration followed by distillation C. Neutralization with sodium hydroxide followed by distillation D. Neutralization with sodium hydroxide followed by filtration E. Esterification with ethanol followed by distillation.

UME/79/15

How many grams of HBr would exactly be required to react with 2g of propyne[C = 12, H = 1, Br = 80]
A. 4.1g B. 6.1g C. 8.1g D. 10.1g E. 16.2g

UME/79/17

The structural formula of ethanoic acid is

A. 
B. 
C. 
D. 
E. 

UME/79/31

Starch can be converted to ethyl alcohol by A. distillation B. fermentation C. isomerization D. crackingE. Cooking.

UME/79/39

Hydrogenation may be effected by. A. the removal of hydrogen from an alkane in the presence of a catalyst B. the addition of hydrogen to an alkane in the presence of a catalyst C. the addition of hydrogen to an alkyne D. the removal of hydrogen from an alkyne E. the addition of hydrogen to an ethyl alcohol.

UME/79/44

One of the following techniques can be used to show that chlorophyll pigment is a mixture of chemical compounds and not a single coloured compound.
A. Crystallization B. Hydrolysis C. Sublimation D. Filtration E. Chromatography.

UME/79/46

When excess ethanol is heated to 145°C in the presence of concentrated sulphuric acid, the product is A. diethyl ether B. ethyne C. diethyl sulphate D. acetone E. ethanoic acid.

SOLUTION TO UME 1979

UME/79/1

An organic compound which is not miscible with water does not contain a polar group like -OH, -COOH, $-NH_2$ etc. which means the absence of hydrogen bond in the organic compound, hence it will boils at a low temperature (i.e.77^{0}C). An organic compound which does not dissolve in $NaHCO_3$, implies that it does not contain -COOH group, since it does not decolourize bromine water it means that it does not contain double (=) or triple bonds (≡).since the organic compound does not contain –OH, -COOH, $-NH_2$, double bond or triple bond but has sweet odour, then it implies that the organic compound contain $RCOOR^1$ group. Hence it is an ester.

Correct option is D.

UME/79/2

The IUPAC name for HCO_2CH_3 and CH = CH are methylmethanoate and ethyne.

Correct option is D

UME/79/3

Polymerization is the process were two or more small molecules known as monomer links together to form a giant molecules known as polymer.

Polymerization is of two types which are addition and elimination polymerization.

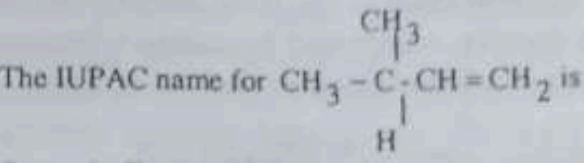
In addition polymerization monomers of the same unit link together to form joint molecules called polymer without the elimination of any small molecules.

In elimination polymerization monomers of different unit link together to form giant molecules called polymers with the elimination of small molecules such as water.

Examples of polymers are PVC, polythene, nylon, artificial rubber etc.

Correct option is C

UME/79/8

The IUPAC name for  is

3-methylbut-1-ene

Correct option is D

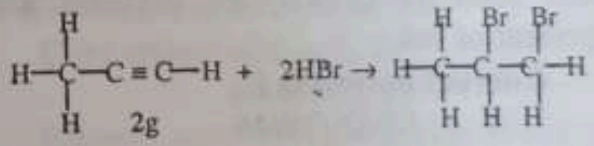
UME/79/9

Since Methanoic acid mixed with water in all proportion and has about the same boiling point with water. It cannot be separated from water by fractional distillation because for effective fractional distillation the boiling point of the components of the mixture must differ by 10°C.

To obtain pure water from a mixture of sand, water and Methanoic acid, neutralized the Methanoic acid with sodium hydroxide to form salt and water. The salt form dissolve in the water leaving the sand behind. Filtration is used to remove the sand. The water is distilled to obtain pure water. Hence the process is neutralization →filtration → distillation.

Correction option D.

UME/79/15



$$\text{R.m.m of propyne } (C_3H_4) = \frac{\text{Reacting mass}}{\text{molar mass}}$$

$$= \frac{2g}{40g/mol} = 0.05mol$$

$$\cap_{HBr} = 2(0.05mol) = 0.1mol$$

$$m_{HBr} = \cap_{HBr} \times M_{HBr}$$

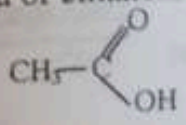
$$= 0.1mol \times 81g/mol$$

$$= 8.10g$$

Correct option is C

UME/79/17

The structural formula of ethanoic acid is



Correct option is E

UME/79/31

Fermentation is the slow decomposition of an organic compound by micro-organism to form smaller molecules such as ethanol.

$$2(C_6H_{10}O_5)_{n(s)} + nH_2O \xrightarrow[\text{Hydrolysis}]{\text{diastase}} n\,C_{12}H_{22}O_{11(aq)}$$
maltose

$$C_{12}H_{22}O_{11(aq)} + H_2O \xrightarrow[\text{Hydrolysis}]{\text{maltase}} 2C_6H_{12}O_{6(aq)}$$
Glucose

$$C_6H_{12}O_{6(aq)} \xrightarrow{\text{zymase}} 2C_2H_5OH(aq) + 2CO_2$$
Decomposition Ethanol

Note that the hydrolysis of starch to glucose can also be catalyst by the enzyme AMYLASE.Also note that the fermentation of starch occur in three stages.

Correct option is B

UME/79/39

Hydrogenation is the addition of hydrogen to unsaturated organic compound (Alkyne, alkene etc) to form a saturated compound.

Correct option is C

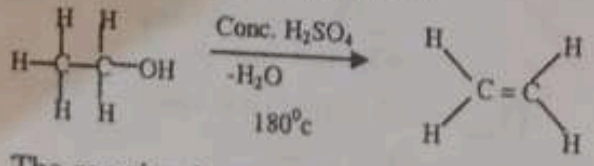
UME/79/44

Chromatography is a separation technique use to separate complex organic mixture such as chlorophyll pigment and component of ink.

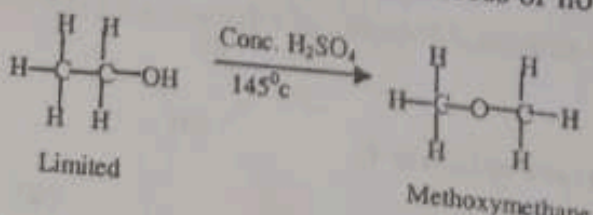
Correct option is E

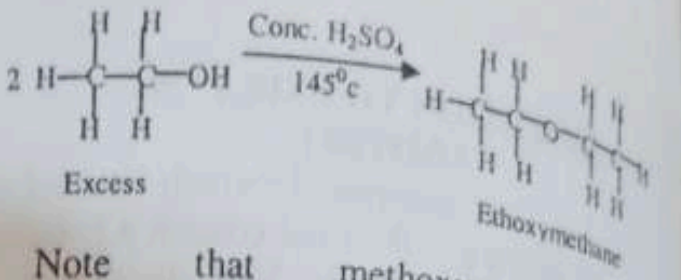
UME/79/46

Generally when ethanol is heated with conc. H_2SO_4 at 180^0 or 170^0c, it losses a water molecule to form ethene



The reaction is generally called dehydration. But if ethanol is heated with conc. H_2SO_4 at a temperature lower than 180^0c (i.e. 145^0c) ethers are form. The ether form depend on the fact that the ethanol is in excess or not.





Note that methoxymethane and ethoxyethane are also known as dimethyl ether and diethyl ether respectively.

Correct option is A

UME 1980

UME/80/21

When Ethene gas reacts with chlorine gas to form 1,2-dichloroethane, the reaction is called A. substitution B. addition C. polymerization D. hydrolysis E. reduction.

UME/80/23

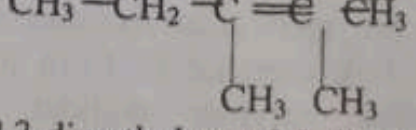
Which of the following is acceptable as the organic product of the reaction of ethanoic acid and ethanol with an acid catalyst? A. Ethyl ethanoate B. Methyl ethanoate C. Ethyl methyl ketone D. Butanol E. None.

UME/80/31

Hardening of oil may be achieved by A. boiling the oil with water B. boiling the oil with a catalyst C. treating the oil with sodium hydroxide D. treating the oil with hydrogen and catalyst E. distilling the oil under reduced pressure.

UME/80/34

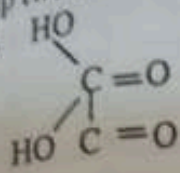
The IUPAC name for the compound

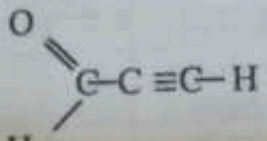


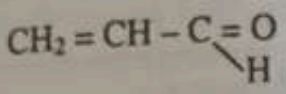
A.2,3-dimethylpent-2,3-diene
B.2,3-dimethylpent-2-ene
C.3,4-dimethylpent-3-ene
D.3,4-dimethylpentene
E.3,4-dimethylhept-2-ene

UME/80/37

Which of the following compounds will take up two molecules of bromine?

I. 

II. 

III. 

A. I. B. II C. III D. I and II E. I and III.

UME/80/38

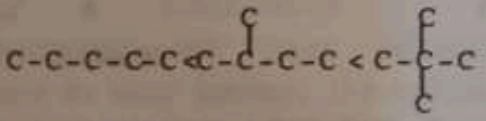
A mixture of ethanol, sodium dichromate, and water is allowed to drop gradually into a boiling solution containing one part concentrated H_2SO_4 and three parts water, and the liberated gas is collected by cooling it with ice water to give a liquid. This liquid is A. ethanoic acid B. acetaldehyde C. ethyl acetate D. methanol E. ethylene.

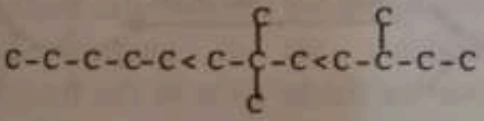
UME/80/41

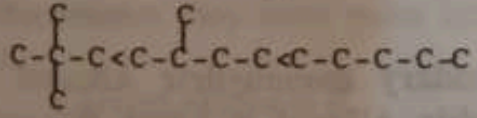
Cellulose and starches can be classified as one of the following A. sugars B. sucrose C. hydrocarbons D. carbohydrates
E. isomers.

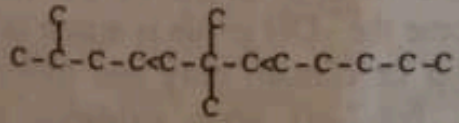
UME/80/41

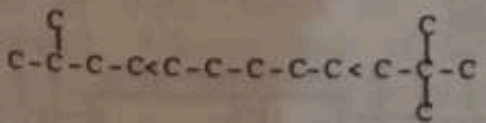
Which of the following is the correct order in increasing boiling point, of the isomeric C_5H_{12} compounds?

A. 

B. 

C. 

D. 

E. 

UME/80/45

Detergents are more advantageous than soaps in hard water districts because A. on treatment with hard water they either form soluble calcium salts or do not react with calcium ions B. on treatment with hard water they form insoluble calcium salts C. on treatment with hard water they form soluble sodium salts D. on treatment with hard water they are converted into soaps E. on treatment with hard water they form more lather than soap does.

UME/80/46

Which of the following classes of organic compounds undergoes rapid oxidation with bromine water? A. Alcohols B. Alkenes C. Carboxylic acids D. Esters E. Alkanes.

SOLUTION TO UME 1980

UME/80/21

Addition reaction is a reaction in which an attacking reagent acts across the double or triple bonds of an unsaturated organic compound to form a saturated one or one in which the degree of saturation is increased.

Hence the major reaction undergo by unsaturated organic compound (i.e. alkenes & alkynes) is addition reaction.

Correction option is B

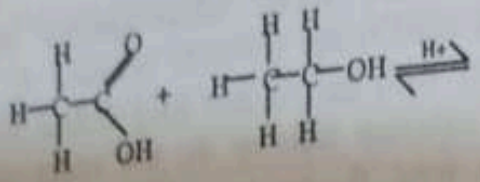
UME/80/23

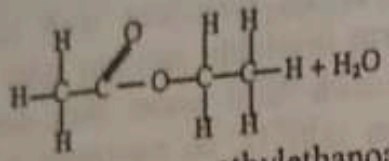
Esterification is the reaction between an organic acid and Alkanol to form ester and water only in the presence of mineral acid such as HCl which act as a catalyst.

Generally esterification reaction is represented as

$$RCOOH + R^1OH \overset{H^+}{\rightleftharpoons} RCOOR^1 + H_2O$$

In naming the ester form the R^1 is name first before the other part. Both parts are name base on the number of carbon atom they contain.





ethylethanoate

The correct option is A

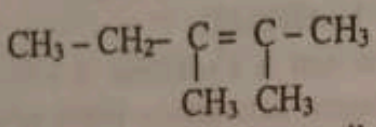
UME/80/31

Hardening of oil is the process of converting oil to fat by boiling oil with hydrogen in the presence of catalyst such as Nickel.

$$\text{Oil} + H_2 \rightarrow \text{Fat}$$

Correct option is D

UME/80/34



i. The compound is an alkene because of the double bond.
ii. The longest carbon chain contains 5 carbons with a double bond in carbon 2. Hence the parent name pent-2-ene.
iii. There is a methyl branch chain in carbon 2 and 3 hence the substituent name is 2,3-dimethyl.
iv. Joining the parent name and the substituent name; the IUPAC nomenclature of the compound is 2,3-dimethylpent-2-ene.

Correct option is B.

UME/80/37

The moles of reagent taken by unsaturated compound in an addition reaction depend on the number of pie bond in that compound (note that in a double bonds, there is one pie bond and in a triple bonds, there is two pie bonds). One pie bond requires one mole of any reagent for saturation. Hence

Multiple bonds	No of pies bonds	Molecules of reagent taken in addition
1 double bonds	1	1
2 double bonds	2	2
1 triple bonds	2	2
2 triple bonds	4	4
1 double bond, 1 triple bond	3	3

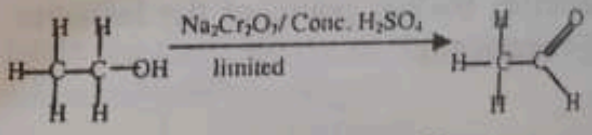
Correct option is B

UME/80/38

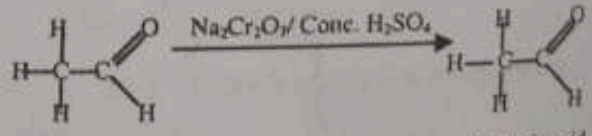
When monohydric Alkanol are heat with a mixture of dichromate and conc. H_2SO_4 oxidation of the Alkanol occur. Different monohydric Alkanol behave in different ways.

Primary monohydric Alkanol on oxidation gives Alkanal and then Alkanoic acid provided that oxidant is an excess. If the oxidant is not in excess the product will be Alkanal.

Note that primary Alkanols are monohydric Alkanols in which the carbon that been the –OH group is link directly to one Alkyne group (i.e. contain only two hydrogen atom) e.g. ethanol.

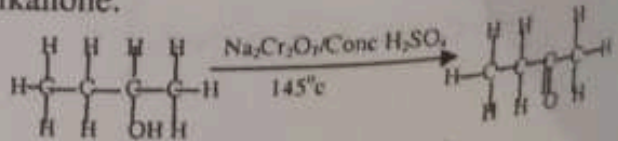


Ethanal



Ethanal Ethanoic acid

Secondary monohydric Alkanol (i.e. Monohydric Alkanol in which the carbon atom become the –OH group is attach to two alkyl group or contain only one hydrogen atom e.g. but-2-ol) upon oxidation give Alkanone.



Butanonne

Tertiary **monohydric alkanol** (i.e. monohydric alkanol in which the carbon atom bearing the –OH group is attached to three alkyl group or does not contain hydrogen atom) does not react or is not affected when heated with a mixture of $Na_2Cr_2O_7$/conc. H_2SO_4 because it does not contain oxidizable hydrogen atom.

Correct option is A

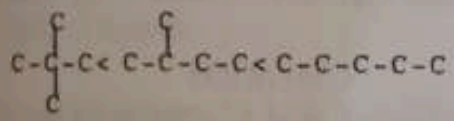
UME/80/41

Carbohydrates are natural occurring organic compounds contain carbon, hydrogen and oxygen, with hydrogen and oxygen in the ratio of 2 to 1 (2:1). The general formulae of carbohydrate is $Cx\ (H_2O)_y$ or $CxH_{2y}O_y$. Carbohydrates are divided into two which are sugar (glucose, fructose, maltose sucrose etc) and non-sugar (cellulose).

Correct option is D

UME/80/43

The greater the degree of branching the lower the boiling point. Hence the correct order of increasing boiling point is:



Correct option is C

UME/80/45

Detergents are more advantageous compare to soap because the calcium and magnesium salt form by detergent are water soluble compare to the calcium and magnesium salt of soap which are not water soluble. Hence they form more lather than soap.

Correct option is E

UME/80/46

Organic compound that undergo rapid oxidation with bromine water contain double or triple bonds i.e. they are unsaturated. Alkenes and alkynes will undergo rapid oxidation with bromine water.

Correct option is B

UME 1981

UME/81/4

Methane is a member of the homologous series called A. alkenes B. alcohols C. esters D. AlkanesE. alkynes.

UME/81/20

Which of the following can have an isomer? A. C_2H_4 B. C_4H_{10} C. C_3H_8 D. C_2H_8 E. C_6H_6.

UME/81/22

A polymerization reaction is one in which A. small molecules form giant molecules B. atoms form molecules C. giant molecules form small molecules D. molecules form volatile compounds E. a molecule rearranges itself.

UME/81/25

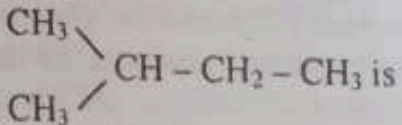
If an organic compound decolorizes bromine water then the compound is A. saturated B. supersaturated C. unsaturated D. a solid E. protonated.

UME/81/27

Fats and oils are A. addition products of long-chain fatty acids and alkali B. addition products of long-chain fatty acids and glycerol C. condensation products of long-chain fatty acids and glycerol D. condensation products of formaldehyde and glycerol E. liquids at 20°C.

UME/81/45

The IUPAC name for



A. 1 -methylpentane B. 3-methylbutane C. 2-methylbutane D. l-dimethylpropane E. 2-methylpentane.

UME/81/50

The general formula of an alkyl halide (where X represents the halide) is A. $C_nH_{2n-2}X$ B. $C_nH_{2n+1}X$ C. $C_nH_{2n+2}X$ D. $C_nH_{2n}X$ E. $C_nH_{2n-1}X$

SOLUTION TO UME 1981

UME/81/4

Alkanes are hydrocarbons which form a homologous series with a general molecular formula of C_nH_{2n+2}. They are also known as PARAFINS because of their low rate of reaction. The first member of the Alkane series is methane (CH_4).

UME/81/20

In the Alkane series, isomerism occurs from member with four carbons upward. So the first member of the series that undergo isomerism is butane (C_4H_{10}). The same goes for the alkenes, and Alkynes.

Correct option is B

UME/81/22

Polymerization is the process whereby two or more compounds called the monomer link together to form a giant molecule called polymer.

Correct option is A

UME/81/25

An organic compound which decolourized bromine water, contain either a double bond or triple bond i.e. it is unsaturated.

Correct option is C

UME/81/27

Fats and oils are Alkanoate of long chain of natural acids and trihydric Alkanol (propan-1,2,3-triol i.e. glycerol). i.e. they are condensation products of fatty acids and glycerol.

Correct option is C

UME/81/45

i. The longest carbon chain contains four carbon atoms. Hence the parent name is butane
ii. There is a branch chain in carbon 2. hence the substituent name is 2-methyl
iii. Putting the parent and substituent name together we have 2-methylbutane.

The correct option is C

UME/81/50

The general formula of the Alkyl halide is $C_nH_{2n+1}X$

The correct option is B

UME 1982

UME/82/2

0.07g of a hydride of carbon occupies $56.0cm^3$ at S.T.P. when vaporized and contains 14.29% by mass of hydrogen. The formula of the hydrocarbon is (C = 12, H = 1) A. CH_4 B. C_2H_2 C. C_2H_4 D. C_2H_6 E. C_3H_8

UME/82/12

How many grams of methylacetylene (propyne)CH_3-C≡CH will completely discharge the colour of 8g of bromine? (Br=80, C=12, H=1)
A 0.5 B.1.0 C.2.0 D.3.0 E.4.0.

UME/82/17

0.16g of methane when burnt raises the temperature of 100g of water by 40°C. What is the heal of combustion of methane if the heat capacity of water is 4.2J $g^{-1}°C^{-1}$? [CH_4 = 16] A. 1,160 kJ mol^{-1} B. 1,680 kJ mol^{-1} C. 1560 $kJmol^{-1}$ D.1,600 $kJmol^{-1}$ E. 1,680 $kJmol^{-1}$.

UME/82/35

Water is poured over a white solid and a colourless neutral gas is evolved which burns with a sooty flame. The white solid is A. calcium B. calcium oxide C. calcium carbide D. sodium peroxide E. sodium sulphate.

UME/82/36

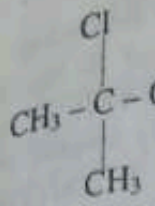
Cotton is almost pure A. starch B. protein C. animal fibre D. cellulose E. mineral fibre.

UME/82/37

Which of the following types of reaction takes place between C_2H_4 and the halogens?
A. Substitution
B. Polymerization C. Addition
D. Saponification E. Oxidation.

UME/82/50

The I.U.P.A.C. name for the compound



is

A.2-chloro-isopentane B. 2-chloro-isopentane C. 2-chloro-2-methylbutane D. 1-chloro-2,2-dimethylpropane

SOLUTION TO UME 1982

UME/82/2

No of mole of hydride =

$$\frac{\text{Reacting mass}}{\text{molar mass}} = \frac{\text{vol at s.t.p}}{\text{molar gas vol}}$$

$$\Rightarrow \frac{0.07g}{\text{molar mass}} = \frac{56cm^3}{22400cm^3/mol}$$

$$\Rightarrow \text{molar mass} = \frac{0.07 \times 22400}{56} = 28g/mol$$

% of hydrogen in hydride = 14.29%

% of carbon in hydride = (100 – 14.29)%

= 85.71%

Since the composition of the hydride is express in percentage, to obtain the mass of each component of the hydride consider 100g of hydride

Mass of carbon= 85.71%% of 100g

$$= \frac{85.71}{100} \times 100g = 85.71g$$

Mass of hydrogen = 14.29% of 100g

$$= \frac{14.29}{100} \times 100g = 14.29g$$

C	:	H
$\frac{85.71}{100}$	:	$\frac{14.29}{100}$
7.0975	:	14.29
1	:	2

Empirical formula is CH_2

let $(CH_2)n = 28$

$(12+2)n = 28$

$14n = 28$

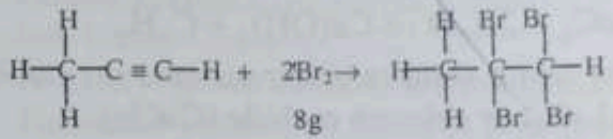
$\therefore n = 2$

$(CH_2)n = (CH_2)_2 = C_2H_4$

Hence the molecular formula of the hydride is C_2H_4

Correct option is C

UME/82/12



$$\cap_{Br_2} = \frac{\text{Reacting mass}}{\text{molar mass}} = \frac{8g}{160g/mol} = 0.05mol$$

$$\cap C_3H_4 = \frac{1}{2} \times 0.05mol = 0.025mol$$

$$= \cap C_3H_4 = \frac{\text{Reacting mass}}{\text{molar mass}}$$

$$0.025 = \frac{\text{Reacting mass}}{40g/mol}$$

Reacting mass = 0.025 x 40g/mol = 1.0g

Correct option is B

UME/82/17

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

$$\cap_{CH_4} = \frac{\text{Reacting mass}}{\text{molar mass}} = \frac{0.16g}{16g} = 0.01mol$$

Heat gain by water (Q) = $mc\Delta\theta$

= 100g x 4.2J/g^{0}c x 40^{0}c

= 16800J = 16.8kJ

But heat gain by water = heat liberated by burning CH_4 provided no heat is loss to the surrounding.

$\Rightarrow$ Heat liberated by CH_4 = Q = 16.8kJ

$\Rightarrow$ 0.01mole of CH_4 liberated 16.8kJ

1 mole of CH_4 .....xkJ

$$\frac{0.01}{1} = \frac{16.8}{x}$$

$$x = \frac{16.8}{0.01} = 1680kJ$$

Hence the enthalpy of combustion of CH_4 is -1680kJ/mol. Note that the negative sign indicate that the process is an exothermic reaction.

Correct option is E

UME/82/35

When water reacts with carbide gases are usually liberated. The gases liberated depend on the carbide used.

$$AL_4C_3 + 12H_2O \rightarrow 4AL(OH)_3 + 3CH_4$$

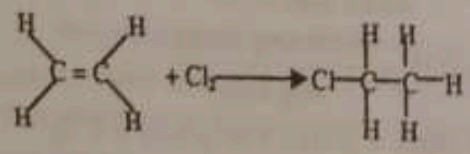
$$CaC_2 + 2H_2O \rightarrow Ca(OH)_2 + C_2H_2$$

The white solid is either aluminium carbide (AL_4C_3) or calcium carbide ($CaCl_2$).

Correct option is C

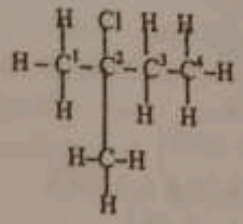
UME/82/37

The reaction that takes place between an alkenes (C_2H_4) and halogens (Cl, Br, F) is an addition reaction e.g.



Correct option is C

UME/82/50



i. The longest carbon chain contains four carbon atoms. Hence the parent name is butane.

ii. There is a chlorine and methyl group attached to carbon 2. hence the name of the substituent group is 2-chloro-2-methyl

Therefore the name of the compound is 2-chloro-2-methylbutane.

Correct option is C

UME 1983

UME/83/2

The Alkanol obtained from the production of soap is A. ethanol B. glycerol C. methanol D. propanol E. glycerol.

UME/83/4

Consecutive members of an Alkane homologous series differ by

A. CHB. CH_2 C. CH_3D. C_5H_5E. C_nH_{2n+2}

Questions 8-10 are base on the following

An unknown organic compound X has a relative molecular mass of 180.It is a colourless crystalline solid,ready soluble in water.X contains the elements C,H, and O in the atomic ratio 1:2:1.The compound has a sweet taste and melts on heating.In the presence of yeast and in the absence of air,X is converted to compound Y and a colourless gas.Compond Y reacts with sodium metal to produce a gas Z which gives a 'pop' sound with a glowing splint.Y also reacts with ethanoic acid to give a sweet smelling compound W.

UME/83/8

Compound W is A. a soap B. an oil C. an Alkane D. an ester E. sucrose.

UME/83/9

The molecular formula of X is

A. $C_{12}H_{22}O_{11}$ B. $C_6H_{12}O_6$ C.$C_3H_6O_3$ D.$C_7H_{14}O_7$ E.$C_4H_8O_2$

UME/83/10

Reaction of X with yeast forms the basis of the A. plastic industry B. textile industry C. brewing industry D. soap industry E. dyeing industry.

UME/83/19

$$C_2H_5 - \underset{\underset{CH_3}{|}}{C} = CH_2$$

The correct name of the compound with the above structural formula is A. 2-methylbutane B. 2-methylbut- 2-ene C. 2-methylbut-1-ene D. 2-ethylprop-1-ene E. 2-ethylprop-2-ene.

UME/83/20

How many isomeric forms are there for the molecular formula $C_3H_6Br_2$? A. 1 B. 2 C. 3 D. 4 E. 5

UME/83/38

The cracking process is very important in the petroleum industry because it A. gives purer products B. yields more lubricants C. yields more engine fuels D. yields more asphalt E. yields more candle wax.

SOLUTION TO UME 1983

UME/83/2

Soaponification is the alkaline hydrolysis of fats and oils to produce soap and glycerol (propane–1,2,3-triol).

Correct option is B

UME/83/4

Homologous series is a family of an organic compound which follows a regular structural pattern and in which each successive member differs from others with a molecular formula of $-CH_2$ or a molecular weight of 14.

Correct option is B

UME/83/8-10

An organic compound with a relative molecular mass of 180 is probably glucose or fructose.Glucose or fructose is a colourless crystalline solid readily soluble in water and contains C, H & O in the radio 1:2:1. Both melt when heated and taste sweet. Hence X is glucose or fructose.

The fermentation of glucose produces ethanol and carbon IV oxide. Hence Y is ethanol.

$$C_6H_{12}O_6 \xrightarrow{\text{Zymase}} 2C_2H_5OH + 2CO_2$$

The above reaction form the bases of the brewing industry

$$2C_2H_5OH + 2Na \rightarrow 2C_2H_5ONa + H_2$$

Hence Z is hydrogen gas

$$C_2H_5OH + CH_3COOH \xrightarrow{H^+} CH3NOC_2H_5 + H_2O$$

Hence W is ethylethanoate which is an ester.

UME/83/8

Correct option is D

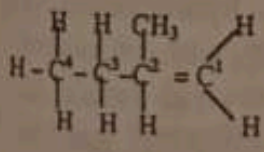
UME/83/9

Correct option is B

UME/83/10

Correct option is C

UME/83/19



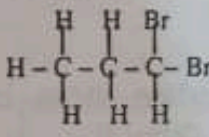
i. Number the carbon atom such that the lowest numbering is given to the functional group i.e. the double bond.
ii. The longest carbon chains contain 4 carbon atoms with a double bond in carbon 1. Hence the parent name is but-1-ene.
iii. A methyl group is attached to carbon 2. Hence the substituent name is 2-methyl.
iv. The name of the compound is 2-methylbut-1-ene.

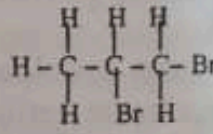
Correct option is C

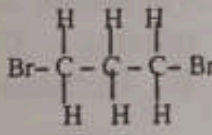
UME/83/20

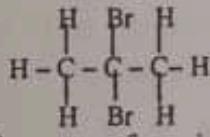
To determine the number of isomers in C_3H_6Br the following are the procedure.

i. Draw the longest carbon chain and varies the position of the bromine along the chain since there are only three carbons in the chain. This is shown below;


1,1-dibromopropane


1,2-dibromopropane


1,3-dibromopropane


2,2-dibromopropane

There are four isomers in $C_3H_6Br_2$

Correct option is D

UME/83/38

Cracking is the process of breaking down high molecular weight of hydrocarbons into simpler ones of economics importance. If heat is applied in the cracking process it is called thermal cracking or pyrolysis while if catalyst is use in the process, it is called catalytic cracking. Thermal cracking occur at 700^0C and a

pressure of 50atm while catalytic cracking occur at 500°C and a pressure of 1atm.

Catalytic cracking is important because the process is more controllable and it gives petrol of high quality.

The whole essence of cracking is to convert hydrocarbon outside petrol range to hydrocarbon within petrol range.

Correct option is C

UME 1984

UME/84/28

An organic compound with a vapour density of 56.5 has the following percentage composition: [C = 53.1%, N = 12.4%, O = 28.3%, H = 6.2%.]

The molecular formula of the compound is A. $C_3H_6O_2N$ B. $C_5H_6O_2N$ C. $(C_5H_7O_2N)½$ D. $C_5H_7O_2N$) E. $(C_5H_7O_2N)_2$

[Relative atomic masses: N=14, 0=16, C=12, H=1]

UME/84/29

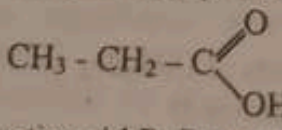
The hybridization of the carbon atom in ethyne is A. sp^4 B. sp^3 C. sp^2 D. sp E. s.

UME/84/30

When the kerosene fraction from petroleum is heated at high temperature,a lower boiling liquid is obtained. This process is known as A. polymerization B. refining C. hydrogenation D. cracking E. fractional distillation.

UME/84/31

The name of the compound



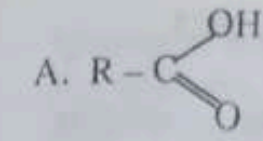
is A. acetic acid B. Propanal C. propanol D. ethanoic acid E. propanoic acid.

UME/84/32

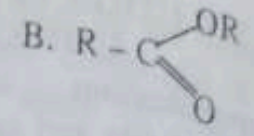
Alkaline hydrolysis of naturally occurring fats and oils yields A. fats and acids B. soaps and glycerol C. margarine and butter D. esters E. detergents.

UME/84/33

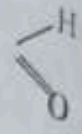
Which of the following represents a carboxylic acid?



B.



C. H_2SO_4 D. R.COOCOR E.



UME/84/34

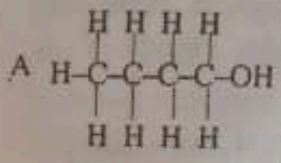
Which of the following statements is INCORRECT?

A. Fractional distillation of crude petroleum will give the following hydrocarbon fuels in order of increasing boiling point: Butane <petrol <kerosene B. HC≡CH will serve as a monomer in the preparation of polythene C. Both but-l-ene and but-l-yne will decolorize bromine readily D. But-2-ene will react with chlorine to form 2,3-dichlorobutane E. Calcium carbide will react with water to form any Alkyne.

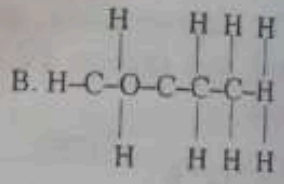
UME/84/42

Which of the following structural fomulae is NOT isomeric with the others?

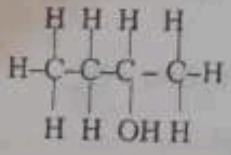
A



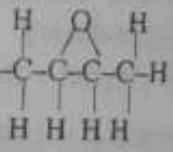
B.



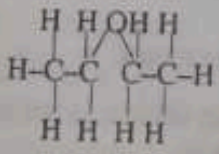
C.



D.



E.



UME/84/43

Alkanes A. are all gases B. have the general formula $C_nH_{2n+2}O$ C. contain only carbon and hydrogen D. are usually soluble in water E. are usually active compounds.

UME/84/44

If an excess of a liquid hydrocarbon is poured into a jar of chlorine, and the sealed jar is then exposed for several hours to bright sunlight, all the chlorine gas is consumed. The hydrocarbon is said to have

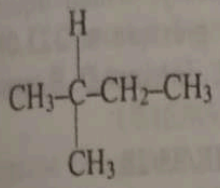
undergone A. a polymerization reaction B. an isomerization reaction C. an addition reaction D. a substitution reaction E. a reduction reaction.

UME/84/45

The function of conc. H_2SO_4 in the esterification of ethanoic acid with ethanol is to A. serve as a dehydrating agent B. serve as a solvent C. act as a catalyst D. Prevent any side reaction E. serve as an oxidizing agent.

UME/84/49

The I.U.P.A.C. name for the compound



is A. isopropylethene B. acetylene C. 3-methyibutane D. 2-methylbutane E. 5-methylpentane

SOLUTION TO UME 1984

UME/84/28

Considering 100g of the compound then

$$\text{Mass of carbon} = 53.1\% \text{ of } 100\text{g} = \frac{53.1}{100} \times 100\text{g} = 53.10\text{g}$$

$$\text{Mass of nitrogen} = 12.4\% \text{ of } 100\text{g} = \frac{12.4}{100} \times 100\text{g} = 12.40\text{g}$$

$$\text{Mass of oxygen} = 28.3\% \text{ of } 100\text{g} = \frac{28.3}{100} \times 100\text{g} = 28.30\text{g}$$

$$\text{Mass of nitrogen} = 12.4\% \text{ of } 100\text{g} = \frac{12.4}{100} \times 100\text{g} = 12.40\text{g}$$

C	:	H	:	O	:	N
$\frac{53.10}{12}$	:	$\frac{6.20}{1}$	:	$\frac{28.3}{16}$	:	$\frac{12.40}{14}$
4.4250	:	6.20	:	1.7688	:	0.8857
4.9960	:	7.0001	:	1.9971	:	1

The empirical formula is $C_5H_7O_2N$

let $(C_5H_7O_2N)n = 56.5x2$

$[5(12) + 7(1) + 2(16) + 14]n = 113$

$[60 + 7 + 32 + 14]n = 113$

$113n = 113$

$$n = \frac{113}{113} = 1$$

The molecular formula of the compound is $(C_5H_7O_2N)$

The correct option is D

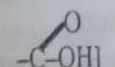
UME/84/29

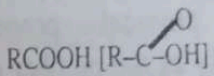
Soaponification is the alkaline hydrolysis of naturally occurring fats or oils to yield soap and glycerol (i.e. propane 1,2,3-triol).

Correct option is B

UME/84/33

Carboxylic acids (organic acid or Alkanoic acid) have the functional group

–COOH [] and the general formula of



Correct option is A

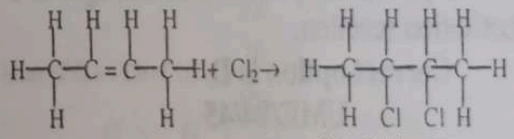
UME/84/34

i. The functional distillation of crude petroleum will yield hydrocarbon whose boiling points are in the order of butane< petrol< kerosene.

ii. Polyethene is a polymer of ethane i.e. ethane is the monomeric unit of polyethene.

iii. Unsaturated hydrocarbon (i.e. Alkyne and alkene) will decolorize bromine water.

iv. The reaction between but-2-ene and chlorine give the product show below



2,3-dichlorobutane

v. Calcium carbide react with water to form only ethyne not any Alkyne.

$$CaC_2 + 2H_2O \rightarrow Ca(OH)_2 + C_2H_2$$

Correct option is E

UME/84/42

Isomerism is the phenomenon whereby two or more compound known as the isomer with the same molecular formula but

different physical and/or chemical properties.

Alkanol and ether are functional isomers. In the given option A and C are Alkanol while E is ether. The compound in option D is an epoxide.

Epoxide is not an isomers with either the Alkanols or ether.

Correct option is D

UME/84/45

The Alkanes have the following properties.

i. They have general formula of C_nH_{2n+2}
ii. Lower member exist as gas at room temperatures while higher member exist as solid at room temperature.
iii. They have similar chemical properties.
iv. Their physical properties change gradually as the number of carbon atom per molecule increases.
v. They contain only carbon and hydrogen.
vi. They have low affinity for reaction i.e. they have low rate of reaction.
vii. They are insoluble in water because they are not polar.

Correct option is D

UME/84/44

The reaction of hydrocarbon and chlorine in the presence of sunlight is a free recalled reaction which is a characteristics reaction of the alkane. Since alkanes are known to undergo substitution reaction, the reaction between liquid hydrocarbon and chlorine gas in the presence of sunlight is a substitution reaction.

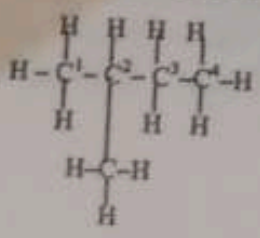
Correct option is D

UME/84/45

In esterification, the function of the mineral acid (H_2SO_4, HCl) is to catalysed the reaction. Note that it is not advisable to used conc. H_2SO_4 to catalyzed esterificaiton because it dehydrate the ester form.

Correct option is C

UME/84/49



2-methylbutane

Correct option is D

UME 1985

UME/85/3

An organic compound contains 72% carbon, 12% hydrogen and 16% oxygen by mass. The empirical formula of the compound is A. $C_8H_{22}O_3$ B. $C_6H_{10}O_3$ C. $C_{12}H_{12}O$ D. $C_6H_{12}O$ E. C_3H_6O. [H = 1, C = 12, O = 16]

UME/85/15

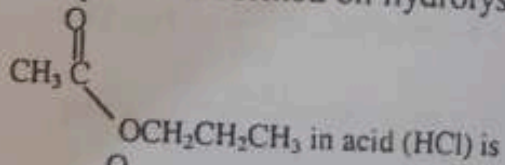
The boiling point of water, ethanol, toluene and butan 2-o1 are 373.0k, 351.3k, 383.6k and 372.5k respectively. Which liquid has the highest vapour pressure at 323.0k? A. Water B. Toluene C. Ethanol D. Butan-2-ol E. None.

UME/85/28

A man suspected of being drunk is made to pass his breath into acidified potassium dichromate solution. If his breath carries a significant level of ethanol, the final colour of the solution is A. pink B. purple C. orange D. blue-black E. green.

UME/85/31

The products formed on hydrolysis of



$OCH_2CH_2CH_3$ in acid (HCl) is

A. $CH_3C(=O)-OH + CH_3CH_2CH_2Cl$

B. $CH_3CH_2CH_2HO + CH_3C(=O)Cl$

C. $CH_3C(=O)-O-H + HOCH_2CH_2CH_3$

D. $CH_3C(=O)-O-H-CH_3CH_3$

E. $CH_3CH_2C(=O)OH + CH_3CH_2OH$

UME/85/33

The oxidation of $CH_3-CH_2-CH_2-\underset{H}{\overset{CH_3}{\underset{|}{\overset{|}{C}}}}-OH$ gives

A. 2-butanone B. 2 butanal C. butane D. butanoic acid E. 3-butanal.

UME/85/35

The I.U.P.A.C. name for the compound

$$CH_3-\overset{CH_3}{\overset{|}{CH}}-CH=CH-CH_3$$

is A. 2-methyl-3-pentene B. 4-methyl-2-pentane C. 2-methyl-2-pentene D. 4-methyl-3-pentene E. 2-methyl-3-pentane.

UME/85/37

An organic compound decolorized acidified $KMnO_4$solution but failed to react with Ammoniacal silver nitrate solution. The organic compound is likely to be A. a carboxylic acid B. an Alkane C. an alkene D. an Alkyne E. an Alkanone.

UME/85/39

Which of the following is the functional group of carboxylic acids?

A. -OH B. $>C=O$ C. $-\underset{|}{\overset{|}{C}}-OH$

D. $-C\begin{matrix}=O\\ \diagdown OH\end{matrix}$ E. $-C\equiv N$

UME/85/40

Which of the following substances is the most abundant in the universe? A. Carbon B. Air C. Water D. Oxygen E. Hydrogen.

Questions 41 and 42 are based on the following:

A colourless organic compound X was burnt in excess air to give two colourless and odourless gases, Y and Z as products. X does not decolorize bromine vapour; Y turns lime milky while Z gives a blue colour with copper(II) tetraoxosulphate (VI).

UME/85/41

Compound X is A. an alkene B. an Alkane C. an Alkyne D. tetrachloromethane E. dichloromethane.

UME/85/42

Y and Z are respectively A. CO_2 and NH_3 B. CO and NH_3 C. SO_2 and H_2O D. CO_2 and H_2O E. $SO_2$and NH_3.

UME/85/47

The process involved in the conversion of oil into margarine is known as A. hydrogenation B. condensation C. pyrolysis D. dehydration E. cracking.

UME/85/49

Which of the following roles does sodium chloride play in soap preparation? It A. reacts with glycerol B. purifies the soap C. accelerates the decomposition of the fat or oil D. separates the soap from the glycerol E. converts the fatty acid to its sodium salt.

UME/85/50

The function of sulphur during the vulcanization of rubber is to A. act as catalyst for the polymerization of rubber molecules B. convert rubber from thermosetting to thermoplastic polymer C. form chains which bind rubber molecules together D. break down rubber polymer E. shorten the chain length of rubber polymer.

SOLUTION TO UME 1985

UME/85/3

Considering 100g of the compound

$$\text{Mass of C} = 72\% \text{ of } 100\text{g} = \frac{72}{100} \times 100\text{g} = 72\text{g}$$

$$\text{Mass of H} = 12\% \text{ of } 100\text{g} = \frac{12}{100} \times 100\text{g} = 12\text{g}$$

$$\text{Mass of O} = 16\% \text{ of } 100\text{g} = \frac{16}{100} \times 100\text{g} = 16\text{g}$$

C	:	H	:	O
$\frac{72}{12}$	:	$\frac{12}{1}$	:	$\frac{16}{16}$
6	:	12	:	1

The empirical formula of the compound is $C_6H_{12}O$

The correct option is D

UME/85/45

A substance boils when the saturated vapour pressure is equal to external atmospheric pressure.

$$P_{sat} = P_{atm} = 1atm$$

$$T_{boil} \ldots\ldots\ldots\ldots P_{atm}$$

$$T_2 \ldots\ldots\ldots\ldots P$$

$$\Rightarrow \frac{T_{boil}}{T_2} = \frac{P_{atm}}{P}$$

i.e.

$$P = \frac{T_2 P_{atm}}{T_{boil}}$$

$$P = \frac{T_2}{T_{boil}} \times P_{atm}$$

where $T_2 = 323.0k$

T_{boil} = temperature at which the substance boils.

P = saturated vapour pressure at T_2

$$P = \frac{T_2}{T_{boil}} \times P_{atm}$$

T_2 and P_{atm} are constant hence

$$P \; \alpha \frac{1}{T_{boil}}$$

which implies that the liquid with the highest boiling point we have the lowest vapour pressure but the liquid with the lowest boiling point will have the highest vapour pressure.

Correct option is C

UME/85/28

Alkanols are reducing agent. They decolourize permanganate ($KMnO_4$) or change the orange colour of $K_2Cr_2O_7$ to green.

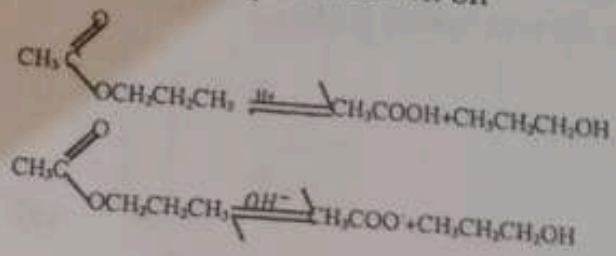
Correct option is E

UME/85/31

The hydrolysis of ester is either carried out in alkaline medium or in acid medium

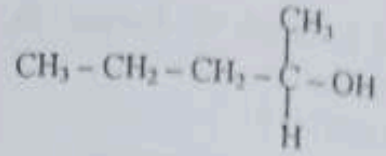
$$RCOOR^1 + H-OH \overset{H^+}{\rightleftharpoons} RCOOH + R^1OH$$

$$RCOOR^1 + H-OH \overset{OH^-}{\rightleftharpoons} RCOO^- + R^1OH$$



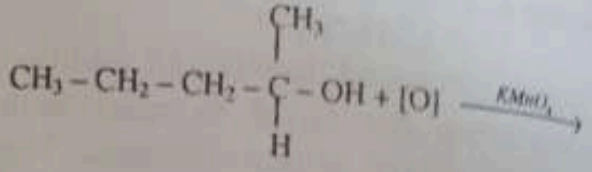
Correct option is C

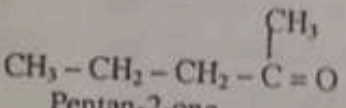
UME/85/33



is a secondary Alkanol because the carbon atom that bear the –OH group is link directly to two alkyl group (i.e. contain one hydrogen atom).

When secondary Alkanol are oxidized they form Alkanone.

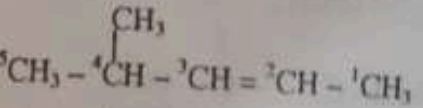




Pentan-2-one

None of the option is correct

UME/85/35



4-methylpent-e-ene

Correct option is B

UME/85/37

An organic compound that decolourize $KMnO_4$ or changes the orange colour of $K_2Cr_2O_7$ to green is unsaturated (i.e it contain double or triple bond). Such compound is either Alkanes or alkynes. But alkenes do not react with Ammoniacal copper I chloride or silver nitrate. Only terminal Alkyne (i.e. Alkyne in which their triple bond is in the first carbon atom) react with Ammoniacal copper I chloride or silver nitrate.

Correct option is C

UME/85/39

The functional and general formulae of carboxylic acid are -COOH [– C – OH]

And RCOOH [R–C(=O)–OH] respectively.

Correct option is D

All hydrocarbons burn in air to produce two primary compounds which are water and CO_2. CO_2 turn lime water milky while water turns anhydrous $CuSO_4$ to blue hydrate $CuSO_4$.

Hence Y is CO_2 and Z is H_2O

Since X does not decolourize bromine water, it is saturated. Hence X is an Alkane.

UME/85/41

Correct option is B

UME/85/42

Correct option is D

UME/85/47

Hydrogenation is the process whereby an oil (from either groundnut, soya beans or palm oil etc) is heated to a temperature of about 200°C (or 180°C) in the presence of a finely divided nickel (Ni), which act as a catalyst and hydrogen is bubbled through the heated oil at a pressure of about 5atm to form solid fat. This process is also called HARDENING OF OIL.

Correct option is A

UME/85/49

Soaponification is the alkaline hydrolysis of fats or oils to produce soap and glycerol. Conc. NaCl is added to the mixture of soap and glycerol to decrease the solubility of the soap so that it separate out of the mixture as a hard cake.

Correct option is D

UME/85/50

Vulcanization is the process of heating sulphur with rubber under pressure in order to toughen it. The sulphur adds to the double bond by breaking them to form carbon-carbon and carbon-sulphur cross link covalent bonds. It was discovered by Charles Goodyear.

Correct option is C

UME 1986

UME/86/42

Which of the following is used as an 'anti-knock' in automobile engines? A. Tetraethyl silane B. Lead tetra-ethyl C. Glycerol D. n-heptane.

UME/86/43

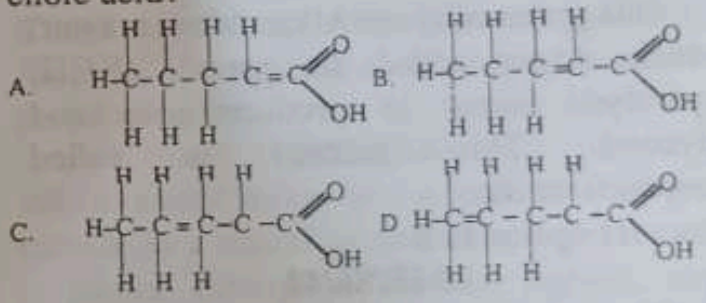
What reaction takes place when palm-oil is added to potash and foams are observed? A. Neutralization B. Saponification C. Esterification D. Sailing-out.

UME/86/44

How many isomers can be formed from organic compounds with the formula C_3H_8O? A. 2 B. 3 C. 4 D. 5

UME/86/45

Which is the structural formula for pent-2-enoic acid?



UME/86/46

When ethanol is heated with excess concentrated sulphuric acid, the ethanol is A. oxidised to ethene B. polymerized to polyethene C. dehydrated to ethanol D. dehydrated to ethyne.

UME/86/47

Which of the following compounds is NOT formed by the action of chlorine on methane? A. CH_3Cl B. C_2H_5Cl C. CH_2Cl_2 D. $CHCl_3$.

UME/86/48

The general formula of an alkyl halide (where X represents the halide) is

A. $C_nH_{2n-2}X$ B. $C_nH_{2n+1}X$ C. $C_nH_{2n+2}X$ D. $C_nH_{2n}X$

UME/86/49

Which of the following are made by the process of polymerization? A. Nylon and

soap B. Nylon and artificial rubber C. Soap and butane D. Margarine and nylon.

UME/86/50

Starch can be converted to ethyl alcohol by A. distillation B. fermentation C. isomerization D. cracking.

SOLUTION TO UME 1986

UME/86/42

Knocking is the violent explosion in the automobile cylinder due to uneven or rapidly burning of the straight chain Alkane (heptane). Knocking is prevent by anti-knocking agent similar tetraethyl lead (TEL) $[(C_2H_5)_4Pb]$, tetraethyl lead (TML) $[(CH_3)_4Pb]$, 1,2-dibromo ethane etc.

Correct option is B

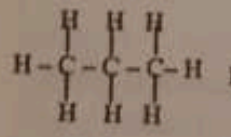
UME/86/43

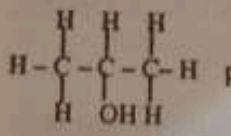
Oils (palm-oils) are Alkanoate (i.e. ester) which when added to potash (KOH) hydrolysis occur to produce soap and glycerol. This process is called soaponification.

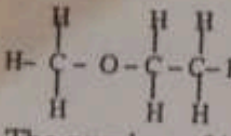
Correct option is B

UME/86/44

The organic compound satisfy the general formulae $C_nH_{2n+1}OH$ which is C_3H_7OH when n=3. Since the compound is an Alkanol it will be a functional isomers to the ether. The isomers are show below;


propan-1-ol


propan-2-ol

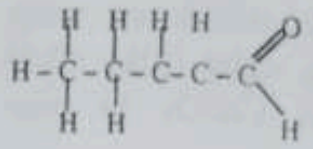

methoxyethane

The number of isomer is 3

Correct option is B

UME/86/45

Pent-2-enoic acid has the structural formulae of



Correct option is D

UME/86/46

When ethanol is heated with excess concentrated acid (H_2SO_4) it loses a water molecule to form ethane. A reaction in which a water molecule is reactive from a substance is called dehydration.

Correct option is C

UME/86/47

The reaction between CH_4 and Cl_2 is an example of free radical reaction which occurs in three stages which are listed and explained below;

1. **Chain limitation** – it is the state whereby molecules break down to form radical

$$Cl_2 \rightarrow 2\dot{C}l$$

2. **Chain propagation** – is the stage in which molecules combine with reached to form molecules and reduced.

$$CH_4 + \dot{C}l \rightarrow \dot{C}H_3 + HCl$$

$$\dot{C}H_3 + Cl_2 \rightarrow CH_3Cl + \dot{C}l$$

also CH_2Cl_2 $CHCl_3$& CCL_4 are also form.

3. **Chain formation** – it is the stage in which free radical combined together to form molecules

$$\dot{C}l + \dot{C}l + S \rightarrow Cl_2$$

$$\dot{C}H_3 + \dot{C}H_3 \rightarrow CH_3CH_3$$

Note that S is a third body which absorbed the heat liberated by chlorine free radical when they combined.

Correct option is B

UME/86/49

Polymers are giant molecules produce by the combination of two or more compound known as monomers. Examples

of polymers are PVC, polyether nylon, artificial rubber, polystyrene, PTFE etc.

Correct option is B

UME/86/50

Fermentation is the phenomenon whereby micro-organisms break down large organic molecules (such as starch) to smaller molecules (such as ethanol also known as ethyl alcohol).

Correct option is B

UME 1987

UME/87/15

Oil spillage in ponds and creeks can be cleaned up by A. burning off the oil layer B. spraying with detergent C. dispersal with compressed air D. spraying with host water.

UME/87/41

Which of the following compounds will give a precipitate with an aqueous Ammoniacal solution of copper (1) chloride? A. $CH_3CH = CHCH_3$ B. $CH_3C \equiv C - CH_3$ C. $HC \equiv C - CH_2CH_3$ D. $CH_2 - CH - CH = CH_2$.

UME/87/42

The efficiency of petrol as a fuel in high compression internal combustion engines improves with an increase in the amount of A. branched chain Alkanes B. straight chain Alkanes C. cycloalkanes D. halogenated hydrocarbons.

UME/87/43

A palm wine seller stoppered a bottle of his palm wine in his stall and after a few hours the bottle exploded. Which of the following equations represents the reaction that occurred A. $C_6H_{12}O_6 \xrightarrow{\text{enzymes}} 2C_2H_5OH + 2CO_{2(g)}$ B. $C_2H_5OH \rightarrow CH_2{=}CH_2(g) + H_2O$ C. $C_2H_5OH + dilH_2SO_4 \rightarrow C_2H_5OSO_2OH$ D. $2C_6H_{12}O_6 \rightarrow C_{12}H_{22}O_{11} \rightarrow + H_2O$.

UME/87/44

Ethanol reacts with aqueous sodium mono-oxolodate (1) to give a bright yellow solid with a characteristic smell. The product is a. trichloromethane B. triiodomethane C. iodoethane D. Ethanal.

UME/87/45

The most volatile fraction obtained from fractional distillation of crude petroleum contains A. butane, propane and kerosene B. butane, propane and petrol C. ethane, methane and benzene D. methane, ethane and propane.

UME/87/46

Local black soap is made by boiling palm oil with liquid extract of ash. The function of the ash is to provide the A. acid B. ester of Alkanoic acid C. alkali D Alkanol.

UME/87/47

Synthetic rubber is made by polymerization of

A. 2-methylbuta-1,3-diene

B. 2- methyl buta-1, 2- diene

C. 2- methyl but-1-ene

D. 2- methyl but-2-ene

UME/87/48

Complete oxidation of propan-1-ol gives A. Propanal B. propan-2-al C. propan-1-one D. propanoic acid.

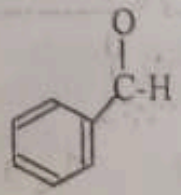
UME/87/49

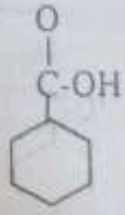
When water drops are added to calcium carbide in a container and the gas produced is passed through a jet and lighted, the resultant flame is called an

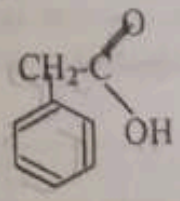
A. oxyethylene flame B. oxyhydrocarbon flame. C. oxyacetylene flame D. oxymethane flame.

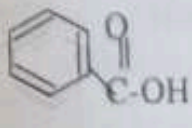
UME/87/50

The structure of benzoic acid is.

A. 

B. 

C. 

D. 

SOLUTION TO UME 1987

UME/87/15

Oil spillage in creeks and ponds (i.e. body of rivers) are cleansed by dispersal with compressed air but for large body of river oil spillages are cleansed by spraying with appropriate solvent.

Correct option is C

UME/87/41

Terminal alkyne reacts with ammoniacal copper (I) chloride or silver nitrate. This reaction distinguishes terminal alkyne from alkene. Terminal alkyne are alkyne with their triple bond in the first carbon atom.

Correct option is C

UME/87/42

Octane number of a petrol is the percentage of 2,2,4-trimethylpentane (iso-octane) in a mixture with a heptane which give the same performance as the petrol when both are used in standard engine.

Hence the efficiency of petrol increases with the amount of branch chain alkanes (i.e. 2,2,4-trimethylpentane).

Correct option is A

UME/87/43

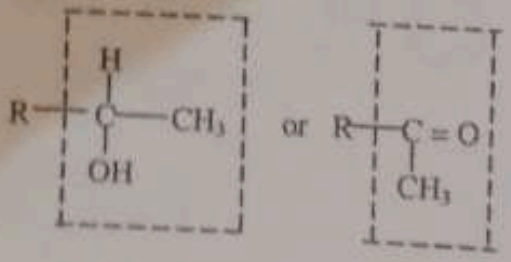
Palm wine taste sweet because of the high sugar content (e.g. glucose) when left for sometime the enzyme zymase in yeast convert the glucose to ethanol and CO_2. As time goes on the ethanol form is converted to ethanoic acid. Hence the major reaction that occur in is

$$C_6H_{12}O_6 \xrightarrow{\text{enzymes}} 2C_2H_5OH + 2CO_2$$

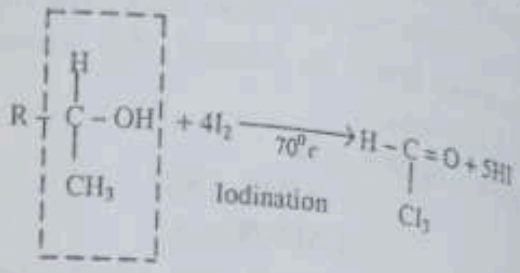
Correct option is A

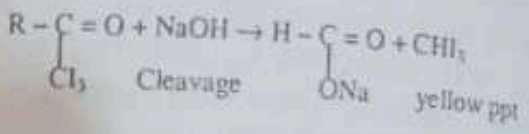
UME/87/44

Iodoform reaction is the reaction between $NaOH/I_2$ and any compound with the functionality.



Which means that any alkanols or carbonyl compound (alkanal or alkanone) with the functionality shown above with undergo idoform test. The iodoform reaction of ethanol is shown below





The yellow precipitate indicates triiodomethane. The first reaction is called IODINATON while the second reaction is called CLEAVAGE. Generally the reaction can be represented as

$$CH_3CH_2OH \xrightarrow[70^0C,\ Heat]{I_2/NaOH} HCOONa + \underset{\text{yellow}}{CHI_3}$$

The correct option is B

UME/87/45

The first products of fractional distillation of crude oil is natural gas consisting of hydrocarbons with $C_1 - C_4$ i.e. methane, ethane, propane and butane.

The correct option is D

UME/87/46

Extract of ash is rich in NaoH or KOH. The function of the ash is to supply the alkaline require to react with the palm oil for the preparation of soap.

The correct option is C

UME/87/47

Synthetic rubbers are artificial rubber preparation by polymerization. Examples are listed and explained below;

(i) **Styrene-butachene rubber (SBR):** This is the most useful synthetic rubber produce by the co-polymerization of

styrene and buta -1, 3-duene. It is used in the making a vehicle types and footwear because of its high resistance to abrasive.

(ii) **Butyl Ruther:** This is a synthetic rubber produce by the co-polymerization of 2-methylpropene and 2-methylbutan-1, 3-diene.

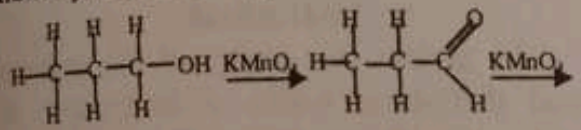
(iii) **Neoprene:** This is a synthetic rubber form by the co-polymerization of chloroprene and styrene. Neoprene rubber is also known as poly (2-chlorobuta-1, 3-diene).

Note that 2-methylbuta-1, 3-diene is also known as isoprene and it is found in natural rubber i.e. it is the monomeric unit of natural rubber.

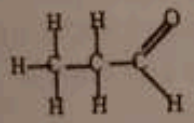
Correct option is A

UME/87/48

Propan-1-o1 is a primary monohydric alcohol. The complete oxidation of primary monohydric alcohol give alkanoic acid.



Propan-1-o1 propanal



Propanoic acid

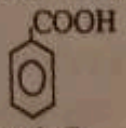
Correct option is D

UME/87/49

Ethyne is also known as acetylene. When ethyne combine with oxygen it give a flame known as oxyacetylene flame. It is used in mending metals.

UME/87/50

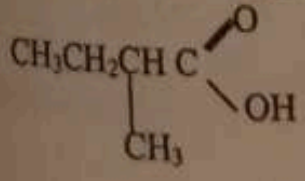
The structure of benzoic acid is



Correct option is B

UME 1988

UME/88/41



The IUPAG name for

A. 2 - methylbutanoic acid

B. 2 - methyl-1-hydroxyketone

C. 2 - methyl-1 -hydroxy aldehyde

D. 2 - methylpentanoic acid.

UME/88/42

Methlyethanoate reacts with ammonia to yield A. methalmine and ethanol B ethylamine and methanol C. methanamide and ethanol D. ethanamide and methanol.

UME/88/43

Alkanoates are formed by the reaction of alkanoic acids with A alkyl halides B. alkanols C. ethers D. sodium

UME/88/44

The acidic hydrogen in the compound $H\text{-}C{\equiv}C\text{-}CH{=}CH\text{-}CH_3$ is the hydrogen attached to carbon number A.5 B.4 C.3 D.1

UME/88/45

The four classes of hydrocarbons are A ethane, ethene, ethyne and benzene B. alkanes, alkenes, alkynes and aromatics C. alkanes, alkenes, alkynes and benzene D. methane, ethane, propane and butane.

UME/88/46

$$\text{Alkanes} \xrightarrow{400\text{-}700^{\circ}C} \text{Alkenes} + \text{hydrogen} + \text{smaller Alkane}$$

The above reaction is known as A. photolysis B. cracking C. isomerization D. forming.

UME/88/47

In the reaction $2(C_6H_{10}O_5)_n + nH_2O \xrightarrow[60^{0}C]{\text{diastase}} {}_nC_{12}H_{22}O_{11}$

diastase is functioning as A. a dehydrating agent B. a reducing agent C. an oxidizing agent D. a catalyst.

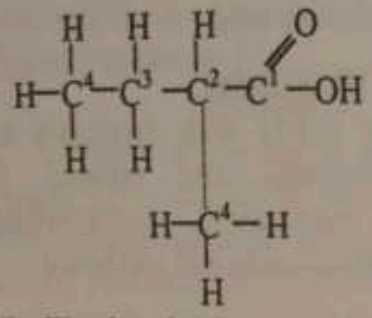
UME/88/48

Which of the following compounds has the highest boiling point?

A. $CH_3CH_2CH_2CH_2OH$ B. $CH_3CH_2CH_2CHO$ C. $CH_3CH_2CH_2CH_3$ D. $CH_3CH_2O\,CH_2CH_3$.

SOLUTION TO JAMB 1988

UME/88/41



(i) The functional group of the compound is –COOH i.e. the compound is an alkanoic acid.

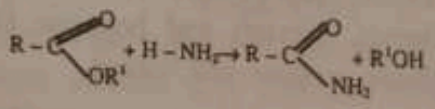
(ii) The longest carbon chain is 4 i.e. the compound butanoic acid.

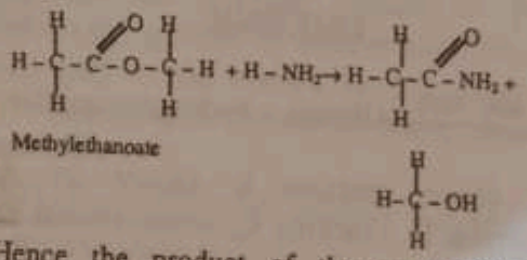
(iii) A methyl group is attacked to carbon atom 2 i.e. the substituent name is 2 methyl.

Therefore the name of the compound is 2-methylbutanoic acid.

UME/88/42

The react between an ester and ammonia (i.e. amonolysis of ester) is show generally below;





Methylethanoate

Hence the product of the ammonolysis of methylethanoate is ammoethane and methanol. Ammoethane is also known as ethylamide.

Correct option is D

UME/88/43

Alkanoates (esters) are form by the reaction of alkanoeil acids with alkanols.

Correct option is B

UME/88/44

The acid hydrogen in an alkyne is the hydrogen attached to the carbon atom bearing the ripple bond i.e. carbon 1.

Correct option is D

UME/88/45

The four class of hydrocarbon are alkanes, alkenes alkynes and aromatics

Correct option is B

UME/88/46

Cracking is the process of breaking down high molecular weigh of hydrocarbons into surplus ones of economics importance. If a catalyst is used to bring about the cracking it is called catalytic cracking but if heat is used to bring about the cracking it is called thermal cracking or pyrolysis.

Correct option is B

UME/88/47

In the conversion of starch to ethanol the enzyme diastase is used to catalyst the reaction.

Correct option is D

UME/88/48

The greater the degree of the chemical bond that exist within a compound, the greater the boiling point. Compound with hydrogen bonding have the highest boiling point followed by compound with permanent dipole-dipole interaction and least by dipole induced dipole interaction.

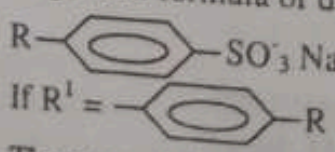
Compound with hydrogen boiling are the alkanol, alkanoic acid, amine etc. compound with permanent dipole-dipole interaction are the ether, alkanal, alkanone etc while compound with dipole induced dipole interaction arevthe Alkanes,Aromatics etc.

The compound give in the options are alkanol, alkanal, alkane and ether. The alkanol will have the highest boiling point.

Correct option is A

UME/88/49

The general formula of detergents is



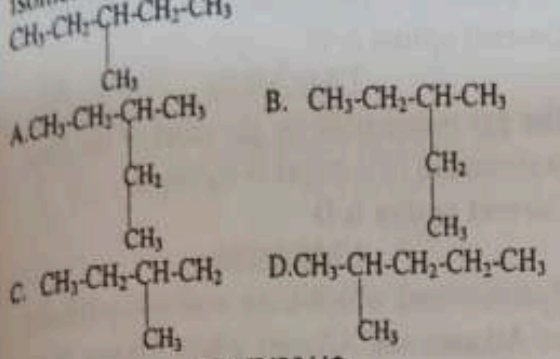
The general formula is $R^1 - SO^-_3Na^+$

Correct option is C

UME 1989

UME/89/41

Which of the following compounds is not an isomer of the compound?



UME/89/42

When excess chlorine is mixed with Ethene at room temperature, the product is A. 1,2-dichloroethane B. 1,2-dichloroethene C. 1,1-dichloroethane D. 1,1-dichloroethene.

UME/89/43

Vulcanization of rubber is a process by which A. isoprene units are joined to produce rubber B. rubber latex is coagulated C. sulphur is chemically combined in the rubber D. water is removed from-the rubber.

UME/89/44

The reaction between ethanoic acid and sodium hydroxide is an example of A. esterification B. neutralization C. hydroxylation D. hydrolysis.

UME/89/45

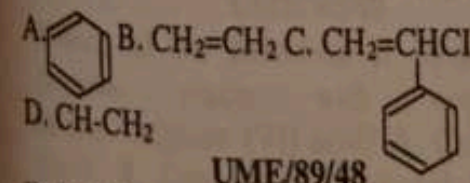
The bond which joins two ethanoic acid molecules in the liquid state is A. a covalent bond B. an ionic bond C. a dative covalent bond. D. a hydrogen bond.

UME/89/46

The alkaline hydrolysis of fats and oils produces soap and A. propane-1, 1, 3-triol B. propane-1, 3, 3-triol C. propane-1, 2, 2-triol D. propane-I, 2, 3-triol.

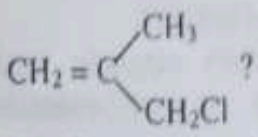
UME/89/47

Which of the following is NOT a monomer?



UME/89/48

What is the IUPAC name for the compound?



A. 1-chloro-2-methylprop-2,3-diene
B. 1-chloro-2-methylprop-2-ene
C. 3-chloro-2-methylprop-1-ene
D. 3-chloro-2-methylprop-1 ,2-ene

UME/89/49

The gas responsible for most of the fatal explosion incoal mines is A. butane B. ethane C. ethane D. methane.

UME/89/50

Three liquids X, Y and Z containing only hydrogen andcarbonwereburntonaspoonX andY burntwithsootyflames while Z did not. V is able to discharge the colour of bromine water whereas X and Z cannot. Which of the liquids would be aromatic in nature? A.XandZ B.Y C.X D.Z.

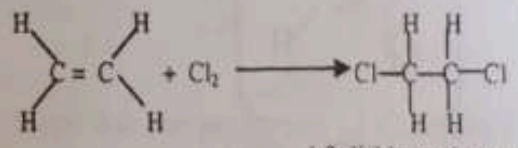
SOLUTION TO UME 1989

UME/89/41

Isomers are compounds with the same molecular formula but different physical and/or chemical properties. The only compound that is not an isomer to the given compound is given in option C.

The correct option is C

UME/89/42



1,2-dichloro ethenes

Correct option is A

UME/89/43

Vulcanization of rubber is the process of heating rubber with sulphur under pressure in order to toughen it i.e. It is the process by which sulphur is added chemical to a substance.

Correct option is C

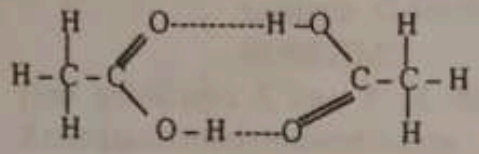
UME/89/44

The reaction between ethanoic acid and sodium hydroxide is an example of neutralization.

Correct option is B

UME/89/45

Alkanoic acids are polar in nature the bond which join two of its molecules together in liquid state is hydrogen bond. The hydrogen bonding in ethanoic acid is shown below.



The broken lines indicate hydrogen bond between two ethanoic acid.

The correct option is D

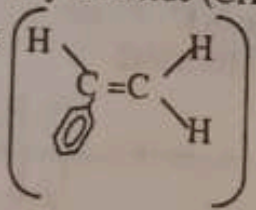
UME/89/46

Soaponification is the alkaline hydrolysis of facts or oils to form soap and glycerol (propan-1,2,3-triol)

Correct option is D

UME/89/47

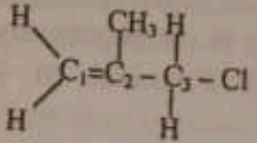
Monomers are compounds which link together to form a giant molecules called polymers e.g. ethene ($CH_2 = CH_2$), chloro ethene or vinyl chloride ($CH_2 = CHCl$),

Styrene 

Tetrafloroethene ($CF_2 - CF_2$),
ethyne ($CH \equiv CH$)

Correct option is A

UME/89/48



i. The longest chain contains 3 carbon atoms with a double bond in the first carbon atom. Hence the parent name is prop-1-ene.

ii. There is a methyl group in carbon 2 and a chlorine atom in carbon 3. hence the substituent name is 3-chloro-2-methyl

iii. The IUPAC is 3-chloro-2-methylpropen-1-ene.

Correct option is C

UME/89/49

The gas responsible for the most of the fatal explosion in coal mines is methane.

Correct option is D

UME/89/50

Hydrocarbons which burn with sooty flames are Alkanes and Alkenes while Alkyne burn with a smoky flame due to its high carbon content. Since Y discharge the colour of bromine water and X does not, then X is an Alkane and Y is alkenes. A hydrocarbon which does not burn with a sooty flame is an aromatic hydrocarbon. Hence Z is an aromatic hydrocarbon.

Correct option is D

UME 1990

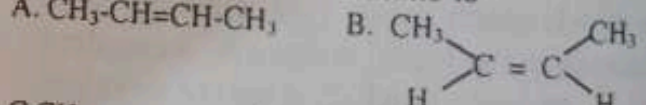
UME/90/41

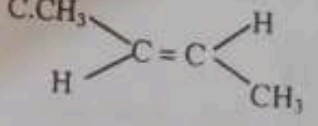
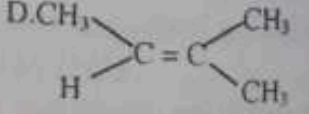
A cycloalkane with the molecular formula C_5H_{10} has.

A. One Isomer B. two isomers C. three isomers D. four Isomers.

UME/90/42

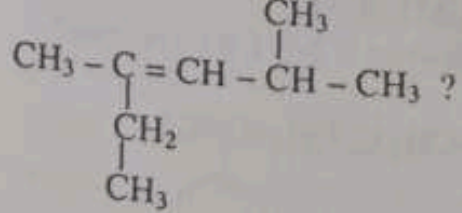
The structure of cis-2-butane is

A. $CH_3-CH=CH-CH_3$ B. 

C.  D. 

UME/90/43

What is the IUPAC name for the hydrocarbon?



A. 2-ethyl-4-methylpent-2-ene B. 3,5-dimethylhex-3-ene C. 2, 4-dlmethylhex-3-ene D. 2-methyl-4.thylpent-3-ene.

UME/90/44

$$CH-C\equiv CH \xrightarrow[liq\ NH_3]{Na} P$$

Compound P, in the above reaction, is

A. $CH_3-C(Na)=CHNH_2$ B. $CH_3-C(NH_2)=CHNa$

C. $CH_3-C\equiv C-Na$ D. $CH_3-C\equiv C-NH_2$

UME/90/45

The label on a reagent bottle containing a clear organic liquid dropped off. The liquid was neutral to litmus and gave colourless gas with metallic sodium. The liquid must be an A. Alkanoate B. alkene C. Alkanol D. Alkane.

UME/90/46

$$\begin{matrix}COOH\\|\\COOH\end{matrix} + NaOH \rightarrow \begin{matrix}COOH\\|\\COO\,Na\end{matrix} + H_2O$$

The above reaction is an example of A. a displacement reaction - B. a neutralization reaction C. an elimination reaction D. saponification.

UME/90/47

Alkanoic acids have low volatility compared with Alkanols because they A. are mole polar than Alkanols B. have two oxygen atoms while Alkanols have one C. form hydrogen bonds while Alkanols do not D. form two hydrogen bonds while Alkanols form one.

UME/90/48

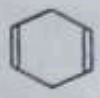
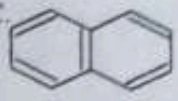
The octane number of a fuel whose performance is the same as that of a mixture of 55g of 2,2, 4-trimethylpentane and 45g of n-heptane is a. 45 B. 55 C. 80 D. 100.

UME/90/49

Which of the following is formed when maltose reacts with concentrated tetraoxosulphate (VI) acid? A. Carbon (IV) oxide B. Coal tar C. Charcoal D. Toxic fumes.

UME/90/50

Which of the following compounds represents the polymerization product of ethyne?

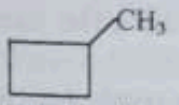
A.  B.  C.  D. 

SOLUTION TO UME 1990

UME/90/41

The numbers of isomer in the cycloalkane are show below;

Cyclopentane



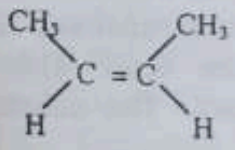
Methylcyclobutane

1, 2-dimethyl cyclopentane

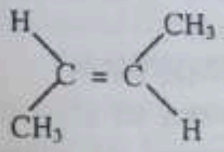
Correct option is C

UME/90/42

The structure of cis-but-2-ene is



While the structure of trans-but-2-ene

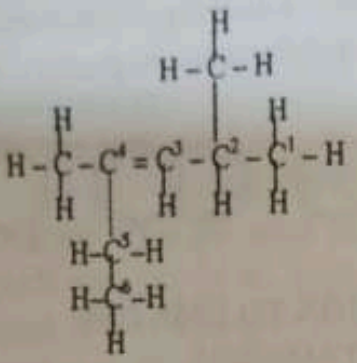


Note that the properties of Cis-trans isomers are determine by Answers-Skita rule.

Auwer-skita rule states that in a pair of geometric isomers, the CIS has the higher boiling point, density and retentive index but the TRANS has the higher stability. Note that the stability refer is in the difficulty of converting TRANS into CIS not probably on heating.

Correct option is B

UME/90/43



i. The longest carbon chain contains 6 carbon with a double bond in the 3rd carbon. Hence the parent name is hex-3-ene.
ii. There is a methyl group in carbon 2 and 4, hence the substituent name is 2, 4-dimenthyl.
iii. The IUPAC nomenclature is 2,4-dimethylhex-2-ene.

Correct option is C

UME/90/45

An organic compound which is a colourless liquid neutral to litmus paper and liberates a colourless gas when react with metallic sodium is an alkanol. The colourless gas form is hydrogen.

$$2ROH + 2Na \rightarrow 2RONa + H_2$$

Correct option is C

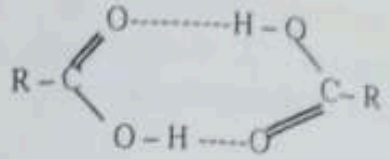
UME/90/46

The reaction between an alkanoic acid and alkanol in the present of mineral acid is known as esterification. But the reaction between an alkanoic acid and alkaline is known as neutralization.

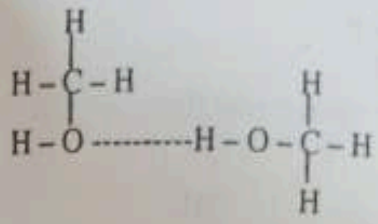
Correct option is B

UME/90/47

Volatility is inversely proportional to intermolecular force. This implies that the greater the intermolecular forces the lesser the volatility. The degree of hydrogen bonding in alkanoic acid is greater than the degree of hydrogen bonding in alkanol. Hence the volatility of alkanoic acid is less than alkanol. Alkanoic acid form two hydrogen bondings while alkanol form one hydrogen bonding. This is shown below.



Hydrogen bonding in alkanoic acid



Hydrogen bonding in alkanol

Correct option is D

UME/90/48

Octane number of a petrol is the percentage of 2, 2, 4-trimethylpentane (iso-octane) in a mixture with heptane which give the same performance as the petrol when both used in a standard engine.

Octane number of petrol =

$$\frac{\text{mass of 2,2,4-trimethylpentane}}{\text{mass of the mixture}} \times \frac{100}{1}$$

$$= \frac{55g}{(55+45)g} \times \frac{100}{1} = \frac{55g}{100g} \times 100 = 55\%$$

Correct option is B

UME/90/49

H_2SO_4 in concentrated form acts as a dehydrating agent, sulphonating agent and oxidizing agent. conc. H_2SO_4 dehydrating maltose to form sugar charcoal (black residue of carbon).

$$C_{12}H_{22}O_{11} \xrightarrow[-11H_2O]{\text{conc}H_2SO_4} 12C$$

Correct option is C

UME/90/50

Ethyne undergoes polymerization reaction when it is heated to a temperature of about 400^0c to form benzene.

$$3C_2H_2 \longrightarrow$$ 

Correct option is A

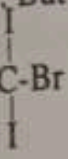
UME 1991

UME/91/2

Which of the following are mixtures? i. Petroleum ii. Rubber latex iii. Vulcanizer's solution iv. Carbon (II) sulphide. A i, ii and iii B. i, ii and iv C. i and ii only D i and iv.

UME/91/40

Which of the following compounds can exist as geometric isomers? A. 2-methylbut-2-ene B. But-2-ene C.But-1-ene

D. 

UME/91/41

How many structural isomers can be written for the alkylbromide, C_4H_9Br? A.3 B.4 C.6 D.8

UME/91/42

The final products of the reaction between methane and chlorine in the presence of ultraviolet light are hydrogen chloride and A. chloromethane B. tetrachlorornethane C. trichloromethane D. dichloromethane.

UME/91/43

How many grams of bromine will be required to completely react with l0g of propyne? A. 20g 8.40g C. 60g D.80g [C=12, H=1, Br=80]

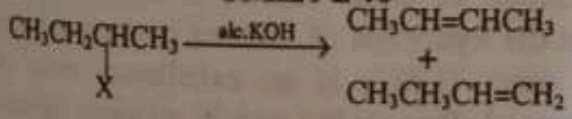
UME/91/44

Ethene when passed into concentrated H_2SO_4 is rapidly absorbed. The product is diluted with water and then warmed to produce A. ethanol B. diethyl ether C. ethanal D. diethyl Sulphate.

UME/91/45

One of the advantages of detergents over soap is that detergents A are, easier to manufacture B. foam more than soap C. form soluble salts with hard water D. are able to deter germs more than soap.

UME/91/46

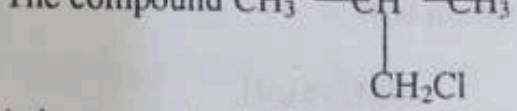


The above reaction is an example of
A. dehydration B. Dehydrohalogenation
C. neutralization D. a fission reaction.

UME/91/47

A certain liquid has a high boiling point. It is viscous, nontoxic, and miscible with water being very hygroscopic. This liquid is most likely to be A. $CH_3CH_2CH_2OH$ B. $CH_3CHOHCH_3$ C. $CH_3CH_2CHOHCH_3$ D. $CH_2OHCHOHCH_2OH$.

UME/91/48

The compound 

is known as A. 1-chloro-2-methylbutane B. 1-chloro-2-methylpropane C. 2-choromethylpropane D. 1-chloro-2, 2-dimethylethane.

UME/91/49

Which of the following statements is TRUE of the complete hydrolysis of a glyceride by sodium hydroxide?
A. 3 moles of NaOH are required for each mole of glyceride B. 3 moles of glycerol are produced C. Only one mole of soap is formed D. Concentrated H_2SO_4 is essential for the completion of the reaction.

UME/91/49

Which of the following are the products of the reaction between CH_3COOH and Cl_2 in the presence of sunlight?
A. $ClCH_2COOH + HCl$ B. $CH_3COCl + HOCl$ C. $CH_3COOCl + HCl$ D. $CH_3COCl + H_2O$.

SOLUTION TO UME 1991

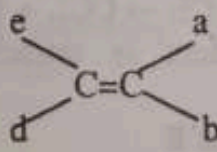
UME/91/2

Petroleum, rubber latex, vulcanizer's solution etc are mixtures

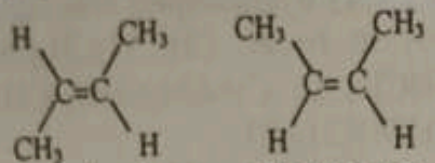
Correct option is A

UME/91/40

For a compound to exhibit a geometric isomerism the structure below must be satisfy.



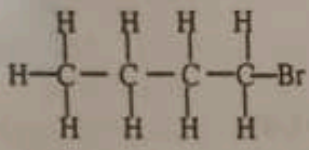
i. A double bond or ring must be present
ii. $e \neq d$ and $a \neq b$ but $e = a$ or $e = b$; $d = a$, or $d = b$ for example

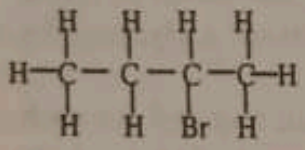

Trans-but-2-ene Cis-but-2-ene

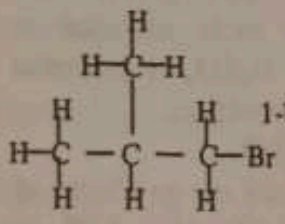
Correct option is B

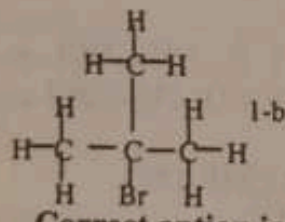
UME/91/41

The number of structural isomers in C_4H_9Br is shown below;


1-bromobutane


2-bromobutane


1-brono-2-methylpropane


1-brono-2-methylpropane

Correct option is B

UME/91/42

The reaction between methane and Cl_2 in the pressure of sunlight is show below;

$Cl_2 + CH_4 \rightarrow CH_3Cl + HCl$
$CH_3Cl + Cl_2 \rightarrow CH_2Cl + HCl$
$CH_2Cl_2 + Cl_2 \rightarrow CHCl_3 + HCl$
$CHCl_3 + Cl_2 \rightarrow CCl_4 + HCl$

The final product is tetrachloromethane (CCl_4).

Correct option is B

UME/91/43

$C_3H_4 + 2Br_2 \rightarrow CH_3CBr_2CHBr_2$

$$\cap_{C_3H_6} = \frac{10g}{40g/mol} = 0.25mol$$

$$\cap_{Br_2} = \frac{2\text{mole of } Br_2}{1\text{mole of } C_3H_6} \times 0.25\text{mol of } C_3H_6 = 0.5mol$$

mass of Br_2 $(M_{Br_2}) = \cap_{Br_2} \times M_{Br_2}$

$= 0.50 \times 160$

$= 80.0g$

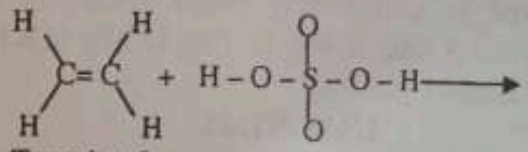
Correct option is D

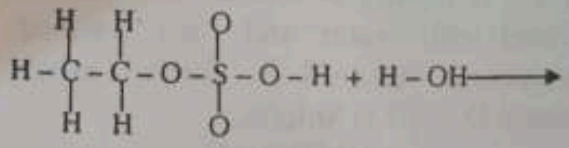
UME/91/43

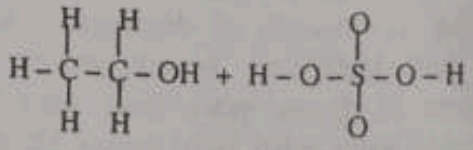
The major advantage of a soapless detergent which is simply called detergent is that its efficiency as a cleansing agent is not affect by types of water used because it does not form scum with hard water as a result of the fact that calcium and magnesium of detergent are soluble.

Correct option is C

UME/91/44


Trans-but-2-ene





The final product of hydrating ethane in the presence of conc. H_2SO_4 is ethanol. Note that the hydration of alkenes in the presence of conc. H_2SO_4 is an excellence way of prepared alkanols but certain alkanols cannot be prepared in this way.

Correct option is A

UME/91/46

Dehydrohalogenation of alkyl halide is a reaction in which alkyl halide are treated with KOH in alcohol to form alkenes.

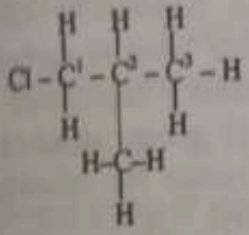
Correct option is B

UME/91/47

A liquid with a high boiling point, viscous, non-toxic, miscible with water in all proportion and hygroscopic nature is propan-1,2,3-tril ($CH_2OHCHOHCH_2OH$).

Correct option is D

UME/91/48

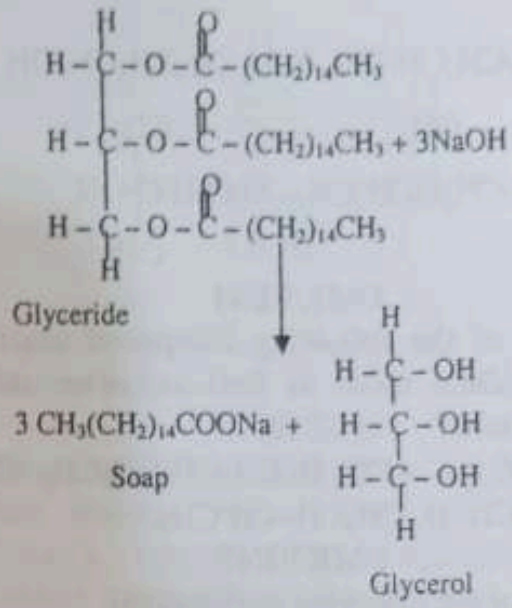


i. The longest chains contain 3 carbon atoms.Hence the parent name is propane.
ii. There is a chlorine atom in carbon 1 and a methyl group in carbon 2.The substituent name is 1-chloro-2-methyl
iii. The IUPAC nomenclature is 1-chloro-2-methylpropane.

Correct option is B

UME/91/49

Glyceride is the general name given to fats and oils. The alkaline hydrolysis of fats or oils produce soap and glycerol (propan-1,2,3-triol),for every three mole of the alkaline one mole of the glyceride is required.



Correct option is A

UME/91/50

The products of the reaction between CH_3COOH and Cl_2 in the presence of sunlight are shown below;

$CH_3COOH + Cl_2 \rightarrow CH_2ClCOOH + HCl$

$CH_2ClCOOH + Cl_2 \rightarrow CHCl_2COOH + HCl$

$CHCl_2COOH + Cl_2 \rightarrow CCl_3COOH + HCl$

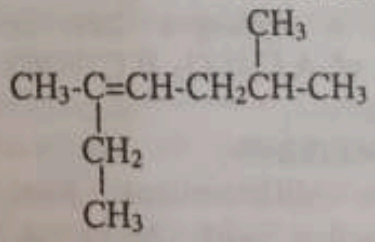
Correct option is A

UME 1992

UME/92/41

The carbon atoms in ethane are A. sp^3 hybridized B. sp hybridized C. sp^2 hybridized D. not hybridized.

UME/92/42



The IUPAC name for the hydrocarbon above is A. 2-ethyl-5-methylhex-2-ene B. 2, 5-dimethylhex-2-ene C. 3, 6-dimethylhept-3-ene D. 3, 6-dimethylhept-3-ene.

UME/92/43

Which of the following compounds is a secondary Alkanol?

A. $CH_3CH_2\underset{OH}{\underset{|}{C}}H\text{-}CH_3$ B. $H_3CH_2CH_2CH_2OH$

C. $CH_3CH_2OCH_2CH_3$ D. $CH_3\text{-}\underset{OH_3}{\underset{|}{\overset{CH_3}{\overset{|}{C}}}}\text{-}OH$

UME/92/44

Which of the following compound reacts with sodium metal as well as. silver and copper salts?

A. $CH_3C \equiv C - CH_3$ B. $CH_3CH_2CH_2CH_3$ C. $CH_3C{\equiv}CH$ D. $CH_3CH{=}CH\ CH_3$.

UME/92/45

Which of the following are isomers?

A. Ethanol and dimethylether B. Benzene and methylbenzene C. Ethanol and propenone D. Trichloromethane and tetrachloromethane.

UME/92/46

Th. functional group present in an organic compound which give bubbles on treatment with a saturated solution of $NaHCO_3$ is A. hydroxyl group B. carboalkoxyl group C. carbonyl group D. carboxyl group.

UME/92/47

The characteristic reaction of carbonyl compound. is A. substitution B. elimination C. addition D. saponification.

UME/92/48

An organic compound containing 40.1% carbon and 6.67% hydrogen has an empirical formula of A.$C_2H_4O_2$ B.C2H302 C. CH_2O D.CH_3O.

UME/92/49

Alkanal can be differentiated from Alkanone by reaction with A. 2, 4-dinitrophenylhydrazine B. hydrogen cyanide C. sodium hydrogen sulphite D. Tollen's reagent.

UME/92/50

An example of a polysaccharide is A. dextrose B. mannose. C. glucose D. starch.

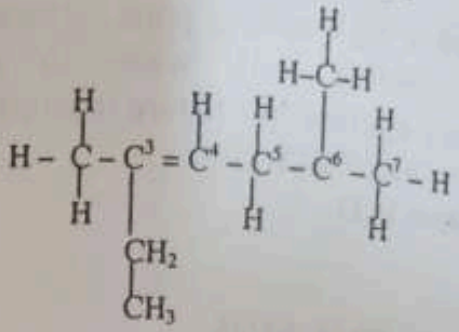
SOLUTION TO UME 1992

UME/92/41

The carbon atom in Alkane, alkene and Alkyne are sp^3, sp^2 and sp hybridized respectively.

Correct option is C

UME/92/42



i. The longest chain contains 7 carbon atoms with a double bond in carbon 3. Hence the parent name is hept-3-ene.
ii. There is a methyl group attached to carbon 3 and 6. Hence the substituent name is 3, 6-dimethyl.
iii. The IUPAC nomenclature is 3, 6-dimethyl hept-3-ene.

Correct option is D

UME/92/43

A second monohydric Alkanol is an Alkanol in which the carbon atom bearing the –OH is link to two alkyl group directly lie the carbon atom which bear the –OH contain only on hydrogen atom. It has the general formula of

RR^1CHOH $\left(R - \underset{H}{\underset{|}{\overset{R^1}{\overset{|}{C}}}} - OH\right)$

e.g. $CH_3CH_2\underset{OH}{\underset{|}{C}}HCH_3$

Correct option is A

UME/92/44

A compound that react with sodium in liquid ammonia is an Alkyne while a substance which react with Ammoniacal copper I chloride or silver nitrate is a terminal Alkyne

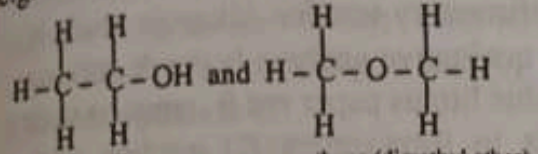
(Alkyne with their triple bond in the first combination e.g. $CH_3 \equiv CH$

Correct option C

UME/92/45

Isomers are compound with the same molecular formula but different physical and/or chemical properties. Note that ether/Alkanol, ester/Alkanoic acid and Alkanal/Alkanone form functional isomers.

e.g.



Ethanol mesoxymethene (dimethyl ether)

Correct option is A

UME/92/46

An organic compound which liberates CO_2 from $NaHCO_3$ is Alkanoic acid. The functional group of ethanoic acid is

$-COOH\ (-\overset{O}{\overset{\|}{C}}-OH)$ Note that this behaviour of Alkanoic acid is use as the basic test for Alkanoic acid.

Note that hydroxyl group is –OH, carbonyl group $(-CHO \text{ or } \overset{}{\overset{\diagdown}{C}}=O)$, carbon alkoxy group(-COC) and carboxyl group (-COOH).

Correct option is D

UME/92/47

Carbonyl compound are the general name given to Alkanal and Alkanone. The characteristics reaction undergo by carbonyl compound is ELIMINATION REACTION.

Correct option is B

UME/92/48

Considering 100g of the compound

$$\text{mass of C} = 40.1\% \text{ of } 100g = \frac{40.1}{100} \times 100g = 40.10g$$

$$\text{mass of N} = 6.67\% \text{ of } 100g = \frac{6.67}{100} \times 100g = 6.67g$$

$$\% \text{ of} = 100 - (40.1 + 6.67) = 53.23\%$$

$$\text{mass of O} = 53.23\% \text{ of } 100g = \frac{53.23}{100} \times 100g = 53.23g$$

C	:	H	:	O
$\frac{401}{12}$	:	$\frac{6.67}{1}$	:	$\frac{53.23}{16}$
3.3417		6.67		3.3269
1.004		2.0047	:	1
1		2		1

Empirical formula is CH_2O

Correct option is C

UME/92/49

Alkanal are differentiated from Alkanone by their reaction with Fehling solution and Tollen's reagent. Their equation with Fehling solution A and B is given as

$$\underset{\text{alkanal}}{RCHO} + 2Cu^{2+} + NaOH + H_2O \xrightarrow{\text{warm}} RCOONa + \underset{\substack{\text{reddish boron}\\ \text{precipitate}}}{Cu_2O} + H^+$$

The reaction of Alkanal with Tollen's reagent is given as:

$$RCHO + Ag_2O \rightarrow RCOOH + \underset{\text{Silver mirror}}{2Ag}$$

Correct option is D

UME/92/50

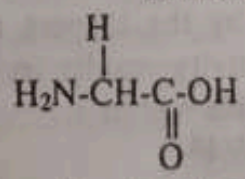
Polysaccharides are carbohydrates which are non-sugars formed by the condensation of monosaccharide. Note that for every bond between two monomers, molecules of water is lost.

$$nC_6H_{12}O_6 \longrightarrow (C_6H_{10}O_5)n + nH_2O$$

Examples of polysaccharides are starch, glycogen, cellulose, insulin etc.

Correct option is D

UME/93/40



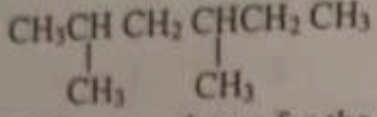
The two functional groups in the above compound are A. alcohol and amine B. acid

andamin. C. aldehyde and acid D. ketone and amine.

UME/93/41

The fraction of crude oil used as jet fuel is A. refinery gas B. diesel oil C. kerosene D. gasoline

UME/93/42



The IUPAC nomenclature for the compound above is A. dimethylhexane B. 3,5, dimethylhexane C. 1, 1-dimethyl, 3 methylpentane D. 2,4-dimethylhexane.

UME/93/43

It is not desirable to use lead tetraethyl as an anti-knock agent because A. it is expensive B. of pollution effects from the exhaust fumes C. it lowers the octane rating of petrol D. it is explosive.

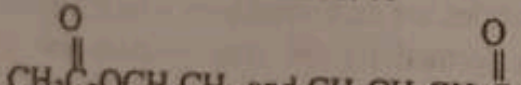
UME/93/44

The carbon atoms on ethane are A. sp^2 hybridized B. sp^3 hybridized C. sp^2d hybridized D. sp hybridized.

UME/93/45

Catalytic hydrogenation of benzene produces A. an aromatic hydrocarbon B, margarine C. cyclohexane D. D.D.T.

UME/93/46



and are A. isomers B. esters C. carboxylic acids D. polymers.

UME/93/47

Palm-wine turns sour with time because A. the sugar content is converted into alcohol B.The carbon (IV) oxide formed during the fermentation process has a sour taste C. it is commonly adulterated by the tappers and sellers D. microbial activity results in the production of organic acids within it.

UME/93/48

The function of the copper (II) tetraoxosulphate (II) in dilute H_2SO_4 in the preparation of ethyne is to A. dry the gas B. absorb phosphine impurity C. absorb Ethene impurity D. form an acetylide with ethyne.

UME/93/49

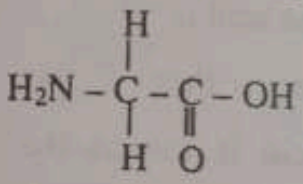
Which of the following represents saponification? A. Reaction of carboxylic acids with sodium hydroxide B. reaction of Alkanoate with acid C. Reaction of carboxylic acids with alcohols D. Reaction of Alkanoate with sodium hydroxide.

UME/93/50

The confirmatory test for Alkanoic acids in organic qualitative analysis is the A. turning of wet blue litmus paper red B. reaction with Alkanols to form esters C. reaction with sodium hydroxide to form salt and water D. reaction with aqueous Na_2CO_3 to liberate a gas which turns lime water milky.

SOLUTION TO UME 1993

UME/93/40



The functional group present in the compound are $-NH_2$ (amine group) and -COOH (carboxylic group).

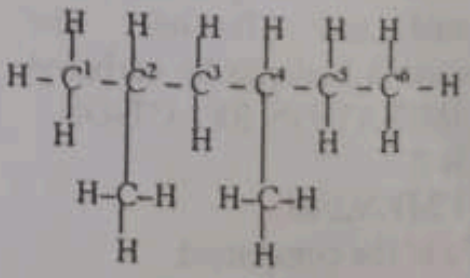
Correct option is B

UME/93/41

The fraction of crude oil used for jet fuel is kerosene.

Correct option is C

UME/93/42



i. The longest chain contains 6 carbon atoms. Hence the name of parent Alkane is hexane.

ii. A methyl group is attached to carbon 2 and 4. Hence the substituent name is 2,4-dimethyl.

iii. The IUPAC name is 2,4-dimethyl hexane.

Correct option is D

UME/93/43

Petrol containing lead is called LEADED PETROL. The combustion of such petrol release leads to the atmosphere leading to air pollution. As a result of this is not advisable to use lead as antiknocking in petrol.

Correct option is B

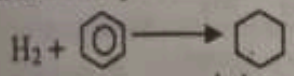
UME/93/44

Alkanes, alkenes and alkynes are sp^3, sp^2 and sp hybridized respectively. Since ethane is an alkene, its carbon atom will be sp^3 hybridized.

Correct option is B

UME/93/45

The catalytic hydrogenation of benzene produces cyclohexane.



benzene cyclohaxane

Note that the general formula of cycloalkane is C_nH_{2n}

Correct option is C

UME/93/46

Alkanoic acid and esters of corresponding carbon atom always form functional isomers.

Correct option is A

UME/93/47

Palm wine is rich in sugar which undergoes fermentation to produce ethanol and carbon iv oxide. The ethanol form is further oxidized to ethanoic acid. The ethanoic acid produce give the sour taste to the palm wine.

Correct option is D

UME/93/48

The function of the copper II tetraoxosulphate is to absorb phosphine (PH_3) the impurity produce in the production of ethyne.

Correct option is B

UME/93/49

Saponification is the alkaline hydrolysis of facts or oils to produce soap and glycerol i.e. saponification is the reaction between alkali (NaOH or KOH) and facts or oils (i.e. Alkanoate) to produce soap and glycerol.

Correct option is D

UME/93/50

The confirmatory test for Alkanoic acid is that they liberate CO_2 from $NaHCO_3$

$RCOOH + NaHCO_3 \rightarrow RCOONa + H_2O + CO_2$

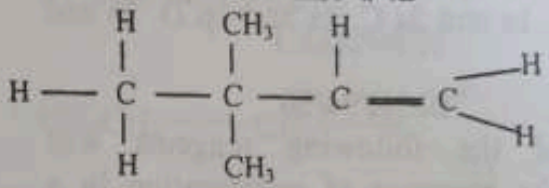
Correct option is D

UME 1994

UME/94/41

Which of the following compounds is NOT an isomer2,2-dimethylbutane? A. 2-methylbutaneB. 3-methylpentane C. 2,3-dimethylbutane D. 2-methylpentane.

UME/94/42



The IUPAC name of thatcompound above is A. 2,2-dimethyl but-1-yne B. 2,2-dimethyl but-2-ene C. 3,3-dimethyl but-1-ene D. 3,3-dimethyl but-1-yne

UME/94/43

When sodium is added to ethanol, the products are A. sodium hydroxide and water B. sodium hydroxide a hydrogen C. sodium ethoxide and water D. sodium ethoxide and hydrogen.

UME/94/44

The general formula of Alkanone is A. RCHO B. R_2CO C. RCOOH D. $RCOOR^1$.

UME/94/45

When sodium ethanoate is treated with a few drops concentrated tetraoxosulphate (VI) acid, one of the products is A. CH_3COOH B. CH_3COOCH_3 C. $CH_3COOC_2H_5$ D. $C_2H_5COOCH_3$.

UME/94/46

One mole of a hydrocarbon contains 48g of carbon. If vapour density is 28, the

hydrocarbon is A. an Alkane B. an alkene C. an Alkyne D. aromatic. [C = 12, H=1].
Use the diagram below to answer questions 47 and 48.pls refer to any UME past question for diagram

UME/94/47

The reaction taking place in flask G is known as A. hydrolysis B. double decomposition C. dehydration D. hydrolysis.

UME/94/48

The caustic soda solution in the conical flask serves to A. dry Ethene gas B. remove carbon (IV) oxide from Ethene C. remove carbon (II) oxide from ethane D. remove sulphur (IV) oxide from Ethene.

UME/94/49

Which of the following orbitals of carbon are mixed with hydrogen in methane? A. 1s and 2p B. 1s and 2s C. 2s and 2p D. 2s and 3p.

UME/94/50

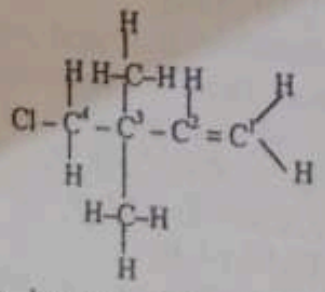
Which of the following reagents will confirm the presence of unsaturation in a compound? A. Fehling's solution B. Bromine water C. Tollen's reagent D. Benedict's solution.

SOLUTION TO UME 1994

UME/94/41

Isomers are compound with the some molecular formula but difficult physical and/or chemical properties. Each of the compound have six carbon atom except 2-methylbutane.

Correct option is A



i. The longest chain contains 4 carbon atoms with a double in the first carbon atom. Hence the name of the parent alkene is but-1-ene.
ii. There are two methyl group attached to carbon 3. Hence the substituent name is 3,3-dimathyl.
iii. The IUPAC nomenclature is 3,3-dimethylbut-1-ene.

Correct option is C

UME/94/43

$$2CH_3CH_2OH + 2Na \rightarrow \underset{\text{Sodium ethoxide}}{CH_3CH_2ONa} + H_2$$

Correct option is D

UME/94/44

The general formula for Alkanone is RR^1CO or R_2CO.

Correct option is B

UME/94/45

$NaCH_3COO + H_2SO_4 \rightarrow CH_3COOH + NaHSO_4$

Correct option is A

UME/94/46

$$\text{No of mole of C (n)} = \frac{\text{reacting mass}}{\text{molar mass}} = \frac{48g}{12gmol} = 4 \text{ moles}$$

R.m.m of hydrocarbon
= 2 x vapour density of hydrocarbon
= 2 x 26 = 56

Hydrocarbon are generally represented as C_xH_y

$\Rightarrow$ R.m.m of $C_xH_y = 56$

$12x + y = 56$

But $x = 4$

$12(4) + y = 56$

$48 + y = 56$

$y = 56 - 48 = 8$

$C_xH_y = C_4H_8$ i.e. alkene

Correct option is B

UME/94/47

When ethanol is dehydrated with excess conc. H_2SO_4 the result formed is ethane. Hence the reaction occurring at C is a dehydration reaction.

Correct option is C

UME/94/48

The caustic soda (NaOH) is used to absorb the impurity SO_2 and CO_2 formed during the preparation of ethane. However the formation of SO_2 predominate.

Correct option is D

UME/94/49

Methane is Sp^3 hybridized. Hence the orbital that are mixed is 2s and 2p orbitals.

Correct option is C

UME/94/50

The presence of unsaturated organic compound is comfirm by the following reagent. $KMnO_4$, $K_2Cr_2O_7$, bromine water, chlorine water etc.

Correct option is B

UME1995

UME/95/15

When plastics and packaging materials made from chloroethene are burnt in the open, the mixture of gases released into the atmosphere is most likely to contain A. ethane B. chlorine C. hydrogen chloride D. ethane.

UME/95/41

$CH_3COOH + CH_3CH_2OH \xrightarrow{Conc.H_2SO_4} X + Y$

X and Y in the reaction above are respectively. A. CH_3COCH_3 and H_2O

B. $CH_3CH_2COCH_3$ and H_2O_2

C. $CH_3COOCH_2CH_3$ and H_2O

D. CH_3CH_2CHO and CH_4

UME/95/42

$CHCl_3 + Cl_2 \rightarrow HCl + CCl_4$

The reaction above is an example of A. an addition reaction B. a substitution reaction C. a chlorination reaction D. a condensation reaction.

UME/95/43

$CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH = CH - CH_3$

The IUPAC nomenclature for the compound above is A. 1,1-dimentylbut-2-ene B. 2-methylpent-3-3n3 C. 4,4-dimethylbut-e-ene D. 4-methylpent-e-ene.

UME/95/44

Which of the following pairs has compounds that are isomers? A. Propanal and propanone B. Ethanoic acid and ethylmethanoate C. Ethanoic acid and ethane-1, 2-diol D. 2-methylbutane and 2, 2-dimethylbutane.

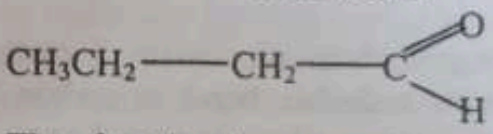
UME/95/45

Aromatic and aliphatic hydrocarbons can be distinguished from each other by the A. action of bromine B. use of polymerization reaction C. action of heat D. use of oxidation reaction.

UME/95/46

The role of sodium chloride in the preparation of soap is to A. purify the soap B. separate the soap from glycerol C. accelerate the decomposition of the fat or oil D. react with glycerol.

UME/95/47



The functional group represented in the compound above is A. Alkanol B. Alkanal C. Alkanone D. Alkanoate.

UME/95/48

$C_x H_y + 4O_2 \rightarrow 3CO_2 + 2H_2O$

The hydrocarbon, C_xH_y, in the reaction above is A. propane B. propene C. propyne D. propanone

UME/95/49

An example of a secondary amine is A propyleneB. di-butylamine

C. methylamine D. trimethylamine.

UME/95/50

The relatively high boiling points of Alkanols are due toA. ionic bonding

B. aromatic character C. covalentbonding D. hydrogen bonding.

SOLUTION TO UME 1995

UME/95/15

Plastic is simply polyvinylchloride (pvc) and packaging material are made form polyethene. When these materials are burnt

in air the products will be H_2O, CO_2 and chlorine.

Correct option is B

UME/95/41

$$CH_3COOH + CH_3CH_2OH \xrightarrow{conc.\ H_2SO_4} CH_3COOCH_2CH_3 + H_2O$$

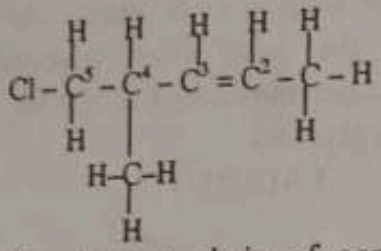
Correct option is C

UME/95/42

The reaction is an example of free radical reaction which is also known as substitution reaction.

Correct option is B

UME/95/43



i. The longest chain of contain 5 carbon atom with a double bond in carbon 2. Hence the parent alkene is pent-2-ene.
ii. There is a methyl group attached to carbon 4. Hence the substituent name is 4-methyl.
iii. The IUPAC nomenclature is 4-methyl pent-2-ene.

Correct option is D

UME/95/44

Alkanal and Alkanone form pair of functional isomers. For instance Propanal is a functional isomer of propane.

Correct option is A

UME/95/45

Aromatic hydrocarbons are hydrocarbons which contain delocalized pie electrons around a ring of carbon atom e.g. benzene, toluene, xylene etc.

Aliphatic hydrocarbons are hydrocarbons which consists of straight or branch chains of carbon atoms.

Unsaturated aliphatic hydrocarbon and aromatic hydrocarbon reacts with bromine, polymerized and undergo oxidation reaction. Also the action of heat converts cycloalkanes to aromatic hydrocarbon by a process known as AROMATIZATION.

Correct option is C

In the process of soap making, sodium chloride is added to the mixture of the soap and glycerol to decrease the solubility of the soap so that the soap separate out of the mixture as hard cake.

Correct option is B

UME/95/47

The functional group represent in the compound and double bond (=) and Alkanol group (-CHO). Hence the compound is both alkene and Alkanal.

Correct option is B

UME/95/48

The general equation of combustion of hydrocarbon is

$C_xH_y + (x + y/4)\ O_2 \rightarrow 2CO_2 + y/2H_2O$

Compare the above equation with the given equation

$C_xH_y + 4O_2 \rightarrow 3CO_2 + 2H_2O$

This implies that

$x = 3$ and $y/2 = 2 \therefore y = 4$

$x = 3$ and $y = 4$

$C_xH_y = C_3H_4$ (i.e. propyne)

Correct option is C

UME/95/49

The general formula of primary, secondary and tertiary amines are respectively RNH_2, RR^1NH (R_2NH) R_3N. Examples of primary, secondary and tertiary amines are methylamine, dibutylamine and trimethylamine respectively.

Correct option is C

UME/95/50

Hydrogen bonding is a bond which arises when hydrogen is directed bonded to small highly charge electronegative element such as oxygen, nitrogen and fluorine. It is the bond responsible to the high boiling point of water, HF, Alkanoic acid Alkanols etc.

Correct option is D

No UME in 1996

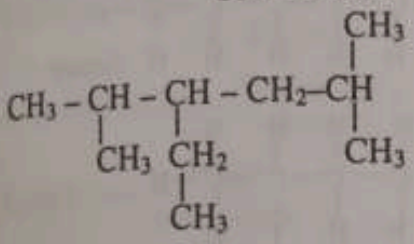
UME/97/39

A sample of a substance containing only C and H burns in excess O_2 to yield 4.4g of CO_2 and 2.7g of H_2O. The empirical formula of the substance is A. CH_3 B. CH_2 C. CH_4 D. C_2H_5 [C=12, O=16, H=1]

UME/97/40

Undesirable paraffin in the petroleum industry which is particularly prone to knocking is A. iso-octane B. n-heptane C. iso-heptane D. n-octane.

UME/97/41



The IUPAC nomenclature of the organic compound with the above structural formula is A. 3-ethyl -2, 5-dimethythexane B. 4-ethyl-2, 5-dimethylhexane
C. 3 - ethyl -1, 1, 4 - trimethylpentane
D. 3 - ethyl -2, 5, 5- trimethylpentane.

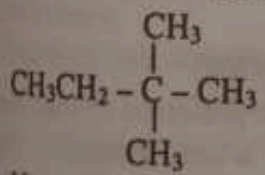
UME/97/42

The reaction of an Alkanol with an Alkanoic acid in the presence of concentrated H_2SO_4 will produce an
A. Alkanal B. Alkanoate C. Alkanone
D. Alkyne.

UME/97/43

The final product of the reaction of ethyne with hydrogen iodide is A. $CH_3 - CHI_2$
B. $CH_2I–CH_2I$ C. $CH_3–Cl_3$ D. $CH_2=CHI$

UME/97/44



How many more isomers of the compound above can be obtained? A. 5 B. 4 C. 3 D. 2.

UME/97/45

Synthetic detergents are preferred to soap for laundry using - hard water because A. detergents are water soluble - while soap is not B. the calcium salts of detergents are water soluble C. the magnesium salt -of soap is soluble in hard water D. soap does not have a hydrocarbon terminal chain.

UME/97/46

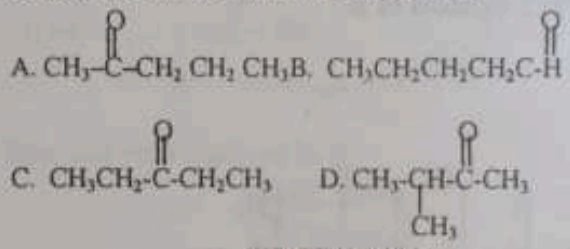
The synthetic rubber obtained by the polymerization of chlorobutadiene in the presence of sodium is called. A. Teflon B. isoprene C. polythene D. neoprene.

UME/97/47

25cm^3 of 0.02 M KOH neutralized 0.03g of a monobasic organic acid having the general formula $C_nH_{2n+1}COOH$. The molecular formula of the acid is
A. HCOOH B. C_2H_5COOH C. CH_3COOH
D. C_3H_7COOH. [C=12, H=1, 0=16]

UME/97/48

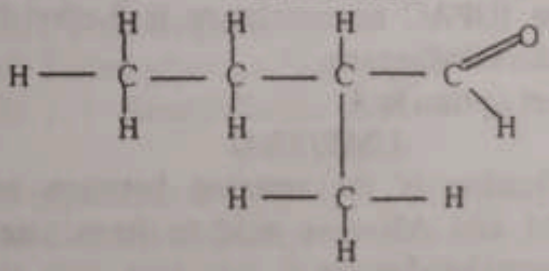
When Fehling's solution is added to two isomeric carbonyl compounds X and Y with the molecular formula $C_5H_{10}O$, compound X gives a red precipitate while Y does not react. It can be inferred that X is



UME/97/49

The compound above contains
A. sp^3 hybridized carbon atoms only
B. sp^2 hybridized carbon atoms only
C sp^3 and sp hybridized carbon atoms
D. sp^3 and sp2 hybridized carbon atoms.

UME/97/50



The compound above is the product of the oxidation ofA. 2- methylbutan- 2- ol

B.2-methylbutan-1-o1C.2,3-dimethylpropan-1-ol D. Pentan -2-ol

SOLUTION TO UME 1997

UME/97/39

$$\text{mass of C in 4.40g of } CO_2 = \frac{12}{44} \times 4.4g = 1.20g$$

$$\text{mass of H in 2.70g of } H_2O = \frac{2}{18} \times 2.7g = 0.30g$$

C	:	H
$\frac{1.2}{12}$	:	$\frac{0.3}{1}$
0.1	:	0.3
1	:	3

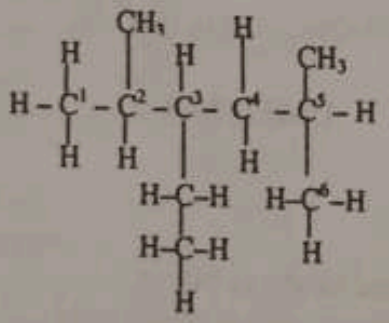
The empirical formula is CH_3

Correct option is A

UME/97/40

The undesirable paraffin in the petroleum industry which is prone to knocking is n- heptane.

Correct option is B



i. The longest chain contain 6 carbon atom. Hence the parent Alkane is hexane.
ii. There is a methyl group in carbon 2 and ethyl group in carbon 3. Hence the substituent names 3-ethyl -2, 5-dimethyl.
iii. The IUPAC nomenclature is 3-ethyl-2, 5-dimethylhexane.

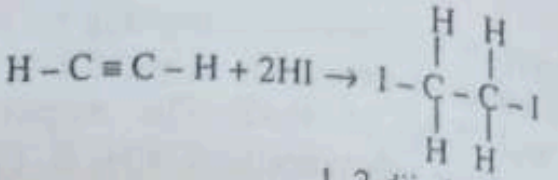
Correct option is A

UME/97/42

Esterification is the reaction between an Alkanol and Alkanoic acid to form ester (Alkanoate) and water.

Correct option is B

UME/97/43

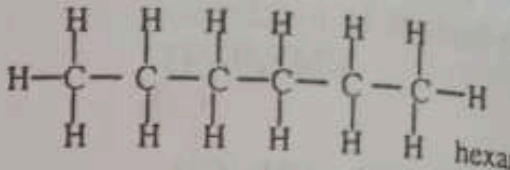


1, 2-diiodoethane

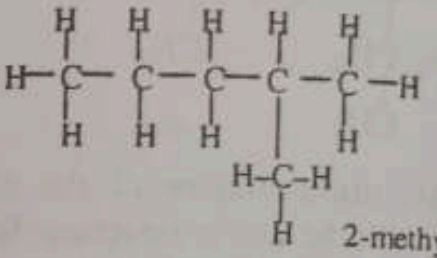
Correct option is B

UME/97/44

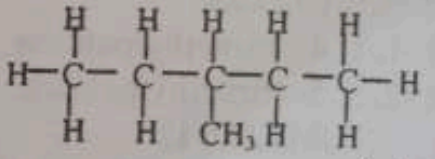
The numbers of isomers in the compound are shown below;



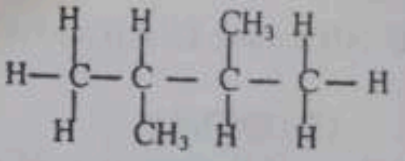
hexane



2-methylpentane



3-dimethylbutane



2, 3-dimethylbutane

Hence the number of isomers is 4

Correct option is B

UME/97/45

Synthetic detergents are preferred to soap for laundry using hard water because the calcium and magnesium salts of detergent are water soluble.

Correct option is B

UME/97/46

Neoprene is a synthetic rubber form by the co-polymerization of 2-chlorobuta-1,3-diene (chloroprene) and styrene.

Correct option is D

UME/97/47

$$\cap_{KOH} = \left(\frac{V}{1000}\right) dm^3 \times \text{molar conc.}$$

$$= \frac{25}{1000} \times 0.02 = 0.0005 mol$$

$$C_nH_{2n+1}COOH + KOH \rightarrow CnH_{2n+1}COOK + H_2O$$

$$\text{No of mole of the acid} = 0.0005mol = \frac{1\,mol\,of\,C_nH_{2n+1}COOH}{1\,mol\,of\,KOH} \times$$

$$0.0005mol\,of\,KOH$$

$$= 0.0005mol$$

$$\text{No of mole of the acid} = \frac{\text{reacting mass}}{\text{molar mass}} = \frac{0.03g}{\text{mola rmass}}$$

$$0.0005mol = \frac{0.03g}{\text{molar mass}}$$

$$\text{molar mass} = \frac{0.03g}{0.0005mol} = 60g/mol$$

$\Rightarrow$ R.m.m of $C_nH_{2n+1}COOH = 60$

$12n + 2n+1+12+32+1 = 60$

$14n + 40 = 60$

$14n = 60 - 46$

$14n = 14$

$n = 1$

$\Rightarrow$ $C_nH_{2n+1}COOH = CH_3COOH$

Correct option is C

UME/97/48

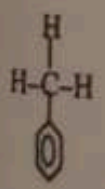
Fehling's solution is used to confirm the presence of the Alkanal group (-CHO) but not Alkanone group $\succ$(CO). Hence Fehling's solution is used to distinguish Alkanal from Alkanone.

Therefore X is an Alkanal and Y is a Alkanone.

Correct option is B

UME/97/49

In Toluene or methylbenzene

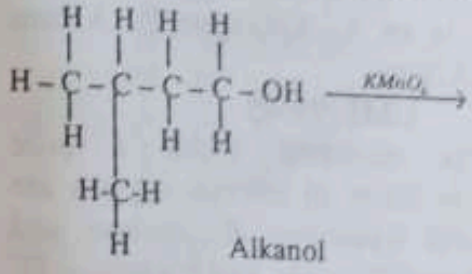


The carbon atom in the methyl group is Sp^3 hybridized while each of the carbon in the benzene ring is Sp^2-hybridized. Hence methylbenzene is Sp^3 & Sp^2 hybridized.

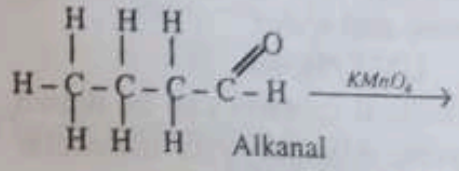
Correct option is D

UME/97/49

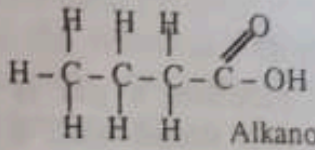
The mild oxidation of primary alkanol gives Alkanal while the complete oxidation of primary Alkanol gives Alkanoic acid.



Alkanol



Alkanal



Alkanoic acid

The correct option is B

UME 1998

UME/98/4

$C_3H_{8(g)} + 5O_{2(g)} \rightarrow 4H_2O_{(g)} + 3CO_{2(g)}$

From the equation above, the volume of oxygen at s.t.p. required to burn $50cm^3$ of propane is A. $250cm^3$ B. $150cm^3$ C $100cm^3$ D. $50cm^3$

UME/98/41

$CH_3CH_2CHCH(CH_3)_2$

The IUPAC nomenclature for the above compound is A. 4-methylpentan-3-o1

B. 2-methylpentan -3-ol

C. 3-methylpentan-3-ol

D. 1, 1- dimethylbutan -2-o1.

UME/98/42

Dehydration of CH_3-H_2-H_2-CH_2 gives

A. CH_2=CH-CH_2-CH_3 B. CH_3CH=CH-CH_3

C. H-C$\equiv$ C-H_2-H_3 D. $CH_3C \equiv$ C-CH_3.

UME/98/43

$$nCH_2 = CH_2 \xrightarrow[1500atm.473k]{O_2\ (initiator)} (-CH_2\text{-}CH_2\text{-})_n$$

The above equations represent the manufacture of A. rubber B. polythene C. Polystyrene D. butane.

UME/98/44

One mole of a hydrocarbon contains 6g of hydrogen. If the molecular weight is 54, the hydrocarbon is an A. Alkanone B. Alkane C. alkene D.Alkyne.

UME/98/45

The products obtained when a pure hydrocarbon is burnt in excess oxygen are A. carbon and hydrogen B. carbon and water C. carbon (II) oxide and hydrogen D. carbon (IV) oxide and water.

UME/98/46

How many structural isomers can be drawn for the non-cyclic Alkanol with molecular formula $C_4H_{10}O$?

A. 1 B. 2 C. 3 D. 4

UME/98/47

On cracking medicinal paraffin, a gas is evolved which gives a pop sound with a lighted splinter and an oily liquid which decolorizes bromine solution is also obtained. The products of the cracking are A. carbon (IV) oxide and Alkyne B. carbon (II) oxide and alkene C. hydrogen gas and alkene D. hydrogen gas and Alkane.

UME/98/48

An example of aromatic compound is A. $C_6H_{13}OH$ B. $C_6H_{13}Cl$ C. C_6H_5OH D. C_6H_{14}

UME/98/49

Terylene is synthesized from ethane -1, 2-dial and benzene-1, 4-dicarboxylic acid by A. addition reaction B. condensation reaction C. elimination- reaction D. substitution reaction.

UME/98/50

Which of the following is true concerning the properties of benzene and hexane? A. Both undergo substitution reaction B. Both undergo addition reaction C. Both are solids D. Both can decolourize bromine water.

SOLUTION TO UME 1998

UME/98/4

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

1mole of C_3H_8 required.....5mole of O_2

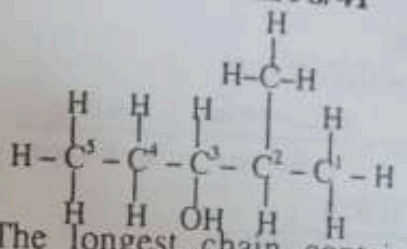
$50cm^3$ of C_3H_8 required.....xcm^3 of O_2

$1/50 = 5/x$

$\Rightarrow x = 5(50) = 250cm^3$

Correct option is A

UME/98/41



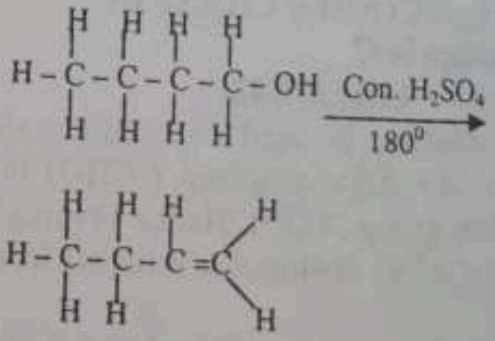
i. The longest chain contain fire carbon atom, with –OH group in carbon 3. Hence the parent Alkanol is penta-3-oL.

ii. There is a methyl group in carbon 2. Hence the substituent name is 2-methyl.

iii. The IUPAC nomenclature is 2-methylpentan-2-oL.

Correct option is B

UME/98/42



Correct option is A

UME/98/43

Polymerization is the phenomenon whereby two or more compounds called monomer (e.g. ethene) link to form a giant molecule called polymer (e.g. polyethane).

$$\underset{\text{Ethane}}{n(CH_2 = CH_2)} \xrightarrow[\substack{\text{15.0 atom} \\ \text{473k}}]{O_2 \text{ (initiator)}} \underset{\text{ply ethane}}{-(CH_2)_n-}$$

Correct option is B

UME/98/44

No of mole of hydrogen in the hydrocarbon

$$(\cap_H) = \frac{\text{Reacting mass}}{\text{molar mass}} = \frac{6g}{1g/mol} = 6\text{mole}$$

Hydrocarbon are generally represented as C_xH_y where y is the number of mole of hydrogen (i.e y = 6)

$\Rightarrow C_xH_y = C_xH6$

R.m.m of $C_xH6 = 54$

$\Rightarrow 12x + 6(1) = 54$

$12x + 6 = 54$

$12x = 54 - 6 = 48$

$x = 48/12 = 4$

$\Rightarrow C_xH_6 = C_4H_6$ i.e. butyne (which is an alkyne)

Correct option is D

All hydrocarbon burnt in excess oxygen to form carbon IV oxide and steam (water).

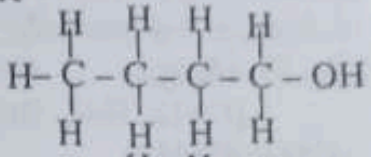
Correct option is D

UME/98/46

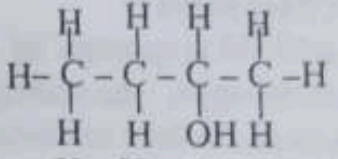
The number of isomers in the non-cyclic Alkanol $C_4H_{10}O$ are shown below;

C_4H_9OH

(i)



(ii)



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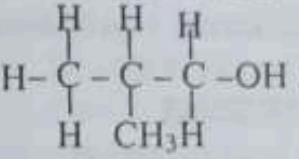

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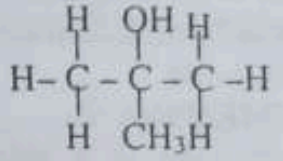


The correct option is D

UME/98/47

Medicinal paraffin $\xrightarrow{\Delta}$ Alkene + H_2

In the cracking alkene which decolourized bromine water and hydrogen gas which give a pop sound to a glowing splinter is form?

Correct option C

UME/98/48

Aromatic Alkanols contain an OH group, but it can be attached either directly to benzene ring or to a hydrocarbon side chain e.g. phenol (C_6H_5OH), benzene-1,3-diol [$C_4H_4(OH)_2$] 2-methylphenol ($CH_3C_6H_4OH$) etc.

Correct option is C

UME/98/49

Terylene is a polyester form by the condensational polymerization of ethan-1, 2-diol and benzene-1, 4-dicarboxylic acid.

Correct option is B

UME/98/50

Benzene and hexane both undergo substitution reaction.

Correct option is A

UME/99/42

When excess ethanol is heated to 145^0C in the presence of concentrated H_2SO_4 the

product is A. ethyne B. diethyl sulphate C. diethl ether D. acetone

UME/99/43

How many grammes of bromine will saturate 5.2g of but-l-ene-3-yne? A. 64.0g B. 48.0g C. 32.0g D. 16.0g.

[C=12, H=1, Br=80]

UME/99/44

When the two end alkyl groups of ethyl ethanoate are interchange, the compound formed is known as A. methy l ethanoate B. ethy l propanoate C. methy l propanoate D. propy l ethanoate.

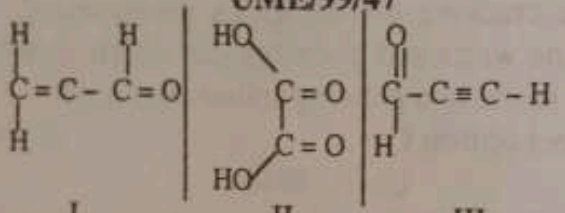
UME/99/45

2-methylprop-l-ene is an isomer of
A. but-2-ene B. pent-l-ene C. 2-methylbut-e-ene D. 2-methylbut-l-ene

UME/99/46

Which of the following is a solvent for perfumes? A. C_5H_{12} B. C_4H_6
C. CH_3COOH D. C_2H_5OH

UME/99/47



I II III

Which of the compounds above would react to take up two molecules of bromine during bromination?
A. I only B. III only C. I and II only D. II and III only.

UME/99/48

The hydrocarbon that burns in air with a sooty flame is A. C_2H_6 B. C_3H_8 C. C_4H_{10} D. C_6H_6

UME/99/49

An organic compound that does not undergo a reaction with both hydrogen cyanide and hydroxylamine can be an
A. alkene B. alkanal C. alkanone D. alkanoic acid.

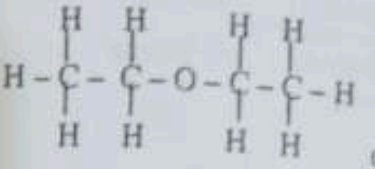
UME/99/50

Polyvinyl chloride is used to produce
A. bread B. pencils C. ink D. pipes

SOLUTION TO UME 1999

UME/99/42

$$2CH_3CH_2OH \xrightarrow[145^0C]{\text{Conc. } H_2SO_4} \underset{\text{excess}}{}$$

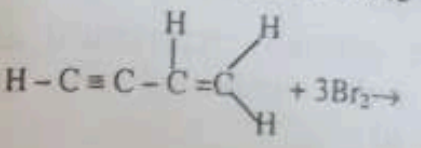


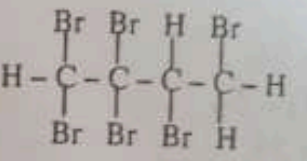
ethoxyethane

Note that ethoxyethene is also known as diethyl ether.

Correct option is C

UME/99/43





No of mole of but-1-ene-3-yne =

$$\frac{\text{Reacting mass}}{\text{molar mass}} = \frac{5.2g}{52g/mol} = 0.1mol$$

No of mole of bromine =

$$\frac{3 \text{ mole of bromine}}{1 \text{ mole of but-1-ene-3-yne}} \times 0.1 \text{ mole of but-1-ene-3-yne}$$

$= 0.3$mole

Mass of bromine = No of bromine x molar mass of bromine

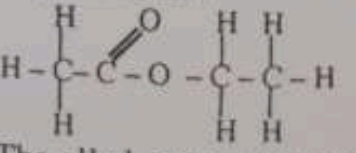
$= 0.3 \times 160 = 48g$

Note that the name but-1-ene-3-yne is wrong. The correct name should be but-1-yne-3-ene because Alkyne is more reactive than alkene.

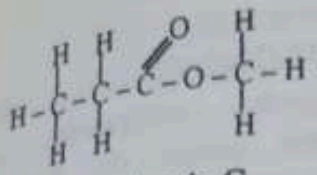
Correct option is B

UME/99/44

Ethyl ethanoate is



The alkyl groups are methyl (CH_3) and ethyl (CH_3CH_2) when the alkyl groups are interchange the ester obtain is



Correct option is C

UME/99/45

2-methylprop-1-ene is an isomer of but-2-ene because both have the same molecular formula.

Correct option is A

UME/99/46

Alkanols are general use as solvent for non-polar substance since perfumes are organic compound which are generally non-polar, the appropriate solvent for it is alkanols e.g. ethanol (CH_3CH_2OH).

Correct option is D

UME/99/47

Organic compounds which take two molecules of a reagent on addition reaction either contain a triple bond or two carbon to carbon double bonds. Hence alkynes and hence will take two molecules of any reagent.

Correct option is B

UME/99/48

Aromatic hydrocarbon (e.g. C_6H_6) and Alkyne burn with a sooty flame while Alkanes and Alkyne burn with a non-luminous flames.

Correct option is D

UME/99/49

The Alkene does no react with both Hydrogen cyanide and Hydroxylamine but Alkanal, Alkanone and Alkanoic acid do

The correct option is A

UME/99/50

Uses of polyvinylchloride (PVC)

i. It is used in making plastics bottles for chemicals & oils.
ii. It is used in making rain coats and caps.
iii. It is used in making plastic pipe.

Correct option is D

UME 2000

UME/2000/35

The substance often used for vulcanization of rubber is A. chlorine. B. hydrogen peroxide C. tetraoxosulphate (VI) acid D. sulphur

UME/2000/36

0.46g of ethanol when burned raised the temperature of 50g of water by 14.3K. Calculate the heat of combustion of ethanol. A. -3000 kJ mol^{-1} B. -300 kJ mol^{-1} C. +300 kJ mol^{-1} D. +3000 kJ mol^{-1}

[C = 12, O=16, H= 1, Specific heat capacity of water = $4.2Jg^{-1}K^{-1}$]

UME/2000/41

$$CH_3 - CH_2 - \overset{\overset{O}{\|}}{C} - OCH_2CH_3$$

The compound above is an

A. ether B. Alkanal C. ester D. Alkanol

UME/2000/44

The reaction of carbide with water gives A. Ethane B. Ethene C. ethane D. ethyne

UME/2000/46

Alkanone are generally obtained by the oxidation of A. primary Alkanols B. tertiary Alkanols C. secondary Alkanols D. Alkanoic acid.

UME/2000/47

Unsaturated organic compounds are identified by decolourization' of A. silver bromide and potassium tetraoxomanganate (VII) solutions B. bromine water and alkaline potassium tetraoxomanganate (VII) solution C. silver bromide solution and bromine water D. bromine water acidified potassium tetraoxomanganate (VU) solution.

UME/2000/48

Sucrose is made up of A. glucose and fructose B. glucose and glucose C. fructose and fructose D. Galactose and glucose.

UME/2000/49

The chlorinated Alkane often used industrially to remove grease is

A. chloromethane B. tetrachloromethane C. trichloromethane D. dichloromethane.

UME/2000/50

The repeating unit in natural rubber is A. alkyne B. neoprene C. n-propene D. isoprene

SOLUTION TO UME 2000 TYPE L

UME/2000/35

Vulcanization is the process of heating sulphur with rubber under pressure in order to toughen it.

Correct option is D

UME/2000/36

No of mole of ethanol =

$$(n_{CH_3CH_2OH}) = \frac{\text{Reacting mass}}{\text{molar mass}} = \frac{0.46g}{46g/mol}$$

$$= 0.01 \text{ mole}$$

Heat liberated in burning ethanol is equal to heat gain by water provided not heat is loss to the surrounding.

Heat gain by water (Q) = meat

$$= 50g \times 4.2J/gk \times 14.3k$$

$$= 3003J = 3.003kJ$$

⇒ Heat liberated by burning 0.46g of ethanol is 3.03kJ.

⇒ 0.01mol of ethanol liberated ...3.003kJ

1mol of ethanol liberated .....xkJ

$$\frac{0.01}{1} = \frac{3.003}{x}$$

$$x = \frac{3.003}{0.01} = 3003kJ \approx 300kJ$$

Hence the heat of combustion of ethanol is -300kJ/mol.

Correct option is B

UME/2000/41

The functional group depicted by the compound is –COOC- which is the functional group of the ester. Hence the compound is an ester.

Correct option is C

UME/2000/44

$$CaC_2 + 2H_2O \rightarrow Ca(OH)_2 + \underset{\text{ethyne}}{C_2H_2}$$

Correct option is C

UME/2000/46

Alkanone are generally obtained by the oxidation of secondary Alkanols.

Correct option is C

UME/2000/47

Unsaturated organic compound are identified by their action on $KMnO_4$, $K_2Cr_2O_7$, bromine water, chlorine water etc. when unsaturated organic compound are made to react with $KMnO_4$ or $K_2Cr_2O_7$ in alkaline and –OH group are added to the unsaturated. But if $KMnO_4$, $K_2Cr_2O_7$ are in acid are made to react with unsaturated compound, hydrogen atoms are added to the compound. But the major test of unsaturated compound is converting them to saturated compound. It best to used bromine or chlorine water and $KMnO_4$, $K_2Cr_2O_7$ in acid for the test.

Correct option is D

UME/2000/48

Glucose + glucose → maltose (malt sugar) + H_2O

Glucose + fructose → sucrose (cane sugar) + H_2O

Glucose + galatose → lactose (milk sugar) + H_2O

Correct option is A

UME/2000/49

Tetrachloromethane is a chlorinated Alkane used as a solvent.

Correct option is B

UME/2000/50

The repeated unit of natural rubber is 2-methylbutan-1,3-diene (isoprene).

Correct option is D

UME 2001

UME/2001/13

The pollution from petroleum spillage in rivers and lakes can best be dispersed by A. pouring detergents B. passing of ships through the area C. pouring organic solvents D. evaporation.

UME/2001/35

Fermentation is the A. breaking down of carbohydrate to glucose B. conversion of sugar to alcohol in the presence of yeast C. breaking down of sugar to carbohydrate D. Conversion of alcohol to sugar in the presence of yeast.

UME/2001/36

The general formula for the Alkanal is

A. ROH B. R_2CO C. $RCOOR^1$ D. RCHO

UME/2001/37

The main impurity in iron ore during the extraction of iron is A, silicon (IV) oxide B. carbon (IV) oxide C. calcium trioxosilicate D. sulphur (II) oxide.

UME/2001/38

During the vulcanization of rubber, sulphur is added to A. break down rubber polymer - B. lengthen the chain of rubber C. bind rubber molecules together D. act as a catalyst.

UME/2001/39

Catalytic hydrogenation of benzene produces A. oil B. cyclohexene C. cyclohexane D. margarine

UME/2001/40

A trihydric Alkanol is A. glycerol B. phenol C. glycol D. ethanol

UME/2001/42

Proteins in acid solution undergo A. polymerization B. substitution C. fermentation D. hydrolysis

UME/2001/43

A characteristic reaction of the compounds with the general formula C_nH_{2n} is A. esterification B. polymerization C. decarboxylation D. substitution

UME/2001/44

The pair of organic compounds that are isomers is A. benzene and methylbenzene B. trichloromethane and tetrachloromethane C. ethanol and propanone D. but-l-ene and but - 2 - ene.

UME/2001/45

A burning candle produces water and A. carbon (II) oxide B. carbon (IV) oxide C. oxygen D. hydrogen

UME/2001/48

Which of the following represents hybridization in ethyne? A. sp^2 B. sp^2d B. sp^3 D. sp

UME/2001/49

$C_{12}H_{22}O_{11(s)} + H_2SO_{4(aq)} \rightarrow 12C_{(S)} + 11\ H_2O_{(1)} + H_2SO_{4(aq)}$

In the reaction above, tetraoxosulphate (VI) acid functions as A. a dehydrating agent B. an oxidizing agent C. a reducing agent D. a catalyst.

SOLUTION TO UME 2001 TYPE R

UME/2001/13

Oil spillage in water bodies can be removed by any of the following;

i. For small bodies of water such as pond, oil spillage is removes by dispersion of air through the pond.
ii. For large bodies of water such as river or lake, oil spillage is removed by pouring organic solvents on the river or lake.

Correct option is C

UME/2001/35

Fermentation is the slow decomposition by micro organisms of large organic molecules (such as starch) to smaller molecular (such as ethanol).

Correct option is B

UME/2001/36

The general formula of Alkanal is RCHO

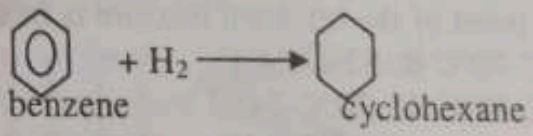
Correct option is D

UME/2001/38

In vulcanization of rubber, sulphur is added to rubber to convert the double bond in rubber to single bond. Thereby bind the molecules of rubber together.

Correct option is C

UME/2001/39



Correct option is C

UME/2001/42

Hydrolysis of protein by means of acid, alkali or enzyme action splits them up into a number of amino-acids.

Correct option is D

UME/2001/43

C_nH_{2n} is the general formula of the Alkanes or cycloalkanes. The - characteristics of reaction of the alkenes are addition reaction or polymerization. While the characteristics reaction of the cycloalkane is substitution

reaction. However for the Jamb syllabus does not include cycloalkanes. Hence C_nH_{2n} in this question means alkenes.

Correct option is B

UME/2001/44

But-1-ene and but-2-ene are position isomers.

Correct option is D

UME/2001/45

$$Candle + \left(\frac{3n+1}{2}\right)O_2 \rightarrow \cap CO_2 + (n+1)H_2O$$

Correct option is B

UME/2001/48

The carbon atom in ethyne is sp-hybridized.

Correct option is D

UME/2001/49

The removal of water from the starch ($C_{12}H_{22}O_{11}$) shows that the reaction was a dehydration reaction and the conc. H_2SO_4 acts as a dehydrating agent.

Correct option is A

UME/2002/3

The formula CH_2O for ethanoic acid is regarded as its A. general formula B. structural formula C. molecular formula D. empirical formula.

UME/2002/4

A little quantity of trichloromethane (b.pt.60°C) was added to a large quantity of ethanol (b.pt.78°C). The most probable boiling point of the resultant mixture is from A. 69°C-70°C B. 82°C-84°C C. 60°C-78°C D. 70°C-74°C

UME/2002/9

The property which makes alcohol soluble in water is A. hydrogen bonding B. covalent nature C. ionic chard D. boiling point.

UME/2002/28

A red precipitate of copper (I) carbide is formed when ammonium solution of copper (I) chloride is introduced into

A. $CH_2{=}CH{-}CH_2CH_3$ B. $CH_3CH_2CH_2CH_3$ C. $CH_3{-}C{\equiv}C{-}CH_3$ D. $CH_3CH_2{-}C{\equiv}CH$

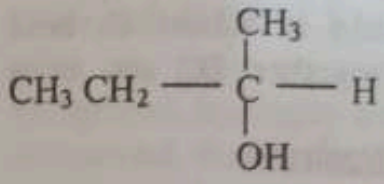
UME/2002/30

The intermediate product formed when ethanol is progressively oxidized to ethanoic acid with potassium heptaoxodichromate (VI) is A Ethanal B. methanol C. butanal D. Propanal

UME/2002/32

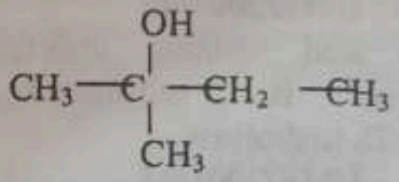
The boiling of fat and aqueous caustic soda is referred to as A. saponification B. esterification C. acidification D. hydrolysis

UME/2002/33

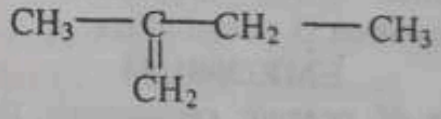


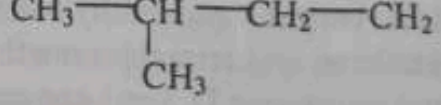
The compound above is a A. tertiary Alkanol B. primary Alkanol C. glycol D. secondary Alkanol

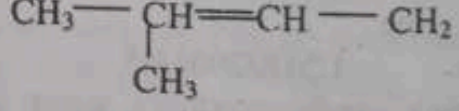
UME/2002/34

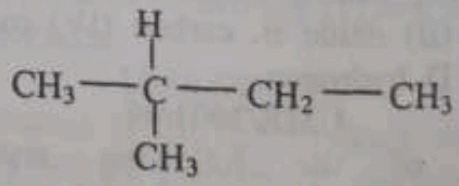


The major product of the dehydration of the compound above is

A. 

B. 

C. 

D. 

UME/2002/35

Which of these are synthetic and natural macromolecules respectively? A. Nylon and creatine; polyethylene and haemoglobin B. Polyethylene and creatine; nylon and haemoglobin C. Haemoglobin and nylon;

creatine and polyethylene D. Nylon and polyethylene; creatine and haemoglobin.

UME/2002/36

The number of isomers formed by C_6H_{14} is A. 5 B. 4 C. 3 D. 2

UME/2002/37

The reaction of an alkene with hydrogen in the presence of a catalyst is A. an oxidative reaction B. a Nucleophilic reaction C. an addition reaction D. a substitution reaction.

UME/2002/38

Ethanol can easily be produced by A. catalytic oxidation of methane B. destructive distillation of wood C. fermentation of starch. D. distillation of starch solution.

UME/2002/39

An example of an element that can catenate is A. carbon B. nitrogen C. bromine D. chlorine

UME/2002/40

Which of the following polymers is suitable for packaging and electrical insulation? A. Polystyrene
B. Polycarbonate C. Polyethene
D. Polyamide

SOLUTION TO UME 2002 TYPE K

UME/2002/3

CH_2O is the empirical molecular of CH_3COOH.

Correct option is D

UME/2002/4

Impurity raise boiling point so if a small quantity of trichloromethene (b.pt 60^0c) is added to a large quantity of ethanol (b.pt 78^0c). The lowest boiling point of the mixture will be greater than the boiling point of the compound of the mixture with the highest boiling point. Thus the probable boiling point of the mixture will be 82-84^0c.

Correct option is B

UME/2002/9

Hydrogen bonding is the bond which comes into play whenever hydrogen atom is directly link to small highly charge electronegative element such as nitrogen oxygen and fluoride. It is responsible for the unusual boiling point of water, Alkanol, Alkanoic acid etc.

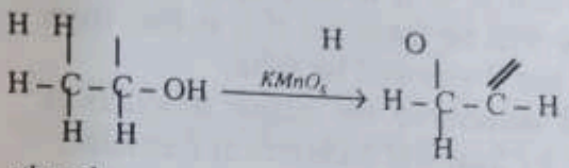
Correct option is A

UME/2002/28

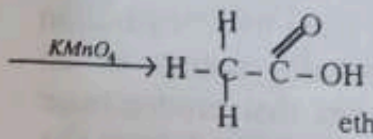
Terminal Alkyne react with Ammoniacal solution of copper I chloride or silver nitrate.

Correct option is D

UME/2002/30



ethanol ethanal



ethanoic acid

Saponification is the alkaline hydrolysis of facts or oils.

Correct option is A

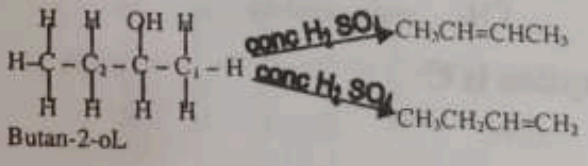
UME/2002/33

Secondary Alkanol have the general formula RCHOH.

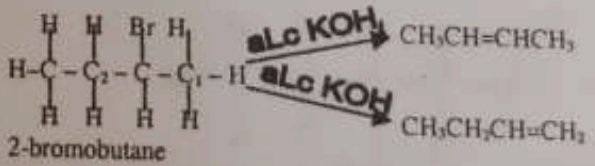
Correct option is D

UME/2002/34

The dehydration of secondary or tertiary Alkanols or dehydrohalogenation of secondary or tertiary alkyl halides yield move than one products e.g.



Butan-2-oL



2-bromobutane

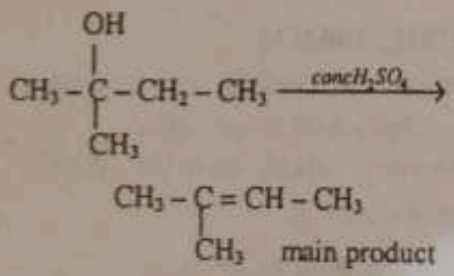
In the dehydration of butan-2-ol, a water molecules will loss but the problem now is that, where will the hydrogen to be joint to the –OH to form the water molecules to be loss comes from. The hydrogen to be loss

can only comes from carbon 1 or 2 since they are directly link to the carbon that bear the –OH. If the hydrogen is loss from carbon 1, but-1-ene will be form but if the hydrogen is loss from carbon 2, but-2-ene will be form.

In the dehydrohalogenation of alkyl halide the hydrogen to join the bromine to form the HBr to be loss can only come from carbon 1 and 2. If it is loss from carbon 1, but -1-ene will be form but if it is loss from carbon 2, but-2-ene will be form.

To determine the major products is determine by Saytzeff's empirical formulae.

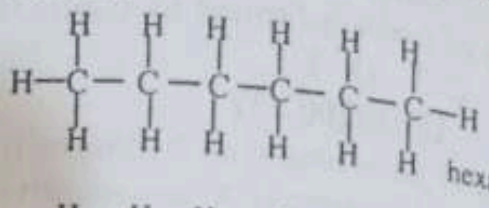
Saytzeff's rule: it states that if two or more alkenes can be formed from the dehydration of alcohol or dehydrohalogenation of an alkyl halides, the alkenes that predominate (i.e. the main products) is formed from the most alkylated carbon atom (i.e. the carbon atom with the least hydrogen atom. Since carbon 2 has least number of hydrogen it will loss the hydrogen atom to form but-2-ene. Hence the major product is but-2-ene while but-1-ene is the side product.

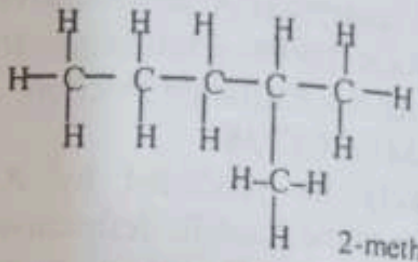


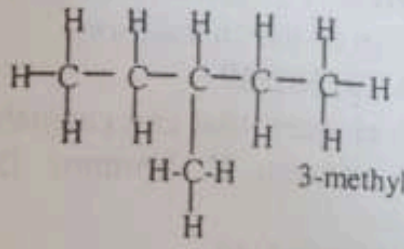
Correct option is C

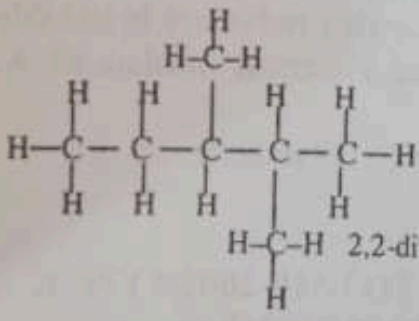
UME/2002/36

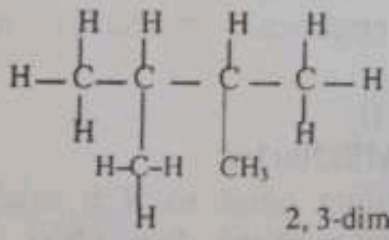
The number of isomers form by C_6H_{14} are show below;


hexane


2-methylpentane


3-methylpentane


2,2-dimethylbutane


2, 3-dimethylbutane

Hence the number of isomers of C_6HC_4 is 5.

Correct option is A

UME/2002/37

$$\text{Alkene} + H_2 \xrightarrow{Ni} \text{Alkanes}$$

The above reaction is an addition reaction.

Correct option is C

UME/2002/38

Fermentation is the slow decomposition by micro organism of large organic compound (starch) to smaller molecule (such as ethanol).

Correct option is C

UME/2002/39

Uses of polyethene

i. It is used in making pipe
ii. It is used in making domestic kitchenware's and toy.
iii. It is used in film or sheet form for packaging
iv. It is used in coating electric wires and cable.

Correct option is C

UME 2003

UME/2003/40

Ethene reacts with hydrogen bromide to give A. CH_2Br_2 B. CH_3CH_2Br C. $C_2H_2Br_2$ D. $CHBr_3$

UME/2003/41

Carbohydrates are compounds containing carbon, hydrogen and oxygen in the ratio A. 3:1:1 B. 2:1:1 C. 1:2:1 D. 1:1:1

UME/2003/42

How many isomers does pentane have?
A. 6 B. 5 C.4 D. 3

UME/2003/43

The leachate of a certain plant ash is used in local soap- making because it contains A. sodium chloride and potassium hydroxide. B. sodium hydroxide C. potassium hydroxide D. soluble carbonates and hydrogen carbonates.

UME/2003/44

The formula for ethyl butanoate is A. $C_3H_7COOC_2H_5$ B. $C_2H_5COOC_3H_7$ C. $C_4H_9COOC_2H_5$ D. $C_2H_5COOC_4H_9$

UME/2003/45

The type of reaction that is peculiar to benzene is A. addition B. hydrolysis C. polymerization D. substitution.

UME/2003/46

Ethanol reacts with excess acidified $K_2Cr_2O_7$ to produce A. ethanedioic acid B. Ethanal C. ethyl ethanoate D. ethanoic acid.

UME/2003/47

A compound contains 40.0% carbon, 6.7% hydrogen and 53.3% oxygen. If the molar mass of the compound is 180, the molecular formula. A. CH_2O B. $C_3H_6O_3$ C. $C_8H_{12}O_6$ D. $C_6H_6O_3$[H=1, C=12, O=16]

UME/2003/48

The process by which atoms are rearranged into different molecular structures in the petroleum refining process is referred to as catalytic cracking B. hydro-cracking C. polymerization D. reforming.

UME/2003/49

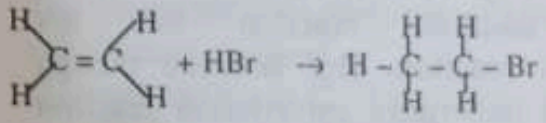
Which of the following is found in cotton? A. Starch B. Cellulose C. Fat D. Oil.

UME/2003/50

The principal constituent of natural gas is A. methane B. ethane C. propane D. butane.

SOLUTION TO UME 2003 TYPE 6

UME/2003/40



Correct option is B

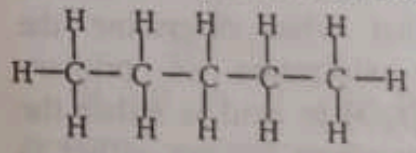
UME/2003/41

$C_xH_{2y}O_y$ is the general formula of carbohydrate. The empirical formula of hydrocarbon is obtain when x = y = 1 (i.e. CH_2O). Hence the ratio of carbon, hydrogen and oxygen is 1:2:1.

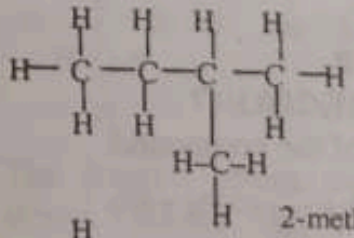
Correct option is C

UME/2003/42

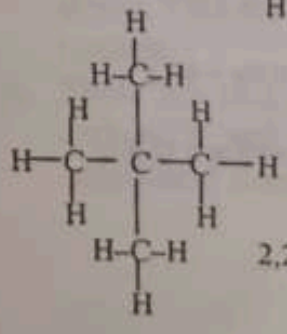
The isomers of pentene are shown below;



pentane



2-methylbutane



2,2-dimethylpropane

Hence the numbers of isomers in pentane is 3.

Correct option is D

UME/2003/43

The leachate of certain plant ash is rich in NaOH. Hence it is used in the making of soap.

Correct option is B

UME/2003/44

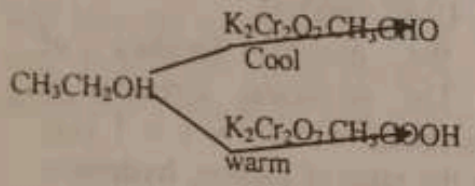
Ethylbutanoate is $CH_3CH_2CH_2COOCH_2CH_3$

Correct option is A

UME/2003/44

The reaction that is peculiar to benzene is substitution reaction. The reason is that unsaturated hydrocarbon is expected to undergo addition reaction but not substitution reaction. But benzene though unsaturated undergoes substitution reaction which is a characteristics of benzene.

Correct option is D



It should be noted that $K_2Cr_2O_7$ in acid is a weak oxidizing agent (also known as oxidant). It will oxidize primary Alkanol to Alkanal when cool but if warm oxidized primary Alkanol to Alkanoic acid. It should be also noted that what determine the product of the oxidization of primary Alkanol with $K_2Cr_2O_7$ in acid is either the $K_2Cr_2O_7$ is cool or warm but not either is excess or not.

Correct option is B

UME/2003/47

Considering 100g of the compound

$$\text{mass of C} = 40\% \text{ of } 100g = \frac{40}{100} \times 100g = 40g$$

$$\text{mass of H} = 6.7\% \text{ of } 100g = \frac{6.7}{100} \times 100g = 6.7g$$

$$\text{mass of O} = 53.3\% \text{ of } 100g = \frac{53.3}{100} \times 100g = 53.30g$$

C	:	H	:	O
$\frac{40}{12}$	:	$\frac{6.7}{1}$	:	$\frac{53.3}{16}$
3.3333	:	6.7	:	3.3313
1.0006	:	2.0113	:	1

The empirical formular is CH_2O

Let $(CH_2O)n = 180$

$(12+2+16)n = 180$

$30n = 180$

$n = 180/30 = 6$

$(CH_2O)_6 = C_6H_{12}O_6$

The molecular formula is $C_6H_{22}O_6$

UME/2003/48

Reforming is a process of converting straight chain hydrocarbons within petrol range to branch, cyclic higher octane rated ones. The reforming processes are; isomerization, aromatization, alkylation and dehydrocyclization.

Correct option is D

UME/2003/49

Cotton is a natural polymer whose monomeric unit is cellulose.

Correct option is B

UME/2003/50

The principal constituent of natural gas is methane.

Correct option is A

UME 2004

UME/2004/40

Oxyacetylene flame is used for iron-welding because it A. makes the iron metal solidify very quickly B. combines with oxygen to give a pop sound C. evolves a lot of heat when burnt. D. dissociates to produce carbon (IV) oxide and oxygen.

UME/2004/41

The alkyl group can be represented by the general formula A. C_nH_{2n+1} B. C_nH_{2n} C. C_nH_{2n+2} D. C_nH_{2n-2}

UME/2004/42

An isomer of C_5H_{12} is A. butane B. 2-methylbutane C. 2-methylpropane D. 2-ethylbutane.

UME/2004/43

A characteristic of the Alkane family is A. addition reaction B. elimination reaction C. substitution reaction D. neutralization reaction.

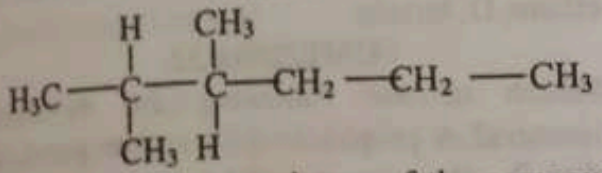
UME/2004/44

Which of these reagents can confirm the presence of a triple bond? A. Bromine water B. Acidified $KMnO_4$ C. Copper (I) Chloride D. Bromine gas.

UME/2004/45

Vulcanization involves the removal of A. a monomer B. the single bond C. the double bond D. a polymer

UME/2004/46



The IUPAC nomenclature of the compound above is A. 2-ethylpenane B. 3,4-dimethylhexane C. 2,3-dimethylhexane D. 2-ethylhexane.

UME/2004/47

$CH_3COOH_{(g)} \rightarrow CH_{4(g)} + CO_{2(g)}$ The reaction above is A. carboxylation B. decarboxylation C. acidification D. esterification.

UME/2004/48

$C_2H_5OH_{(aq)} \xrightarrow[180^0C]{Conc.H_2SO_4} Y$ in the reaction above, Y represents A. CH_4 B. C_2H_5COOH C. C_2H_4 D. CH_3OCH_3

UME/2004/49

Alkanol + Alkanoic acid $\rightleftharpoons$ Ester + Water

The reverse reaction of the equation above is known as A. hydrolysis B. saponificaiton C. hydration D. fermentation.

UME/2004/50

In the production of soap, concentrated sodium chloride solution is added to A. increase the solubility of the soap B. decrease the solubility of the soap C. saponify the soap D. emulsify the soap.

SOLUTION TO UME 2004 TYPE H

UME/2004/40

Oxyacetylene flame is a flame form when ethyne (acetylene) combined with oxygen. The temperature of oxyacetylene is about 1200^0C. Hence it is used in welding metal.

Correct option is C

UME/2004/41

The general formular of alkyl group is C_xH_{2n+1}

Correct option is A

UME/2004/42

The isomers of C_3H_{12} is a compound with the molecular formula e.g. 2-methylbutane.

Correct option is B

UME/2004/43

The characteristics reaction of the alkene is substitution reaction.

Correct option is C

UME/2004/44

The reagent that can confirm the presence of terminal triple bond is ammoniacal solution of copper I chloride or silver nitrate.

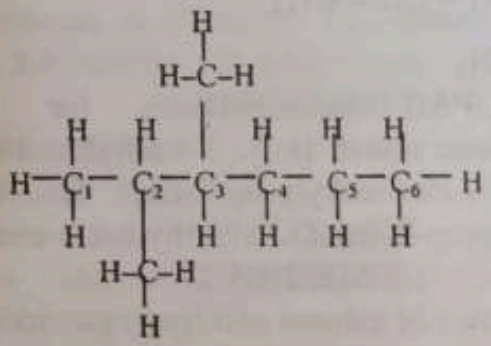
Correct option is C

UME/2004/45

Vulcanization of rubber involves the conversion of a double bond to a single bond.

Correct option is B

UME/2004/46



i. The longest chain contains 6 carbon atoms. Hence the parent Alkane is hexane.

ii. There are two methyl group attached to carbon 2 and hence the mane of the substituent name is 2,3-dimethyl

iii. The IUPAC nomenclature is 2,3-dimethylhexane.

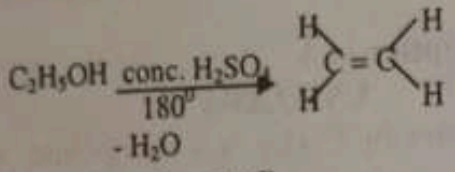
Correct option is C

UME/2004/47

Decaboxylation reaction is a reaction in which carbon IV oxide is/are loss from a compound.

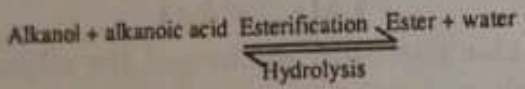
Correct option is B

UME/2004/48



Correct option is C

UME/2004/49



Correct option is A

UME/2004/50

It decrease the solubility of soap in order to separate out of glycerol as a hard cake.

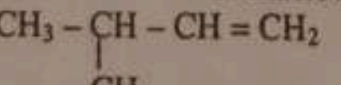
Correct option is B

UME 2005

UME/2005/22

The shape of the hydrocarbon compound CH_4 is A. square planar B. tetrahedral C. planar D. linear.

UME/2005/26



The IUPAC nomenclature for the hydrocarbon above is A. 3-methylbut-l-ene B. 1, 1-dimenthylprop-2-ene C. 1,2-dimethylprop-2-ene D. 2-methylbut-3-ene.

UME/2005/27

Equal moles of ethyne and hydrogen iodide react to give A. $CH_2 = CH_2$
B. $CH_2 = CHI$ C. CH_2-CHI D. CH_3-Cl_3

UME/2005/28

How many hydrogen atoms does a single ring cycloalkane have less than the corresponding open-chain Alkane? A. three B. one C. four D. two

UME/2005/29

The decolourization of the purple colour of A. tetraoxomanganate (VII) ion is a test for A. Alkanal B. Alkanes C. alkenes D. Alkanols.

UME/2005/30

In the purification of impure samples of ethyl ethanoate synthesized by esterification, concentrated sodium trioxocarbonate (IV) solution is used to remove A. water B. acidic impurities C. basic impurities D. ethoxyethane.

UME/2005/31

A substance that is used as a ripening agent for fruits is A. propene B. methane C. ethane D. butane.

UME/2005/32

Which of the following are structural isomers? A propanoic acid and propan-l, 2-diol B. ethanoic acid and propanoic acid C. ethan-1, 2-diol and ethanoic acid D. propanal and propanone.

UME/2005/33

The enzyme responsible for converting sucrose into two simple isomeric sugars is A. invertase B. amylase C. lactase D. maltase.

UME/2005/46

What is the correct IUPAC name for NO_2^-? A. Dioxonitrate (III) ion B. Dioxonitrate (IV) ion C. Trioxonitrate (III) ion.

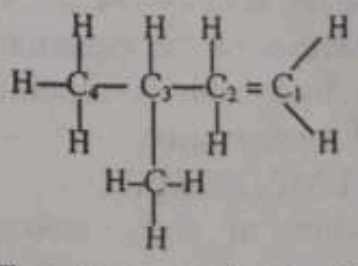
SOLUTION TO UME 2005 TYPE K

UME/2005/21

The shape of methane is tetrahedral

Correct option is B

UME/2005/25

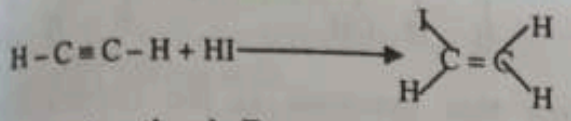


i. The longest chain contains 4 carbon atoms with a double bond in carbon 1. The parent alkene is but-1-ene.

ii. There is a methyl group in carbon 3. Hence the substituent name is 3-methyl.
iii. The IUPAC nomenclature is 3-methylbut-1-ene.

Correct option is A

UME/2005/27



Correct option is B

UME/2005/28

The general formula of Alkanes is C_xH_{2n+2} while the general formula of cycloalkanes is C_xH_{2n}. so cycloalkanes have 2 hydrogen less than the corresponding open chain alkene.

Correct option is D

UME/2005/29

Alkenes decolourize bromine water, chlorine, water, $KMnO_4$ $K_2Cr_2O_7$ etc.

Correct option is C

UME/2005/30

Na_2CO_3 solution is alkaline in nature, hence it is used to absorb acid gases e.g. SO_2, CO_2, NO_2 etc.

Correct option is B

UME/2005/31

Uses of ethane

i. It is in the formation of compound like ethane, epoxyethane, ethen-1, 2-diol, ethanoic acid.
ii. It is used in the production of synthetic rubber e.g. styrene-butadiene rubber (SBR)
iii. It is used in making plastic
iv. It is used in quickening the ripening of fruits.
v. It is used as a fuel.

Correct option is C

UME/2005/32

Propanal and propanone are functional isomers which is an example of structural isomerism. Structural isomerism is also known as constitutional isomerism.

Correct option is D

UME/2005/33

$C_6H_{12}O_6 + C_6H_{12}O$

The conversion of sucrose to glucose can be effected by the enzyme invertase or hydrochloric acid.

Correct option is A

UME2006

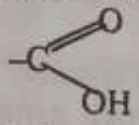
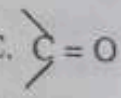
UME/2006/15

$2C_2H_{2(g)} + 5O_{2(g)} \rightarrow 4CO_{2(g)} + 2H_2O_{(g)}$

In the reaction above, the mass carbon(IV) oxide produced on burning 78g of ethyne is
A. 39 B. 352g C. 264g D. 156g
[C=12, O=16, H= 1]

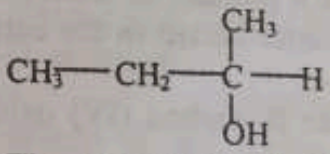
UME/2006/22

Which of the following functional groups will give gasbubbles when treated with a saturated solution of sodium hydrogen trioxocarbonate(IV)?

A.  B. $-NH_2$ C. 

D. –OH

UME/2006/23



The oxidation of the compound above produces A.3-butanal B.2-butanal
C. 3-butanone D. 2-butanone.

UME/2006/24

Which of the following has an isomer?
A C_4H_{10} B. C_6H_6 C. C_2H_4 D. C_2H_6

UME/2006/25

An example of aliphatic unsaturated hydrocarbon is A butanol B. propene C. pentane D. benzene

UME/2006/26

2- methylbut -2-ene has the structure

A. $C_2H_5CH(CH_3)C=CH_2$ B. $CH_3CH(CH_3)CH=CH_2$

C. $CH_3CH=C(CH_3)CH_3$ D. $CH_3CH_2C(CH_3)=CH_2$

UME/2006/27

One mole of a hydrocarbon contains 36g of carbon and vapour density is 20. The structure of the hydrocarbon is

A. $CH_3CH_2CH_3$ B. $CH_3CH = CH_2$

C. $CH_3CH_2C{\equiv}CH$ D. $CH_3C{\equiv}CH$

UME/2006/28

$CH_3- CH_2 - C = CH$

The hybridization in the compound above is

A sp^3 and sp B. sp^3 and sp^2 C. sp D. sp^2

UME/2006/29

Nigerian crude oil is described as light crude because of its

A low aliphatic-hydrocarbon content

B. low sulphur content C. high natural gas content . high octane number.

UME/2006/30

The gas obtained as a product of anaerobic action on organic matter buried in the earth is

A nitrogen(IV) oxide B. carbon (IV) oxide C. methane D. ethane

UME/2006/32

The products of the combustion of candle wax are A. carbon (IV) oxide and water B. oxygen and water C. hydrogen and water D. carbon (II) oxide and water.

SOLUTION TO UME 2006 TYPE J

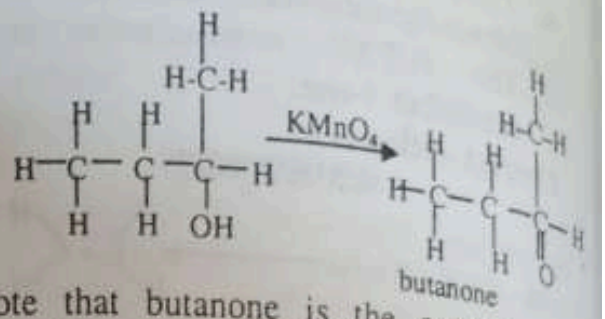
UME/2006/22

The functional group that gives gas bubble when treated with a saturated solution of $NaHCO_3$ is carboxylic group

(- C(=O) – OH).

Correct option is A

UME/2006/23

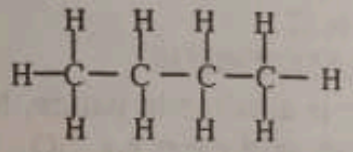


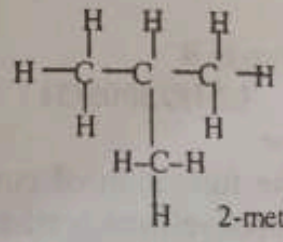
Note that butanone is the correct name butan-2-one or 2-butanone is not correct because varying the carbon atom in which the oxygen is attached does not chain the name.

Correct option is D

UME/2006/24

C_6H_6, C_2H_4 and C_2H_6 do not undergo isomerism, hence they do not have isomers. But C_4H_{10} exhibit isomerism as shown below;


butane


2-methylpropane

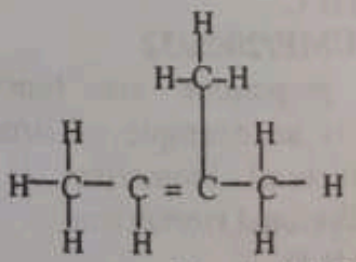
Correct option is A

UME/2006/25

Aliphatic unsaturated hydrocarbon are alkenes and alkynes e.g. propene and propyne.

Correct option is B

UME/2006/26


2-methylbut-2-ene

Correct option is C

UME/2006/27

No of mole of C = 30g/12glmol = 3mole

Let the hydrocarbon be represented by C_xH_y

$\Rightarrow C_xH_y = C_3H_y$

R.m.m of C_3H_y = 2 x vapour density

$3(12) + y(1) = 2 \times 20$

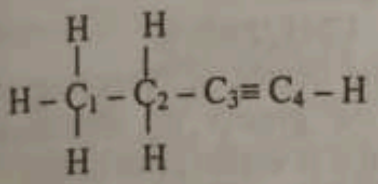
$36 + y = 40$

$y = 40-36 = 4$

$\Rightarrow C_xH_y = C_3H_4$ i.e. propyne [$CH_3 C{\equiv}CH$]

Correct option is D

UME/2006/28



i. carbon 1 and 2 is Sp^3-hybridized

ii. carbon 3 and 4 is Sp-hybridized

iii. the carbon atom in the compound is Sp^3& Sp – hybridize.

Correct option is A

UME/2006/29

Nigeria crude oil is describe as light because of its high natural gas content.

UME/2006/29

The gas obtained as a product of anaerobic (absent of oxygen) action on organic matter buried in the earth is methane.

Correct option is C

UME/2006/32

Candle wax + $O_2 \rightarrow CO_2 + H_2O$

Correct option is A

CHEMISTRY U.M.E. 5TH MAY 2007

UME/2007/17

Tartaric acid is used industrially to

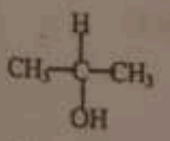
A. dry substances B. makes baking powder

C. make fruit juices D. remove rust

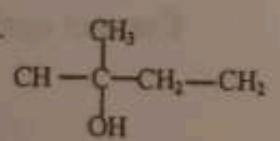
UME/2007/43

Which of the following compounds is atertiaryAlkanol?

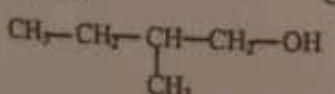
A.



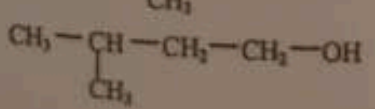
B.



C.



D.



UME/2007/43

$CH_3CH_2Cl + KCN \rightarrow CH_3CH_2CN + KCl$

In the reaction above, the cyanide is

A Nucleophilic B. Electrophilic

C. hydrophilic D. hydrophobic

UME/2007/45

How many structural isomers of chlorobutane are possible?

A. l B.2C.3 D.4

UME/2007/46

Certain useful waxesare composedmainlyof

A Alkanes B. amino acids C. Alkanoate D. glycerols

UME/2007/47

Which ofthe following compounds is the best possible anti-knock agentfor petrol?

A. $CH_3CH_2CH_2CH_2CH_2CH_3$

B. $CH_3CH_2(CH_3)CHCH_2CH_2CH_3$

C. $(CH_3)_3 C - CH_2CH_2CH_3$

D. $(CH_3)_2CH_2\text{-}CH(CH_3)CH_2CH_3$

UME/2007/48

Which of the following represents an aromatic compound?

A. C_6H_{12} B. C_6H_5OH

C. C_3H_6 D. C_6H_9OH

UME/2007/49

The hydrocarbon used in the production of Styrene is A. ethane B. ethane C. ethyne D. propyne

UME/2007/50

Which of the following Alkanes has the highest boiling point? A. Ethane B. Methane C. Pentane D. Propane

SOLUTION TO UME 2007

UME/2007/17

Tartaric acid is use in making fruit juices

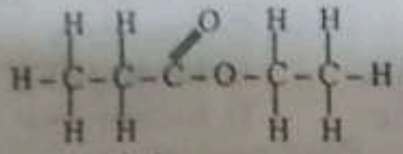
Correct option is C

UME/2007/41

Reforming is a process of converting straight chain hydrocarbons within petrol range to branch, cyclic higher octane rated ones.

Correct option is C

UME/2007/42

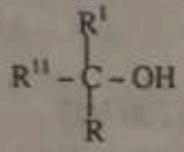


ethylpropanoate

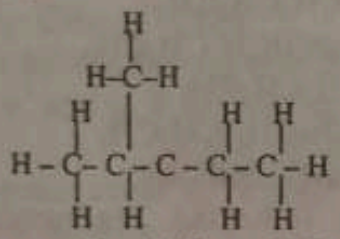
Correct option is B

UME/2007/43

Tertiary Alkanols have the general formula R_3COH i.e.



Example of tertiary Alkanol is given below;



2-methylbutan-2-oL

UME/2007/44

Nucleophiles or Nucleophilic reagent is a reagent that attack electron deficient centre. The following are Nucleophiles.

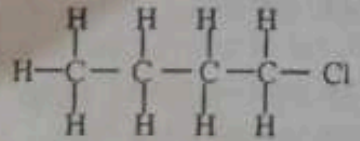
i. molecules that are electron rich e.g. H_2O, NH_3
ii. All anions e.g. OH^-, Cl^- etc.
iii. All Lewis base.

Hence KCN act as a Nucleophilic in the reaction.

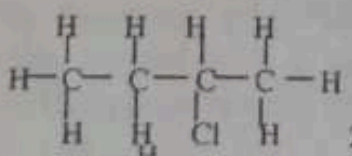
Correct option is A

UME/2007/45

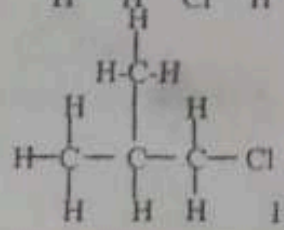
The possible isomers of chlorobutane are given below;



1-chlorobutane



2-chlorobutane



1-chloro-2-methylpropane

Hence chlorobutane have four isomers.

Correct option is D

UME/2007/46

Certain useful wax are composed mainly of Alkanoate

The correct option is C

UME/2007/47

The greater the degree of branching of an hydrocarbon the greater its efficiency as petrol provided it is within petro range.

Correct option is C

UME/2007/48

Aromatic hydrocarbon and Alkanol have the general formula Ar-H and Ar-OH respectively. Where Ar is an Aryl group which may be benzene or other hydrocarbon e.g. benzene is an aromatic hydrocarbon while phenol is (C_6H_5OH) is an aromatic Alkanol.

Correct option is B

UME/2007/49

Uses of ethene.

i. It is used in the production of polyethene, polystyrene ethanol, ethylene oxide, 1,2-dibromo ethane, ethan-1,2-diol etc.
ii. It is use as a fuel.
iii. It is used in quickening the ripening of fruits.

Correct option is B

UME/2007/50

The greater the molecular weight of an hydrocarbon of a given homologous series the greater the boiling point. Some pentene have the highest molecular weight it will have the highest boiling point.

Correct option is C

U. M. E. CHEMISTRY 2008 TYPE: A

UME/2008/1

Chlorophyll obtained from, green leaves of plant can be shown to be composed of more than one coloured component by the technique of A. crystallization B. hydrolysis C. chromatography D. sublimation

UME/2008/15

The vulcanizer's solution is prepared by dissolving rubber in A. ethanol B. kerosine C. benzene D. petrol

UME/2008/23

What is the IUPAC nomenclature of the compound NaClO? A. Sodium oxochlorate (I) B. Sodium chloro(I) oxide C. Sodium monooxochlorate (II) D. Sodium chloro(I) monoxide.

UME/2008/42

If glucose is heated with concentrated tetraoxosulphate (VI) acid, it will be dehydrated to A. carbon B. carbon (IV) oxide C. Ethene D. ethanol

UME/2008/43

A hydrocarbon X with a molar mass of 26 consists of 92.3% carbon. What is its molecular formula?

A. C_2H_2 B. C_3H_3 C. C_4H_4 D. C_5H_5

UME/2008/44

A red precipitate of copper (I) carbide is formed when ammonium solution of copper (I) chloride is introduced into

A. $CH_2 = CH - CH_2 - CH_3$

B. $CH_3CH_2-C{\equiv}CH$

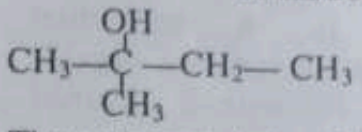
C. $CH_3CH_2CH_2CH_3$ D. $CH_3-C \equiv C -CH_3$

UME/2008/45

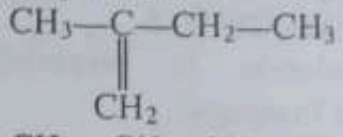
Reduction of nitroalkanes, nitrites and amides is a route for the preparation of

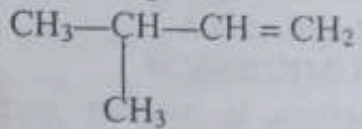
A. amines B. alkenes C. polymers D. detergents

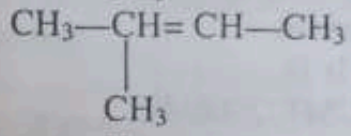
UME/2008/46

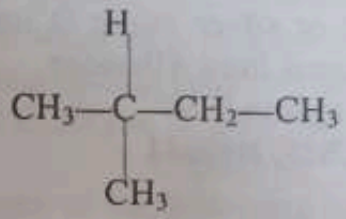


The major products of the dehydration of the above compound is

A. 

B. 

C. 

D. 

UME/2008/47

Reduction of Alkanone with $LiAlH_4$ produces A. primary Alkanols B. secondary Alkanols C. tertiary Alkanols . D. polyhydric Alkanols.

UME/2008/48

The product obtained when a mixture of benzene vapour hydrogen are passed over a nickel catalyst at 180°C is A. cyclohexane B. cyctopentane C. n-hexane D. n-pentane

UME/2008/49

Polyvinyl chloride is used in the production of A. glass B. alloy C. pipes D. ceramics

UME/2008/50

Detergents are manufactured with straight hydrocarbon chain so as to make them

A. soluble B. biodegradable C. cheaper D. foamy

SOLUTION TO UME 2008 TYPE A

UME/2008/1

Chromatography is a separation technique used to separate complex organic mixture such as ink, chlorophyll obtained from green leaves of plants etc.

Correct option is C

UME/2008/15

Vulcanizer's solution is prepared by dissolving rubber in ethanol.

Correct option is A

UME/2008/39

Cis-trans isomerism is another name of geometric isomerism.

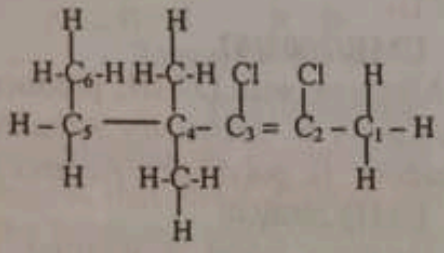
Correct option is D

UME/2008/40

Tollen's reagent or silver minor is used to differentiate Alkanal from Alkanone.

Correct option is D

UME/2008/41



i. The longest chain contains 6 carbon atoms with a double bond in carbon 2. Hence the name of the parent alkene is hex-2-ene.

ii. There two chlorine attach to carbon 2 & 3 and two methyl group in carbon 4. Hence the substituent name is 2,3-dichloro-4-methyl.

iii. The IUPAC nomenclature is 2,3-dichloro-4,4-dimethylhex-2-ene.

Correct option is C

UME/2008/42

$$C_6H_{12}O_6 \xrightarrow[-6H_2O]{\text{conc } H_2SO_4} 6C$$

Correct option is A

UME/2008/43

% of carbon = 92.3%

% of hydrogen = (100-923)% = 7.7%

Considering 100g of the hydrocarbon

Mass of C = 92.3% of 100g

$$= \frac{92.3}{100} \times 100g = 92.30g$$

Mass of H = 7.70% of 100g

$$= \frac{7.7}{100} \times 100g = 7.70g$$

C	:	N
$\frac{92.30}{12}$	:	$\frac{7.70}{1}$
7.6917		7.70
1	:	1.0011

The empirical formula is CH

$(CH)n = 26$

$(12+1)n = 26$

$\Rightarrow 13n = 26$

$N = 2$

$(CH)n = C_2H_2$

Correct option is A

UME/2008/44

Terminal Alkyne reacts with Ammoniacal $AgNO_3$ to form whitish yellow precipitate of silver carbide (Ag_2C_2). It also reacts with Ammoniacal copper I chloride (CuCl) to form a reddish brown precipitate of copper I dicarbide.

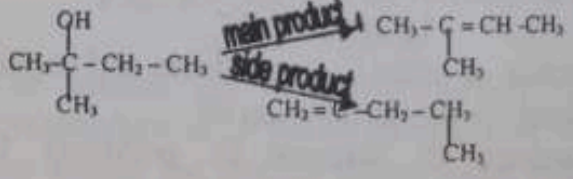
Correct option is B

UME/2008/45

The reduction of nitroalkanes, nitriles and amides lead to the formation of amines.

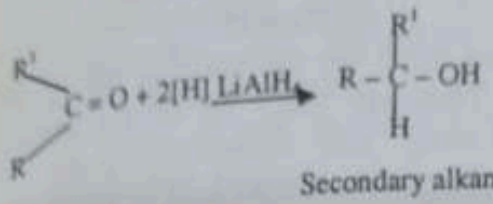
Correct option is A

UME/2008/46



Correct option is C

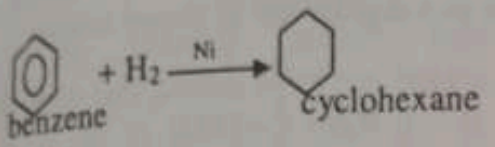
UME/2008/47



Secondary alkanol

Correct option is B

UME/2008/48



Correct option is A

UME/2008/49

Uses of polyvinyl chloride

i. It is used in making plastic bottles for chemicals and oils.
ii. It is used in making rain coats and caps.
iii. It is used in making plastics pipes.

Correct option is C

UME/2008/50

Detergents and manufactured with straight hydrocarbon chain so as to make them biodegradable.

Correct option is B

U/2009/14

U/2009/14

Water can be obtained as the only product during the A. combustion B. neutralization of an acid by a base C. combustion of hydrogen D. electrolysis of brine

U/2009/41

A cracking process in petroleum refining can be represented by A. heptane to heptene B. heptane to 3 – methylhexane C. heptane to propene and butane D. heptane to 2, 3, 3 – trimethybutane

U/2009/42

Which of the following class molecules has two other positional isomers? A. CH_3CH_2Br B. $CH_3CHBr\ CH_3$ C. CBr_2F_2 D. $CH_3CHBrCHBr$

U/2009/43

Which of the following class of compounds can exist as dipolar ions in solution? A. Alkanoic acids B. Fatty acids C. Dialkanoic acids D. Amino acids

U/2009/44

Lucas reagent is used to test for A. alkanes B. alkanoic acids C. alkanols D. amines

U/2009/45

A compound commonly used for sterilization and preservation of specimens and food is A. ethanol B. benzene C. ether D. ammonia

U/2009/46

An organic compound reacted with bromine water to give a colourless solution. The compound is probably an A. alkene B. alkanal C. alkyne D. alkanone

U/2009/47

Which of the following hydrocarbons is mainly used as fuel? A. Methylene B. Ethylene C. Methane D. Ethyne

U/2009/48

The molecular formula of a common organic laboratory anaesthetic is A. $CHCl_3$ B. CHl_3 C. CCl_4 D. CHF_3

U/2009/49

The simplest branched - chain hydrocarbon is A. ethane B. ethane C. propane D. butane

U/2009/50

Organic molecules that have the suffix-ene are unsaturated hydrocarbons that have A.a single bond B.a double bond C.a triple bond D.an ionic bond

U/2009/14

Combustion is an oxidation reaction in which heat and light is produce. Combustion of organic compounds gives water and carbon IV oxide. But the combustion of elements gives oxide. Note that the oxide of hydrogen is called water.

$$2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(g)}$$

The correct option is C

U/2009/41

Cracking is the process of breaking down high molecular weight of hydrocarbons into simpler ones of economics importance. There are two types of cracking: thermal & catalytic cracking. Thermal cracking is also known as a pyrolysis.

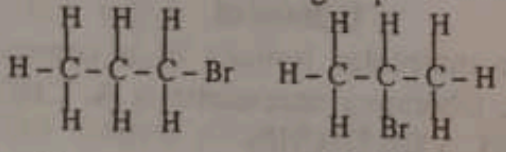
Cracking yields petrol or fuel of high quality. n-heptane is a bad fuel because it is incline to knocking while 2,2,4-trimethlpentane is a good fuel because it is less incline to knocking. This implies that the more branch a hydrocarbon within petrol range is, the less prone to knocking and the high its petrol quality. Hence cracking will convert heptanes (straight chain hydrocarbon) to 2,3,3-trimethylbutane (a more branch hydrocarbon).

The correct option is D.

U/2009/14

Positional isomers have the same carbon chain but differ in the position occupying by substituent or functional groups.

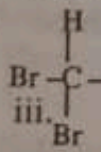
i.



1-bromopropane 2-bromopropane

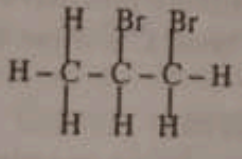
One additional position isomer

ii.

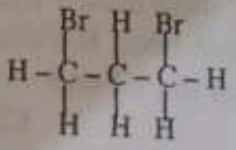


No positional isomer

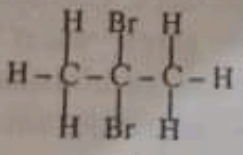
iii.



1,2-dibromopropane



1,3-dibromopropane



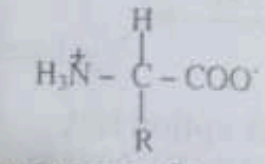
2,2-dibromopropane

Hence $CH_3CHBrCH_2Br$ has two positional isomers.

The correct option is D

U/2009/43

Amino acids are the building blocks of protein. They are made up of the amino group ($-NH_2$) and carboxylic group (-COOH) groups. An amino acid in which the two groups ($-NH_2$ & -COOH) are attach to the same carbon atoms are known as alpha (α) amino acid. In aqueous medium amino acid exist as a dipolar ion as shown below:



The correct option is D

U/2009/44

Lucas reagent is a mixture of concentrated hydrochloric acid and zinc chloride. It is use to test for either an alkanol is primary, secondary and tertiary. Tertiary alkanols react immediately, secondary alkanols react within five minutes but primary alkanols take a longer time to react with Lucas reagent.

The correct option is C

U/2009/45

Ethanol is commonly used for sterilization and preservation of specimens and food.

The correct option is A

U/2009/46

Unsaturated organic compound such as alkene, alkyne etc always decolourize bromine water i.e. convert the reddish brown colour of bromine water (HOBr) to colourless.

The correct option is A & C

U/2009/47

Methane, ethane (ethylene) and ethyne (acethlene) are all use as fuel either pure or mixed with other gas. However methane is mainly use as fuel because the alkanes are use mainly as fuel.

The correct option is C

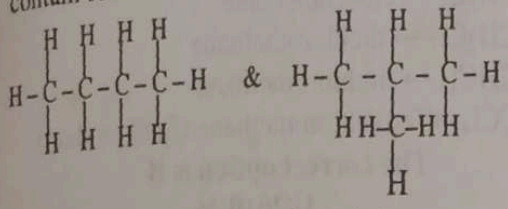
U/2009/48

Trichloromathene ($CHCl_3$) is used as anaesthetic. Note that Dinitrogen I oxide (N_2O) also has anaesthetic effect but it is not use in major surgery because it leads to uncontrolleable laughter after the patient recover from the anaesthetic effect. As a result, it is called laughing gas.

The correct option is A

U/2009/49

The simplest branch hydrocarbon contain four carbon atom e.g. butane.



butane 2-methylpropane

The correct option is D

U/2009/50

Alkenes are unsaturated hydrocarbon with double bonds while alkynes are unsaturated hydrocarbon with three bonds.

The correct option is B

UTME 2010

UTME/2010/16

Coffee stains can best be removed by A. turpentine B. solution of borax in water C. ammonia solution D. kerosine

UTME/2010/33

Which of the following is used as a rocket fuel? A. CH_3COOH B. H_2SO_4 C.HCl B. H_2SO_4 P. HNO_3

UTME/2010/40

$CH_3(CH_2)_3CHC_2H_5$
C_3H_7

The IUPAC nomenclature of the compound above is A. 5-ethyloctane B. 5-propylheptane C. 3-propylheptane D. 4-ethyloctane

UTME/2010/41

Which of the following is used as fuel in miners' lamp? A. Ethyne. B, Ethene. C. Ethane D. Ethanal.

UTME/2010/42

Which of the following organic compounds is very soluble in water? A. C_2H_2 B. C_2H_4 C. $CH_3COOC_2H_5$ D. CH_3COOH

UTME/2010/43

Benzene reacts with hydrogen in the presence of nickel catalyst at 180°C to give A. toluene B. cyclopentane C. cyclohexane D. xylene

UTME/2010/44

Which of the following is used to hasten the ripening of fruit? A. Ethanol. B. Ethyne. C. Ethane D. Ethene.

UTME/2010/45

The final products of the reaction between methane and chlorine in the presence of ultraviolet light are hydrogen chloride and A. dichloromethane B. tetrachloromethane C. chloromethane D. trichloromethane

UTME/2010/46

The correct order of increasing boiling points of the following compounds C_3H_7OH, C_7H_{16} and C_4H_{10} is

A. $C_4H_{10} \rightarrow C_7H_{16} \rightarrow C_3H_7OH$

B. $C_7H_{16} \rightarrow C_3H_7OH \rightarrow C_4H_{10}$

C. $C_4H_{10} \rightarrow C_3H_7OH \rightarrow C_7H_{16}$

D. $C_3H_7OH \rightarrow C_4H_{10} \rightarrow C_7H_{16}$

UTME/2010/47

One of the major uses of alkanes is A. in the hydrogenation of oils B. in the textile industries C. in the production of plastics D. as domestic and industrial fuels

UTME/2010/48

The haloalkanes used in the dry-cleaning industries are A. chloroethane and dichloroethene B. trichloroethene and tetrachloroethene C. chloroethane and dichloroethene D. trichloromethane and tetrachloromethane

UTME/2010/48

Two hydrocarbons X and Y were treated with bromine water. X decolorised the solution and Y did not. Which class of

compound does Y belong? A. Alkynes. B. Alkenes C. Alkanes D. Benzene

UTME/2010/50

The compound that is used as an, anaesthetic is A. $CHCl_3$ B. CH_2C_2 C. CH_3Cl D.CCl_4

U/2010/16

Borax dissolves readily in water, forming an alkaline, antiseptic solution that is used as a disinfectant, detergent, and water softener. It is an excellent flux for soldering and welding because it dissolves the coating of metallic oxide to leave a clean metal surface.

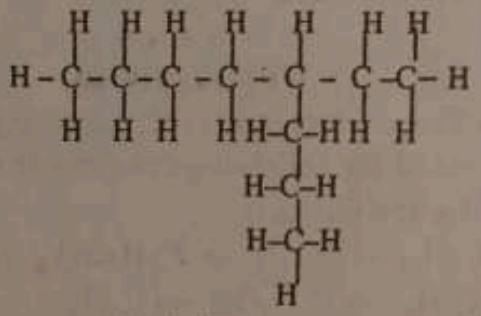
The correct option is B

U/2010/33

HNO_3 is use as a rocket fuel

The correct option is D

U/2010/40



4-ethyloctane

The correct option is D

U/2010/41

Ethyne (Acetylene) is used as fuel in miner's lamp.

The correct option is A

U/2010/42

The solubility of organic compounds is a function of the degree of hydrogen bond in such compound. The greater the degree of hydrogen bonding within the compound, the greater the solubility. Hence the order of solubility of organic compound is given by

-COOH> -OH> - NH_2> -$CONH_2$ >COOC

The correct option is D

U/2010/43

$$C_6H_6 + 3H_2 \xrightarrow[180^0C]{Ni} C_6H_{12}$$

Cyclohexane

The correct option is C

U/2010/44

In agriculture little quantity of ethane is use to quicken the ripening of fruits.

The correct option is D

U/2010/45

$CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$

$CH_3Cl + Cl_2 \rightarrow CH_2Cl_2 + HCl$

$CH_2Cl_2 + Cl_2 \rightarrow CHCl_3 + HCl$

$CHCl_3 + Cl_2 \rightarrow CCl_4 + HCl$

$CH_3Cl \rightarrow$ chloromethane

$CH_2Cl_2 \rightarrow$ dichloromethane

$CHCl_3 \rightarrow$ trichloromethane

$CCl_4 \rightarrow$Tetrachloromethane (final product)

The correct option is B

U/2010/46

$C_4H_{10} < C_7H_{16} < C_3H_7OH$

Molecules with hydrogen bonding have higher boiling points. But if the intermolecular bonding is the same, the molecule with the higher molecular weight will have the highest boiling point.

The correct option is A

U/2010/47

The major uses of the alkanes are domestic and industrial fuels.

The correct option is D

U/2010/48

Trichloromethane and Tetrachloromethane are used as organic solvent to dissolve stain in dry-cleaning industries.

The correct option is D

U/2010/49

Since X decolourize bromine water it is unsaturated that is X is alkenes or alkynes. Since Y does not decolourize bromine water it is saturated. That is Y is an alkane.

The correct option is C

U/2010/50

Trichloromethene ($CHCl_3$) is used as an organic solvent and anaesthetic.

The correct option is A

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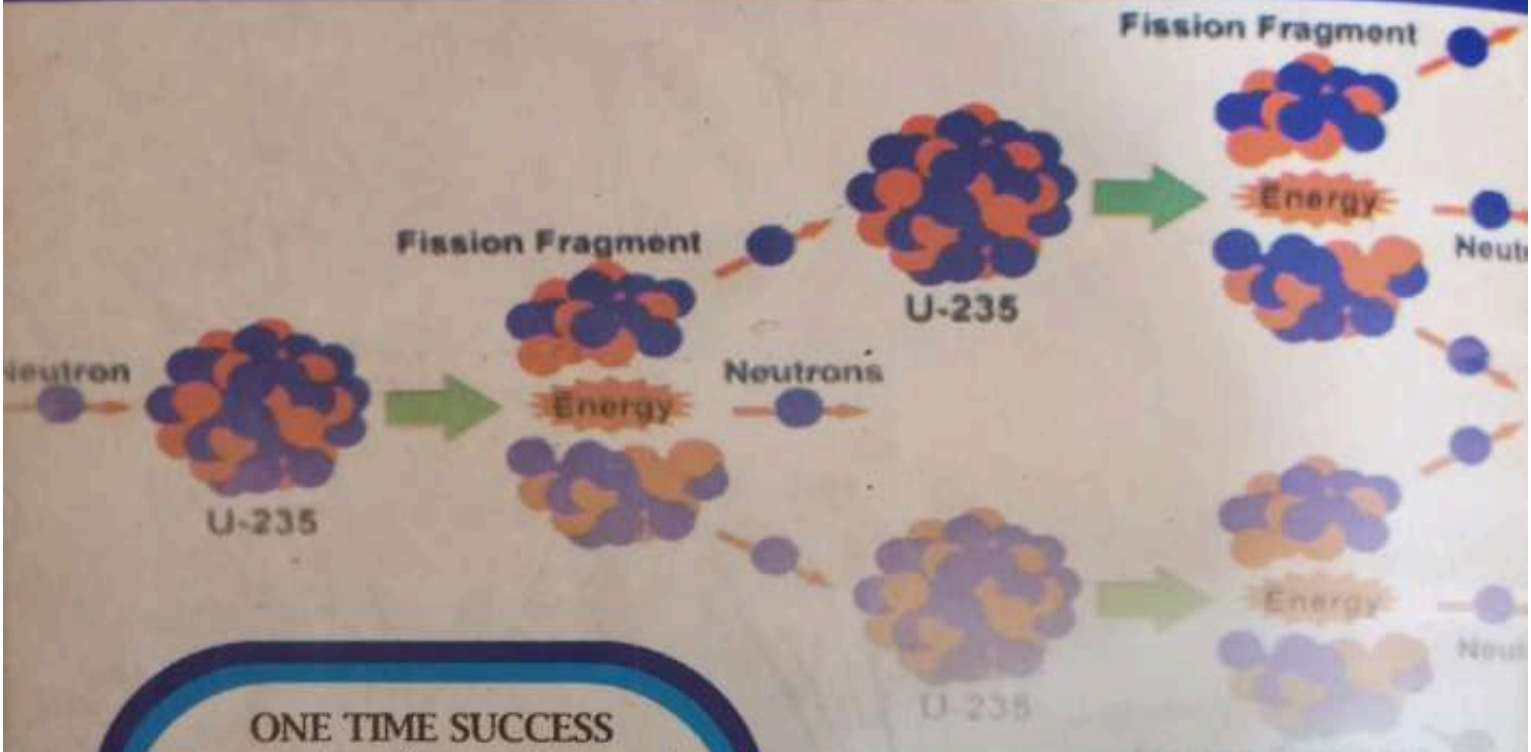

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