



OBAFEMI AWOLOWO UNIVERSITY, ILE-IFE, NIGERIA
DEPARTMENT OF CHEMISTRY
B.Sc., Degree (Industrial Chemistry) Examination
Part II Rain Semester 2021/2022

ICH 206 -CHEMISTRY OF DYESTUFF AND PIGMENTS

TIME ALLOWED: 2 Hrs

DATE: JUNE 2023

INSTRUCTIONS: Attempt ALL Questions

SECTION A

- 1a.i. Using the concept of hybridization, predict the structures of PF_5 and PCl_5 and state with reasons
- if they are meant to exhibit colours or not.
 - choose the one that has the tendency to absorb light rays of higher energy?
 - which of these two is expected to be more stable?

- ii. Using the energy profile diagram, compare the CFSE of *your predicted* structure in (1a.i) above and their square pyramidal structures clearly stating the one that will be more colour fast if they exhibit the two structures.

- iii. What is the relationship between solvent resistance and heat stability in organic pigments? How does this relate to the inorganic pigments? Give reasons for your answers.

- b.i. What adverse effects would the following have on the colour exhibited by paints or coatings?
- TiO_2
 - (Stabilizers)
 - Small particle size of pigments.

What role does Fe_2O_3 play when included in such paints or coatings?

- ii. What role do crystallinity and semi-crystallinity play in colour impartation in materials?

Also state what is responsible for the better colour variations observed in the crystalline pigments?

- vii. Why do fluorescent pigments produce exceptionally bright colours? *— because they absorb light outside the visible spectrum.*
- Compare the energy of the absorbed light rays in the fluorescent pigments with those absorbed by the ordinary pigments. *— The one absorbed by the pigment are limited.*

- iv. Under what conditions will classical organic pigments be non-resistant to chemical attacks?

- 2a.i. Fluorapatite ($\text{Ca}_5(\text{PO}_4)_3$) and hydroxyapatite ($\text{Ca}_{10}(\text{OH})_2(\text{PO}_4)_6$) are ores of phosphorus with the hydroxyapatite known to exhibit more variance in colour than the Fluorapatite.

- What is the oxidation state of phosphorus in the two ores?

$10 + 3P + 24$

• State with proof whether they are meant to exhibit colours or not and the type of colour they are likely to exhibit if they do.

• Use the variance in the colours displayed to determine the level of purity of the ores.

Give reasons for all your answers.

ii. How can the inorganic pigments be made to change or vary the colours they impart in materials at high temperatures despite their renowned thermal stability.

iii. What determines the type of colour observed when light rays are transmitted through a material?

• How is this different from what is observed in inorganic pigments?

iv. A cosmetologist made this pronouncement that "*cosmetics with bright colours are the most harmful to the user.*" Briefly explain what this statement signifies.

b i. You are provided with four pieces of chinos materials coloured *white, brown, yellow-brown, and orange-brown*. Use these samples to answer the following questions.

a. Name the compound(s) responsible for colours displayed and categorize each of them.

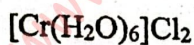
b. Which of these colours would appear the same based on the colours absorbed when light rays, paints and dyes are considered? Give reason(s) for your answer.

c. Arrange the colours in an increasing order of: • the amount of opacity causing agent • amount of pigments present • susceptibility to photodegradation • penetrating power • level of absorption

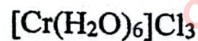
ii. What do you understand about fastness to solvents and blend resistance?

Arrange the inorganic and the organic types of pigments in an increasing order of fastness. Give reasons for your answers.

iii. In which of these complexes was a higher energy light rays are absorbed? Diagrammatically explain this and give reasons for your answers.



and



(Cyan colour) *red*

(Purple colour)

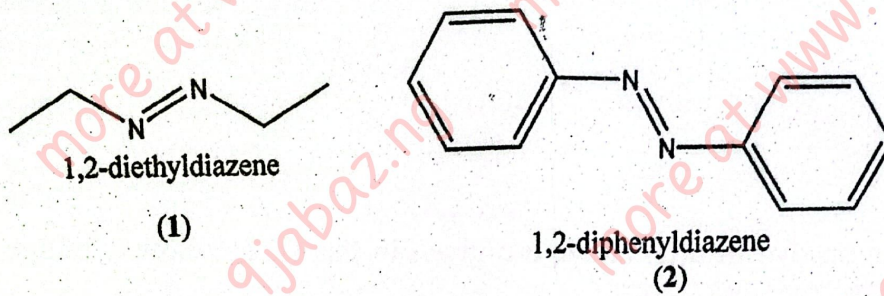
iv. Where is the colour displayed by a material when light rays are focused on it located? Briefly explain.

SECTION B

1a. Define the following terms (i) Substantivity of dye (ii) Colour fastness.

b. Give reasons for the following:

- (i) Both compound (1) and (2) have chromophoric groups but compound (1) is colourless while (2) is orange in colour

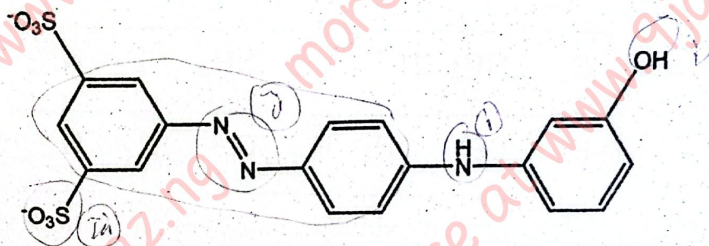


(ii) Basic dyes should be handled with care.

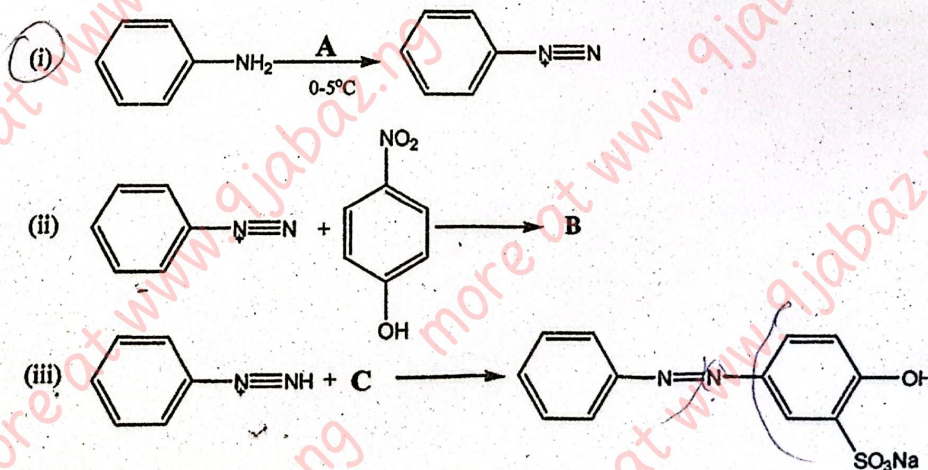
(iii) Alkaline medium is necessary for permanent oxidative hair dyeing.

c. Copy the structure and identify the following:

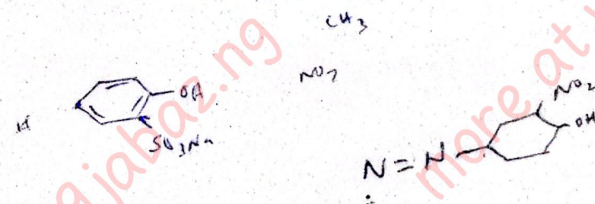
- (i) binding site (ii) chromophore (iii) solubilizing group (iv) auxochrome

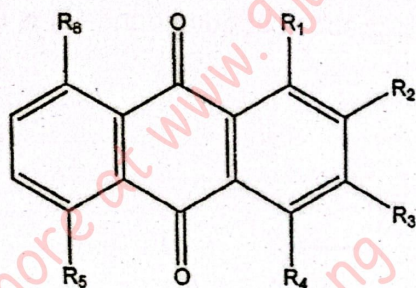


2a. Identify A, B and C in the diazotisation and coupling reaction shown below:



b (i) Which class of dye has its basic structure as shown below?





(ii) The substituents on dye in c (i) above are given in the Table below. Arrange the dyes in increasing order of depth of shade.

Dye	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆
A	NH ₂	H	OH	OH	H	NH ₂ ④
B	NH ₂	H	H	OH	H	H ①
C	NH ₂	H	H	NH ₂	NH ₂	NH ₂ ④
D	OH	NH ₂	H	OH	H	H ②

b (i) In one sentence, why are permanent oxidative hair dyes resistant to shampoo washes compared to temporary and semi-permanent non-oxidative dyes?