OBAFEMI AWOLOWO UNIVERSITY, ILE-IFE, NIGERIA
DEPARTMENT OF CHEMISTRY

CHM 201: BASIC INORGANIC CHEMISTRY
HARMATTAN MID-SEMESTER EXAMINATION (2022/2023)

ATTEMPT ALL QUESTIONS   **TIME ALLOWED: 35 MINS**

$$c = 3 \times 10^8 \ m.s^{-1}; \ h = 6.626 \times 10^{-35} \ J.s; \ Avogadro's \ number; = 6.023 \times 10^{23}$$

1. Which is the correct IUPAC name for $K_2[Fe(H_2O)_2(CN)_4]$
   a. Potassium diaquotetracyanoferrate(II)
   b. Dipotassium diaquotetracyanoferrate(III)
   c. Dipotassium diaquotetracyanoferrate(II)
   d. Diaquotetracyanoferrate(II) ion

2. A compound with 7 bond pairs and no lone pair will adapt
   a. the shape does not exist
   b. an heptagonal planar shape
   c. pentagonal bipyramid shape
   d. hexagonal pyramid shape

3. The Retina of an amphibious crocodile is most sensitive to light having a wavelength of 390 nm. What is its frequency?
   a. $5.94 \times 10^{14} \ Hz$
   b. $7.69 \times 10^{14} \ Hz$
   c. $6.50 \times 10^{14} \ Hz$
   d. $8.26 \times 10^{14} \ Hz$

4. What is the energy of a single photon having the calculated Frequency above?
   a. $4.07 \times 10^{-19} \ J$
   b. $4.19 \times 10^{-19} \ J$
   c. $5.10 \times 10^{-19} \ J$
   d. $2.43 \times 10^{-19} \ J$

5. The splitting of the d-orbitals in a tetrahedral field is
   a. $t_{2g} \rightarrow e_g$
   b. $e \rightarrow t_2$
   c. $e_g \rightarrow t_{2g}$
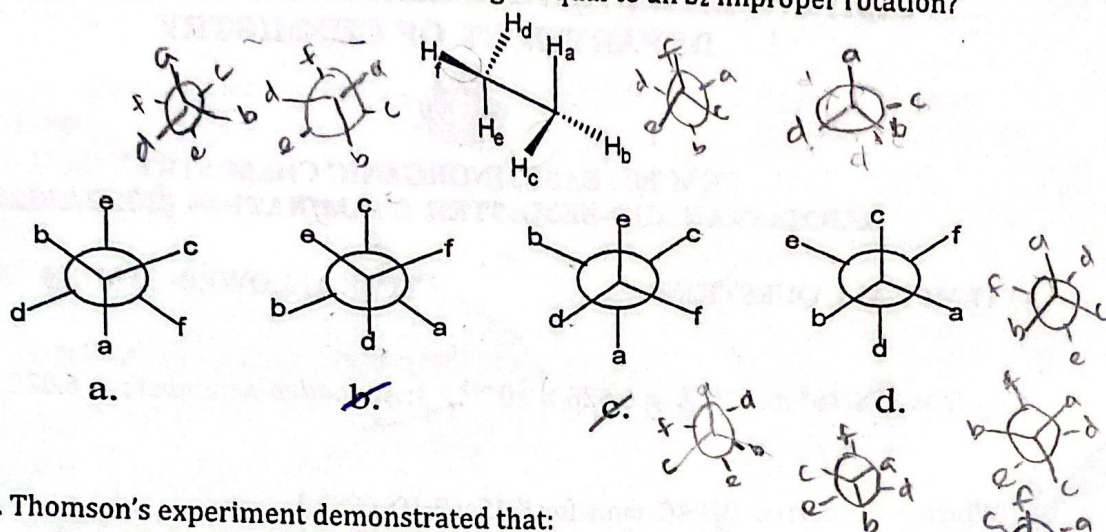   d. $t_2 \rightarrow e$
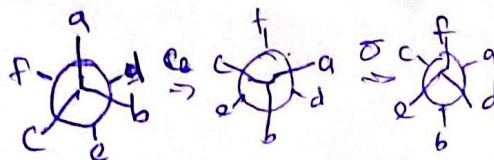
6. In staggered ethane which of the following is equal to an S_2 improper rotation?

a.   b.   c.   d.

7. J. J. Thomson's experiment demonstrated that:
   i. All the mass of an atom is essentially in the nucleus
   ii. The Charge-to-Mass ratio (e/m) of electrons is much greater than the (e/m) of protons.
   iii. Cathode rays are streams of negatively charged ions.
   iv. The (e/m) ratio of the cathode ray particles changes when a different gas is placed in the discharge tube.

   a. i and ii
   b. i, ii and iii
   c. ii, iii and iv
   d. ii and iii

8. Calculate the uncertainty in position Δx of a dust particle if the velocity is $2 \times 10^{-6}\ m.s^{-1}$ and it has a mass of $5.86 \times 10^{-26}\ kg$.
   a. $9.00 \times 10^{-4}\ m$
   b. $2.83 \times 10^{-4}\ m$
   c. $5.86 \times 10^{-4}\ m$
   d. $1.80 \times 10^{-4}\ m$

   $m\Delta v \cdot \Delta x \geqslant \frac{h}{4\pi}$

9. When $Na_2[Co(H_2O)_2(Cl)_4]$ is dissolved in water it will dissociate into
   a. $Na^{2+}_{(aq)} + Co^{2+}_{(aq)} + 4Cl^-_{(aq)}$
   b. $2Na^+_{(aq)} + [Co(H_2O)_2(Cl)_4]^{2-}_{(aq)}$
   c. $2Na^+_{(aq)} + Co^{2+}_{(aq)} + 4Cl^-_{(aq)}$
   d. $Na^{2+}_{(aq)} + [Co(H_2O)_2(Cl)_4]^{2-}_{(aq)}$

10. Which statement(s) is/are true?
    I. Hybridization of atomic orbitals generate new hybrid orbitals
    II. Energy is gained during bond formation and lost during the hybridization process.
    III. The number of hybrid orbitals is equal to the number of atomic orbitals
    a. I & III only

b. I & II only
c. II & III only
d. I, II & III

$1.092x$

11. Find the energy of an electron making a transition from second energy level to the ground state.
   a. $2.76 \times 10^{-19} J$
   b. $1.64 \times 10^{-18} J$
   c. $1.98 \times 10^{-18} J$
   d. $3.80 \times 10^{-19} J$

$$\frac{1}{\chi} = R_\infty \left(\frac{1}{1^2} - \frac{1}{2^2}\right)$$

$$\frac{1}{\chi} = E = \frac{hc}{\lambda}$$

$1^2 \ 2s^2$

12. Based on Molecular Orbital theory, Be₂ will be
   a. Stable
   b. Unstable
   c. A radical
   d. Non-existent

$\sigma 1s^2 \ \sigma 1s^{2*} \ \sigma 2s^2 \ \sigma 2s^{2*}$

$Bond = \frac{1}{2}(4-4)$

13. According to VSEPR theory, valence electrons in a molecule would experience
   (I)   bond pair – bond pair repulsion
   (II)   bond pair – lone pair attraction
   (III) lone pair – lone pair repulsion
   (IV)   bond pair – lone pair repulsion
   (V)   lone pair – lone pair repulsion
   (VI)   bond pair – bond pair attraction
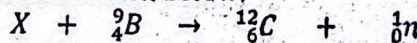   a. I, V, VI
   b. I, II, IV
   c. I, II, III
   d. II, V, IV

14. An oil droplet having a net charge of 56 µC is placed in a uniform electric field of 630 N/C directed vertically. What is the mass of this object, if it floats in the field?
   a. $1.8 \times 10^{-2} \ kg$
   b. $1.4 \times 10^{-3} \ kg$
   c. $3.6 \times 10^{-3} \ kg$
   d. $2.0 \times 10^{-4} \ kg$

$q = \frac{mg}{E}$

$mg = qE$

$m = \frac{qE}{g}$

15. The reaction which occurred in Chadwick's experiment is an example of artificial transmutation where an atom of beryllium ($^{9}_{4}B$) isotope is converted to a carbon atom through the nuclear reaction shown below;
$$X + {}^{9}_{4}B \rightarrow {}^{12}_{6}C + {}^{1}_{0}n$$
What is the identify of particle X in the above equation?
   a. Alpha
   b. Gamma
   c. Omega
   d. Beta

16. The wavelengths of various spectral lines seen in hydrogen spectrum show that these lines lie in various regions of the electromagnetic spectrum. Where does the lines of Lyman series, Balmer series and Paschen series lie respectively?
    a. Ultraviolet, Infrared and Visible
    b. Visible, Ultraviolet and Infrared
    c. Ultraviolet, Visible and Infrared
    d. Visible, Infrared and Ultraviolet

17. The auxiliary valence of $[Ru(NH_3)_3Br_3]Cl_3$ is
    a. 6
    b. 4
    c. 3
    d. 5

18. A C_6^8 is equivalent to
    a. C_6^1
    b. C_6^2
    c. C_6^3
    d. C_6^4

19. Which of these points best represents Rutherford's nuclear model?
    (i)   Atoms consist of a positively charged centre called nucleus
    (ii) A large extranuclear space surrounds the nucleus containing electrons.
    (iii) Electrons have a constant Charge-to-Mass ratio of $1.76 \times 10^{11} \ C.kg^{-1}$
    (iv) Electrons moving round a nucleus loses energy and its speed decreases and ultimately falls into the nucleus
    (v)   The mass of atom is concentrated in the centre.
    a. i, iii, iv
    b. i, ii, iii, iv
    c. i, ii, iii, v
    d. i, ii, v

20. An isotope x has a half-life of 4 days, if there are 800 g of this sample, how much of x will remain after 24 days.
    a. 12.5 g
    b. 10.2 g
    c. 11.7 g
    d. 14.2 g

21. Calculate the de·Broglie wavelength of a body of $1.0 \times 10^{-6} \ kg$ moving with a velocity of $3.00 \ m.s^{-1}$
    a. $2.21 \times 10^{-28} \ m$
    b. $3.30 \times 10^{-28} \ m$
    c. $4.50 \times 10^{-27} \ m$
    d. $1.24 \times 10^{-24} \ m$

7.53×10^{-19}

TYPE 2

22. Electromagnetic radiation of wavelength 264 nm is just sufficient to ionize the outermost electron of the potassium atom. Calculate the ionization energy of potassium atom.
   a. 5.10×10^3 kJ/mole
   b. 4.54×10^2 kJ/mole
   c. 3.14×10^3 kJ/mole
   d. 8.27×10^2 kJ/mole

23. An oil droplet having a net charge of 56 µC is placed in a uniform electric field of 630 N/C directed vertically. What is the mass of this object, if it floats in the field?
   a. 1.8×10^{-2} kg
   b. 1.4×10^{-3} kg
   c. 3.6×10^{-3} kg
   d. 2.0×10^{-4} kg

24. Which one is a form of stereoisomerism
   a. Linkage isomerism
   b. Polymerization isomerism
   c. Geometrical isomerism
   d. Ionization isomerism

25. The two possible sets of quantum numbers that describe an electron in a 2s atomic orbital are.
   i. $n = 2, l = 0, m_l = 0, m_s = +\frac{1}{2}$
   ii. $n = 2, l = 0, m_l = 0, m_s = -\frac{1}{2}$
   iii. $n = 2, l = 0, m_l = 2, m_s = -\frac{1}{2}$
   iv. $n = 2, l = -2, m_l = 0, m_s = +\frac{1}{2}$

   a. i and ii
   b. i, ii and iii
   c. ii and iv
   d. i, ii, iii and iv

26. How many molecules are in 6.96 g of potassium heptaoxodichromate(VI), $K_2Cr_2O_7$? (K= 39, Cr = 52, O = 16)
   a. 1.47×10^{22}
   b. 2.89×10^{23}
   c. 1.43×10^{22}
   d. 3.46×10^{21}

27. In modern science, the valid postulation of Dalton atomic theory is that:
   i. Matters are composed of atoms
   ii. Atoms are very small
   iii. Atoms are indestructible
   iv. Atoms of the same elements are completely identical.

a. i and ii
b. i, ii, iv
c. i and iv
d. iii and iv

28. The molecular orbital electronic configuration of C_2^{2-} is

a. $\sigma_{1s}^2, \sigma_{1s}^{*2}, \sigma_{2s}^2, \sigma_{2s}^{*2}, \left(\pi_{2p_x}^2, \pi_{2py}^2\right), \sigma_{2p_z}^1, \sigma_{2p_z}^{*1}$

b. $\sigma_{1s}^2, \sigma_{1s}^{*2}, \sigma_{2s}^2, \sigma_{2s}^{*2}, \left(\pi_{2p_x}^2, \pi_{2py}^2\right), \sigma_{2p_z}^2, \sigma_{2p_z}^{*0}$

c. $\sigma_{1s}^2, \sigma_{1s}^{*2}, \sigma_{2s}^2, \sigma_{2s}^{*2}, \sigma_{2p_z}^2, \left(\pi_{2p_x}^2, \pi_{2py}^2\right), \sigma_{2p_z}^{*0}$

d. $\sigma_{1s}^2, \sigma_{1s}^{*2}, \sigma_{2s}^2, \sigma_{2s}^{*2}, \sigma_{2p_z}^2, \left(\pi_{2p_x}^1, \pi_{2py}^1\right), \sigma_{2p_z}^{*0}$

$\sigma_{1s}^2 \ \sigma_{1s}^{*2} \ \sigma_{2s}^2 \ \sigma_{2s}^{*2} \left(\pi_{2p_x}^2, \pi_{2py}^2\right)$

↑↓ ↑↓
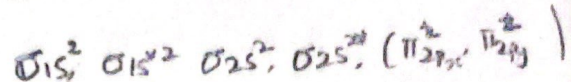
29. Which symmetry operation can BF₂I undergo?
a. C₂, C₃, σᵥ, σₕ, E
b. C₃, σᵥ, σₕ, E
c. C₂, σᵥ, σₕ, E
d. C₂, C₃, σᵥ, E

30. A compound that can undergo the inversion operation is said to
a. Can be inverted with no changes.
b. Be able to undergo improper rotation
c. Retain its symmetry
d. Have a center of symmetry