

QUARTERLY EXAMINATION - 2023

CLASS: XI
CHEMISTRY

 Reg.No

Time : 3.00 Hours

MAX MARKS : 70

PART - I

Answer all the questions.
15x1=15

1. The equivalent mass of a trivalent metal element is 9 g e⁻¹ the molar mass of its anhydrous oxide is
 a) 102 g b) 27 g c) 270 g d) 78 g
2. **Assertion** : Number of radial and angular nodes for 3p orbital are 1,1 respectively
Reason : Number of radial and angular nodes depends only on principal quantum number
 a) both assertion and reason are true and reason is the correct explanation of assertion
 b) both assertion and reason are true and reason is not correct explanation of assertion
 c) assertion true but reason is false d) both assertion and reason is false
3. In a which of the following orders of ionic radii is correct?
 a) $H^- > H^+ > H$ b) $Na^+ > F^- > O^{2-}$ c) $F > O^{2-} > Na^+$ d) None of these
4. Ionic hydrides are formed by
 a) Halogens b) chalcogens c) inertgas d) Group one elements
5. What is the density of N₂ gas at 227°C and 5.00 atm pressure? (R=0.082 L atm K⁻¹ mol⁻¹)
 a) 1.40 g/L b) 2.81 g/L c) 3.41 g/L d) 0.29 g/L
6. In an adiabatic expansion of an ideal gas
 a) $W = -\Delta U$ b) $W = \Delta U + \Delta H$ c) $\Delta U = 0$ d) $W = 0$
7. -I effect is shown by
 a) -Cl b) -Br c) both (a) and (b) d) -CH₃
8. Functional group of ester is
 a) -COOH b) -COOR c) -COX d) -CHO
9. The boiling point of heavy water(D₂O) is
 a) 375.4K b) 373.4K c) 376.2K d) 374.4K
10. If K_b and K_f for a reversible reaction are 0.8×10^{-5} and 1.6×10^{-4} respectively, the value for equilibrium constant is
 a) 20 b) 0.2×10^{-1} c) 0.05 d) 0.2
11. which of the following is optically active?
 a) 3-Chloro pentane b) 2-Chloro propane c) Meso tartaric acid d) Glucose
12. What is hybridisation state of benzyl carbonium ion?
 a) sp² b) spd² c) sp³ d) sp² d
13. An engine operating between 127°C and 47°C what is the efficiency of engine.....
 a) 25% b) 20% c) 24% d) 23%
14. Solubility of carbon dioxide gas in cold water can be increased by
 a) increase in pressure b) decrease in pressure
 c) increase in volume d) None of these
15. Match the given in column I with suitable items given in column II

| | | |
|-----------------------|-----------------------|-------------------------|
| Column - I | Column - II | M.Poovarasana M.Sc B.Ed |
| A) Electro negativity | 1. fuel cell | PG ASST IN CHEMISTRY |
| B) Hydrogen | 2. Free radical | Dharmapuri District. |
| C) Metabolic study | 3. Nature of bond | |
| D) homolytic fission | 4. Bomb calorimeter | |
| a) A-2, B-1, C-3, D-4 | b) A-4, B-2, C-1, D-3 | |
| | c) A-3, B-1, C-4, D-2 | |
| | d) A-1, B-3, C-2, D-4 | |

PART-II**Answer any 6 questions : (Question no.24 is compulsory)****6X2=12**

16. Define Gram equivalent mass
17. Give the electronic configuration of Mn^{2+} and Cr^{3+}
18. Define modern periodic law
19. How is Tritium Prepared?
20. What is inversion temperature?
21. State third law of thermodynamics
22. Write the K_C and K_p Values for following equations.
 - i) $4NO_{(g)} + 6H_2O_{(g)} \rightleftharpoons 4NH_{3(g)} + SO_{2(g)}$
 - ii) $NO_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)}$
23. what are nucleophiles? Give Example.
24. Identify the possible isomerism exhibited by C_3H_8O with examples.

PART -III**Answer any 6 question (Q.No.33 is compulsory)****6X3=18**

25. Write short notes on Principal Quantum Number
26. Explain diagonal relationship
27. Write the use of heavy water
28. Write the critical constant values for V_c , T_c and P_c
29. List the characterstic of internal energy
30. State Le-chatliar principal
31. Explain geometrical isomerism in alkene by considering 2-butene as an example
32. write short notes on inductive effect
33. How much volume of chlorine is required to form 11.2 lit HCl at 273 k and 1 atm pressure?

PART -IV**Answer all the questions.****5X5=25**

34. a) A compound on analysis give Na=14.31% S=9.97% H=6.22%, O=69.5% calculate the molecular formula of the compound if all the hydrogen in the compound is present in combination with oxygen as water of crystallisation (molecular mass of the Compound=322)
(OR)
 - b) i) Explain Bohr atom model (3 m)
 - ii) State Hund's rule (2 m)
35. a) Explain the pauling method for determlnation of ionic radii (5 m)
(OR)
 - b) i) What are isotopes? Write the name of isotopes of hydrogen (2 m)
 - ii) Explain ion exchange method (3 m)
36. a) i) State Grahams law (2 m)
ii) Write the relation between ΔH and ΔU (3 m)
(OR)
 - a) i) Define molar heat capacity give it unit (2 m)
 - ii) Derive ideal gas equation (3 m)
37. a) Derive the relation between K_p and K_c (OR) (5 m)
b) Explain paper chromatography. (3 m)
38. a) i) Explain eletromeric effect (2 m)
ii) What is hyperconjugation effect (OR) (5 m)
b) Describe the reactions involved in the detection of nitrogen in an organic compound by Lassaigne method. (5 m)

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1. The equivalent mass of a trivalent metal element is $\frac{1}{3}$ the molar mass of its anhydrous oxide is
 $\Rightarrow 102 \text{ g}$
2. Assertion : Number of radial and angular nodes for 3p orbital are 1, 1 Respectively.
Reason : Number of radial and angular nodes depends only on Principal Quantum number.
 \Rightarrow Assertion true but Reason is false.
3. In a Which of the following orders of Ionic Radii is correct ?
 \Rightarrow None of these
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PG Asst in Chemistry
dharmapuri District
4. Ionic hydrides are formed by
 \Rightarrow Group one elements
5. What is the density of N_2 gas at 27°C and 5.00 atm Pressure?
 $\Rightarrow 3.14 \text{ g/L}$
6. In an adiabatic expansion of an Ideal gas is
 \Rightarrow both (a) and (b)

7 Δ effect is shown by a -

$$\Rightarrow W = -\Delta U$$

8 Functional Group of Ester is



9 The boiling point of heavy water (D_2O) is

$$\Rightarrow 374.4 \text{ K}$$

10 If K_b and K_f for a reversible reaction are 0.8×10^{-5} and 1.6×10^{-4} respectively, the value for equilibrium constant is

$$\Rightarrow 20$$

11 Which of the following is optically active?

\Rightarrow Glucose

12 What is hybridisation state of benzyl carbonium ion?



13 An engine operating between 127°C and 47°C

What is the efficiency of engine -

$$\Rightarrow 20\%$$

14 Solubility of carbon dioxide gas in cold

water can be increased by

\Rightarrow Increase in Pressure

Match the Given in column I With Suitable items given in column II

Column I

column II

- | | |
|----------------------|-----------------------------------|
| a) Electronegativity | - 1 ^o Fuel cell |
| b) Hydrogen | - 2 ^o Free radical |
| c) Metabolic Study | - 3 ^o Nature of bond |
| d) Homolytic fission | - 4 ^o bomb calorimeter |

⇒ A-3, B-1, C-4, D-2

PART-II

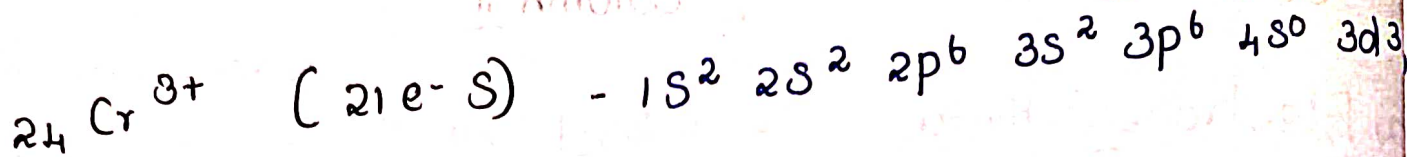
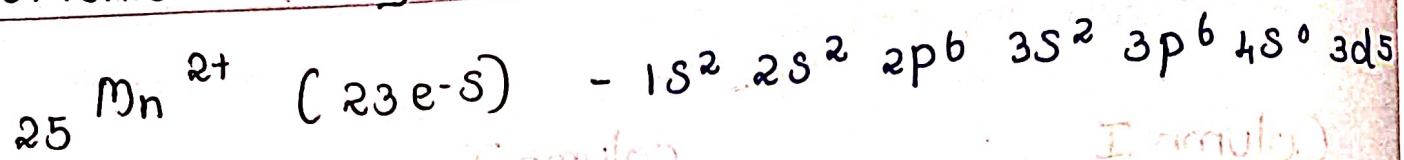
Gram equivalent mass :

* Gram equivalent mass is defined the mass of an Element that compound ion that combines or displaces 1.008 g hydrogen or 8 g oxygen or 35.5 g chlorine.

$$\text{Gram Equivalent mass} = \frac{\text{Molar mass (g mol}^{-1}\text{)}}{\text{Equivalence factor eq mol}^{-1}}$$

* Equivalent mass has no unit but

Gram equivalent mass as the unit eq^{-1} .

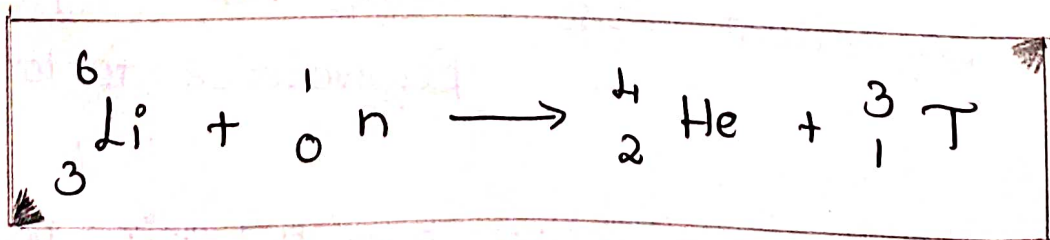
17. Electronic Configuration :18. Modern Periodic Law :

*The Physical and chemical Properties of the element are Periodic functions of their atomic numbers.

19. Tritium Prepared :

*So it can be artificially Prepared by bombarding lithium With Slow neutrons in a nuclear fission Reactor.

*The nuclear transmutation Reaction for this Process is as Follows.



Inversion Temperature :

* The temperature below which a gas obeys Joule Thomson Effect is called Inversion Temperature.

$$T_i = \frac{2a}{Rb}$$

Third Law Thermodynamics :

* Thus the third law of Thermodynamics states that the entropy of Pure crystalline substance at absolute zero is zero. otherwise it can be stated as it is impossible to lower the temperature of an object to Absolute zero in a finite number of steps.

* Mathematically ,

$$\lim_{T \rightarrow 0} S = 0$$

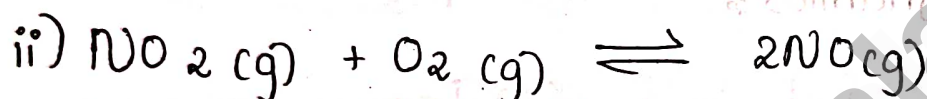
for a Perfectly ordered crystalline State.

22 K_c and k_p Value Find



$$K_c = \frac{[\text{NH}_3]^4 [\text{SO}_2]}{[\text{NO}]^4 [\text{H}_2\text{O}]^6}$$

$$k_p = \frac{P[\text{NH}_3]^4 P[\text{SO}_2]}{P[\text{NO}]^4 P[\text{H}_2\text{O}]^6}$$



$$K_c = \frac{[\text{NO}_2][\text{O}_2]}{[\text{NO}]^2}$$

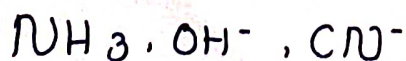
$$K_p = \frac{P[\text{NO}_2] P[\text{O}_2]}{P[\text{NO}]^2}$$

23 What are nucleophiles and eg ::

* Electron Rich Species having a lone pair of Electron. Negatively charged ions.

* All Lewis bases act as Nucleophiles.

Eg ::



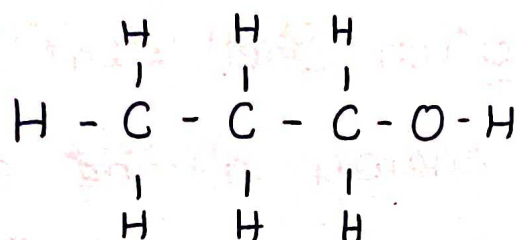
Identify the Possible Isomerism exhibited by

C_3H_8O With Example

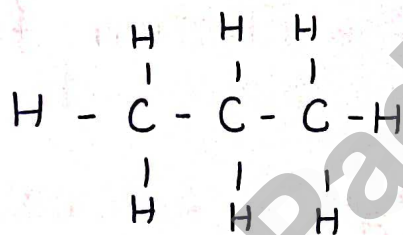
* C_3H_8O have 3 Constitutional

Isomers.

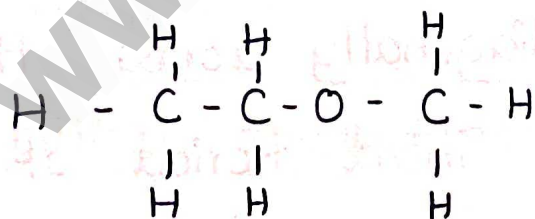
i) 1 propanol ($CH_3 CH_2 CH_2 OH$)



ii) 2 Propanol $CH_3 CH(CH_3) CH_3$



iii) Ethyl - Methyl Ether $CH_3 CH_2 OCH_3$



M.Poovarasam M.Sc B.Ed
PG Asst in Chemistry
dharmapuri District

PART-III

25. Write Short notes on Principal quantum number?

* It is denoted by the Symbol 'n'

* 'n' can have the Values 1, 2, 3...

* n=1, 2, 3, 4 Represent the Shells K, L, M, N

Respectively.

* The maximum number of Electron that can be accommodated in a given Shell = $2n^2$

* 'n' gives the energy of the electron.

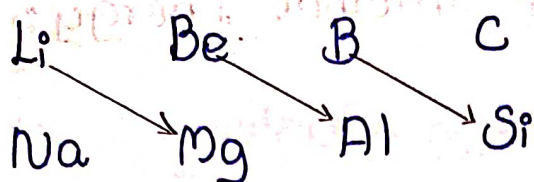
$$E_n = \left(\frac{-1312.8}{n^2} \right) \text{ kJ mol}^{-1}$$

* The exchange of the Electron from the nuclear

$$r_n = \left(\frac{-0.529}{Z} \right) n^2 \text{ \AA}$$

26 Explain diagonal Relationship ∞

* On moving diagonally across the Periodic table, the Second and Third Period of elements Show certain Similarities, Even though the Similarity is not Same as We Seen in a group it is quite Pronounced in the Following Pair of the Elements.



*The Similarity in Properties existing between the diagonally Placed Element is Called diagonal Relationship.

Give the Uses of heavy Water:

* Heavy Water is Used as moderator in nuclear Reactor.

* It is used as a tracer to Study organic reaction mechanism and mechanism of metabolic Reaction.

* It is also used as a coolant in Nuclear Reactor.

Write the critical constant Values for V_c , T_c and P_c

a) $V_c = 3b$

b) $T_c = \frac{8a}{27Rb}$

c) $P_c = \frac{a}{27b^2}$

29. List the characteristics of Internal Energy:

* Internal Energy of a System is an Extensive Property. It is a State Function.

* The change in internal Energy of a System is Expressed as $\Delta U = U_f - U_i$

* In a cyclic Process, there is no internal energy change $\Delta U(\text{cyclic}) = 0$

* If the internal energy of the System at Final State (U_f) is less than the internal energy of the System at initial State (U_i) then ΔU would be negative.

$$\Delta U = U_f - U_i = -ve (U_f < U_i)$$

* If the internal energy of the System at Final State (U_f) is greater than the internal energy of the System in its initial State (U_i), then ΔU would be Positive.

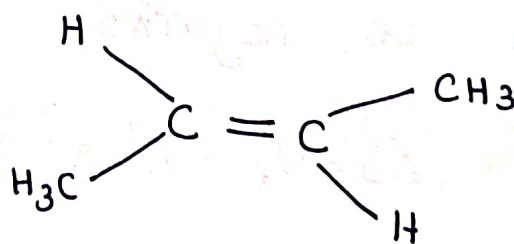
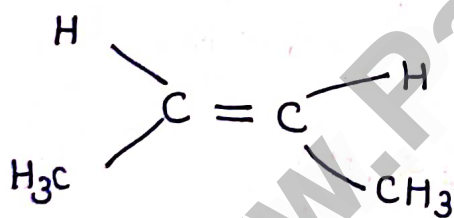
$$\Delta U = U_f - U_i = +ve (U_f > U_i)$$

30 State Le - chatliar Principal.

* In a system at equilibrium is disturbed then the system shifts itself in a direction that nullifies that effect of that disturbance.

31 Briefly explain geometrical isomerism in alkene by considering 2- butene as an example

* Geometrical isomers which have different arrangement of groups or atoms around a C=C. This isomerism occur due to restricted rotation of double bonds, or about single bond in cyclic compounds.



* The cis isomer is one in which two similar groups are on the same side of the double bond.

* The Trans isomer is that in which the two similar groups are on the opposite side of the double bond.

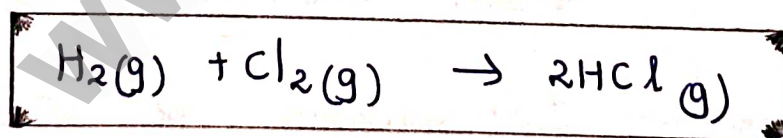
Write short note on inductive effect?

* Inductive effect is defined as the change in the Polarisation of a covalent bond due to the Presence of adjacent bonds, atoms or groups in the molecule. This is a Permanent Phenomenon.

* The inductive effect represents the ability of a Particular atom or a group to either withdraw or donate electron density to the attached carbon

How much volume of chlorine is required to form 11.2 L of HCl at 273 K and 1 atm Pressure?

* The balanced equation for the formation of HCl is



* As Per the stoichiometric equation, under given conditions

* To produce 2 moles of HCl

* 1 mole of chlorine gas is required

* To Produce 44.8 litres of HCl

* 22.4 litre of chlorine gas are required

∴ To Produce 11.2 litres of HCl

$$\Rightarrow \frac{22.4 \text{ L Cl}_2}{44.8 \text{ L of HCl}} \times 11.2 \text{ L of HCl,}$$

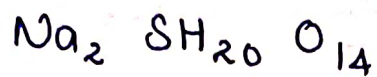
= 5.6 litres of chlorine are required.

PART- IV

34 a) A compound on analysis give Na = 14.31%, S = 9.97%, H = 6.22%, O = 69.5%. Calculate the molecular formula of the compound if all the hydrogen in the compound present in combination with oxygen as water of crystallisation?

| Element | % | Relative no of atoms | Simple ratio |
|---------|-------|---------------------------|--------------------------|
| Na | 14.31 | $\frac{14.31}{23} = 0.62$ | $\frac{0.62}{0.31} = 2$ |
| S | 9.97 | $\frac{9.97}{32} = 0.31$ | $\frac{0.31}{0.31} = 1$ |
| H | 6.22 | $\frac{6.22}{1} = 6.22$ | $\frac{6.22}{0.31} = 20$ |
| O | 69.5 | $\frac{69.5}{16} = 4.34$ | $\frac{4.34}{0.31} = 14$ |

Empirical formula = $\text{Na}_2 \text{SH}_{20} \text{O}_{14}$



$$= (2 \times 23) + (1 \times 32) + (20 \times 1) + 14(16)$$

$$= 46 + 32 + 20 + 224$$

$$= 322$$

$$n = \frac{\text{Molar mass}}{\text{Calculated Empirical formula mass}} = \frac{322}{322} = 1$$

* Molecular formula = $\text{Na}_2 \text{SH}_{20} \text{O}_{14}$.

* Since all the hydrogen in the compound present as water

* Molecular formula is $\text{Na}_2 \text{SO}_4 \cdot 10\text{H}_2\text{O}$

b) i) Explain Bohr atom model.

* The energies of electrons are quantised

* The electron revolving around the nucleus in a certain fixed circular path called stationary orbit

* The angular momentum of the electron

must be equal to an integral multiple of $\frac{h}{2\pi}$

(i.e) $mvr = n \frac{h}{2\pi}$ Where, $n = 1, 2, 3, \dots$

* In a fixed stationary orbit, electron does not lose its energy. When an electron jumps from higher energy state to a lower energy state, the excess energy is emitted radiations.

$$E_2 - E_1 = h\nu$$

$$\nu = \frac{E_2 - E_1}{h}$$

* When suitable energy is supplied to an electron it will jump from lower energy orbit to an higher energy orbit.

ii) state Hund's rule.

* Electron Pairing in the degenerate orbitals does not take place until all the available orbitals contains one electron each.

a) Explain the Pauling method for determination of ionic radii.

* Ionic radius of uni-univalent crystals can be calculated using Pauling method from the inter ionic distance between the nuclei of the cation and anion.

* Pauling method assumed that ions present in a crystal lattice are perfect spheres, and they are in contact with each other.

$$* \text{ Therefore } d = r_{C^+} + r_{A^-} \rightarrow \textcircled{1}$$

Where d is the distance between the centre of the nucleus of cation C^+ and anion A^-

* r_{C^+} , r_{A^-} are the radius of the cation and anion respectively.

* Pauling also assumed that the radius of the ion having noble gas electronic configuration is inversely proportional to the effective nuclear charge felt at the periphery on the ion.

$$* r_{C^+} \propto \frac{1}{(Z_{eff})_{C^+}} \rightarrow \textcircled{2}$$

$$* r_{A^-} \propto \frac{1}{(Z_{eff})_{A^-}} \rightarrow \textcircled{3}$$

* Where Z_{eff} is the effective nuclear charge and $Z_{eff} = Z - S$

* Dividing the equation 2 by 3

$$\frac{r_{C^+}}{r_{A^-}} = \frac{(Z_{eff})_{A^-}}{(Z_{eff})_{C^+}} \rightarrow \textcircled{4}$$

* By solving equation $\textcircled{1}$ & $\textcircled{4}$, r_{C^+} and r_{A^-} can be calculated.

b) i) what are isotopes? Write the names of isotopes of hydrogen.

* Elements with same atomic number but with different mass number are called isotopes.

* Hydrogen has three naturally occurring isotopes, viz, protium (${}_1\text{H}^1$ or H), deuterium (${}_1\text{H}^2$ or D) and (${}_1\text{H}^3$ or T) Tritium.

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www.CBSEtips.in (19)
ii) Explain ion exchange method.

* Ion exchange is the reversible exchange of one type of ion on an insoluble solid with another of a similar charge present in a solution surrounding the solid.

a)
i) State Graham's law

* Graham's law states that the rate of diffusion or effusion of a gas is inversely proportional to the square root of the molar mass

ii) Write the relation b/w ΔH and ΔU

$$H = U + PV$$

$$\Delta H = \Delta U + P\Delta U$$

$$\Delta H = \Delta U + \Delta n(g) RT.$$

b) i) Define molar heat capacity give its unit.

* "The amount of heat absorbed by one mole of the substance to raise its temperature by 1 kelvin"

* Unit : $\text{JK}^{-1} \text{mol}^{-1}$ (SI)

ii) Derive ideal gas equation.

* According to Boyle's law, $V \propto \frac{1}{P} \rightarrow (1)$

* Charles law, $V \propto T \rightarrow (2)$

* Avogadro's law, $V \propto n \rightarrow (3)$.. on equating

equation 1, 2, 3 we get

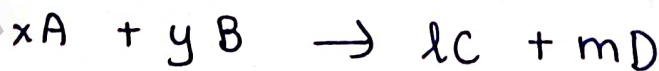
$$* V \propto \frac{nT}{P} \quad V = \frac{nRT}{P}$$

$$* PV = nRT$$

* This equation is called ideal gas equation where.

31 a) Derive the relation b/w K_p and K_c .

Let us consider the general equilibrium relation in which all reactants and products are ideal gases.



The equilibrium constant K_c is

$$K_c = \frac{[C]^l [D]^m}{[A]^x [B]^y} \rightarrow (1)$$

The equilibrium constant K_p is

$$K_p = \frac{(P_C)^l \cdot (P_D)^m}{(P_A)^x \cdot (P_B)^y}$$

From the ideal gas Equation.

$$* PV = nRT$$

$$* P = \frac{n}{V} RT$$

$$* \text{Active mass} = \text{Molar concentration} = \frac{n}{V}$$

$$P = \text{Active mass} \times (RT)$$

$$* P_A^x = [A]^x \cdot [RT]^x \quad P_C^l = [C]^l \cdot [RT]^l$$

$$* P_B^y = [B]^y \cdot [RT]^y \quad P_D^m = [D]^m \cdot [RT]^m$$

on substituting equation 2.

$$* K_p = \frac{[C]^l [RT]^l [D]^m [RT]^m}{[A]^x [RT]^x [B]^y [RT]^y} \rightarrow \textcircled{3}$$

$$* K_p = \frac{[C]^l [D]^m [RT]^{l+m}}{[A]^x [B]^y [RT]^{x+y}}$$

$$* K_p = \frac{[C]^l [D]^m}{[A]^x [B]^y} RT^{(l+m) - (x+y)} \rightarrow \textcircled{4}$$

* By comparing equation ① & ④ we get

$$* K_p = K_c (RT)^{\Delta n_g} \rightarrow \textcircled{5}$$

* Δn_g is the difference between the sum of number of moles of gaseous products and the sum of the number of moles of Gaseous reactants

b) Explain paper chromatography:

* Paper chromatography (PC) is an example of Partition chromatography.

* A strip of Paper acts as an adsorbent. This method involves continuous differential Partitioning of components of a mixture between Stationary and mobile Phase.

* In Paper chromatography, a special quality paper known as chromatography paper is used. This Paper act as a stationary phase.

* A strip of chromatographic paper spotted at the base with the solution of the mixture is suspended in a suitable solvent which act as the mobile Phase.

* The solvent rises up and flows over the spot.

* The Paper selectively retains different components according to their different partition in the two phases where a chromatogram.

* The spots of the separated colored compounds

compounds are visible at different heights from the position of initial spots on the chromatogram.

* The spots of the separated colorless compounds may be observed either under ultraviolet light or by the use of an appropriate spray reagent

a) i) Explain electromeric effect.

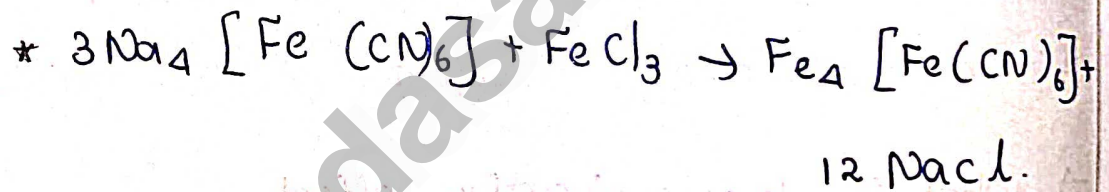
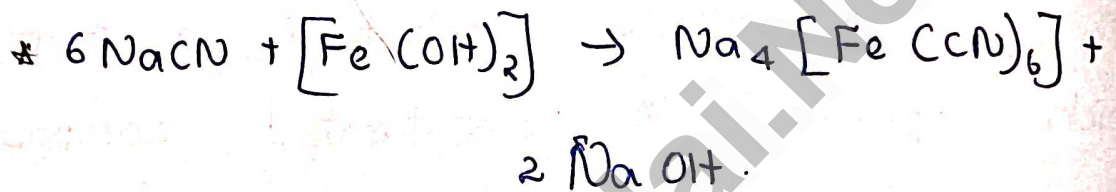
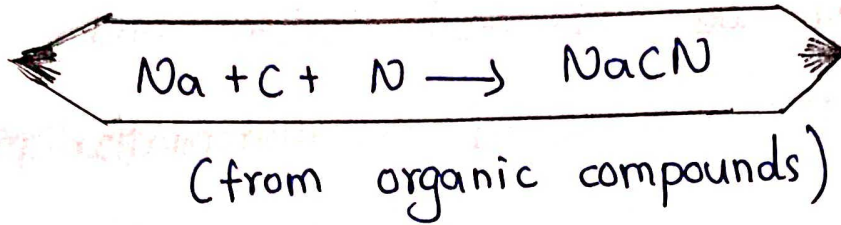
* Electromeric effect is a temporary effect which operates in unsaturated compounds (containing $>C=C<$, $>C=O$, etc...) in the presence of an attacking reagent.

ii) What is hyperconjugation effect.

* The delocalisation of electrons of σ bond is called as hyperconjugation. It is a special stabilising effect the results due to the interaction of electrons of a σ bond (usually C-H or C-C) with the adjacent, empty non-bonding p-orbitals or an anti-bonding σ^* or π^* orbitals resulting in an extended molecular orbital.

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b) Describe the reaction involved in the detection of nitrogen in an organic compound by Lassaigne method.



* (Prussian blue (or) green ppt. Ferric ferro cyanide.

M.Poovarasam M.Sc B.Ed

PG Asst in Chemistry

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