Class XI Session 2023-24
Subject - Chemistry
Sample Question Paper - 1

Time Allowed: 3 hours **Maximum Marks: 70**

General Instructions:

1. There are 33 questions in this question paper with internal choice.
2. SECTION A consists of 16 multiple-choice questions carrying 1 mark each.
3. SECTION B consists of 5 very short answer questions carrying 2 marks each.
4. SECTION C consists of 7 short answer questions carrying 3 marks each.
5. SECTION D consists of 2 case-based questions carrying 4 marks each.
6. SECTION E consists of 3 long answer questions carrying 5 marks each.
7. All questions are compulsory.
8. The use of log tables and calculators is not allowed

Section A

1. Choose the most appropriate answer for the statement, "Rearrangement of atoms occurs whenever a chemical bond breaks or is formed, when **[1]**

   a) a chemical reaction takes place
   b) products appear,
   c) catalysts are produced.
   d) reactants disappear

2. An atom of an element contains 29 electrons and 35 neutrons. The electronic configuration of an element **[1]**

   a) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^{10}$
   b) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p\ 4s^2\ 3d^6\ 4s^2\ 4p^2$
   c) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5\ 4s^1\ 3d^9\ 4s^2$
   d) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p\ 4s^2\ 3d^8\ 4s^2$

3. The enthalpies of all elements in their standard states are: **[1]**

   a) zero
   b) < 0
   c) unity
   d) different for each element

4. According to the quantum theoretical model of an atom, each orbital is designated by three quantum numbers labelled as n, l, and ml. The values these can take are: **[1]**

   a)
   - n = 1,2,3..
   - l= 0,1,..n;
   - m = -l,-l+1, ..0,1..l-1, l

   b)
   - n = 1,2,3..
   - l= 0,1,..n-1;
   - m = 0,1..l-1, l

   c)
   - n = 1,2,3..
   - l= 0,1,..n
   - m= -l,-l+1, ..0,1

   d)
   - n = 1, 2, 3..
   - l = 0, 1,.. n-1;
   - ml = -l,-l+1, ..0,1..l-1, l

5. Enthalpy of atomization is enthalpy change on breaking: **[1]**

a) one kg of bonds completely to obtain atoms in the gas phase.

b) one mole of bonds completely to obtain atoms in the liquid phase.

c) one kg of bonds completely to obtain atoms in the liquid phase.

d) one mole of bonds completely to obtain atoms in the gas phase.

6. For azimuthal quantum number (l) = 2, the values of magnetic quantum number will be: **[1]**

a) +2, +1, 0, -1, -2

b) s, p, d

c) 0, 1, 2

d) $2l + 1$

7. When methane is burnt in oxygen to produce CO_2 and H_2O the oxidation number of carbon changes by? **[1]**

a) +4

b) Zero

c) +8

d) -8

8. In which of the following compounds the carbon marked with asterisk is expected to have greatest partial positive charge? **[1]**

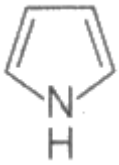
a) $*CH_3 - CH_2 - Br$

b) $*CH_3 - CH_2 - Cl$

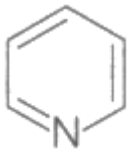
c) $*CH_3 - CH_2 - I$

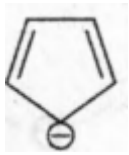
d) $*CH_3 - CH_2 - CH_3$

9. Which of the following compounds is not aromatic? **[1]**

a) 

b) 

c) 

d) 

10. Predict the position of an element having the electronic configuration ls ^{2}2s^{2}2p^{6}3s^{2}3p^{6}3d^{5}4s^1. **[1]**

a) Period 3, group 1

b) Period 4, group 5

c) Period 4, group 6

d) Period 4, group 6

11. Thermodynamics is the branch of physical science concerned with **[1]**

a) mass and its transformations to and from other forms of energy.

b) heat and its transformations to and from other forms of energy.

c) kinetic energy and its transformations to and from other forms of energy.

d) potential and its transformations to and from other forms of energy.

12. Among the following compounds, the one that is most reactive towards electrophilic nitration is _____. **[1]**

a) Nitrobenzene

b) Benzene

c) Toluene

d) Benzoic Acid

13. **Assertion:** Cis- 1, 3-dihydroxycyclohexane exists in a boat conformation. **[1]**

Reason: In the boat form, there will not be hydrogen bonding between the two hydroxyl groups.

a) If both Assertion & Reason are true and the reason is the correct explanation of the assertion.

b) If both Assertion & Reason are true but the reason is not the correct explanation of the assertion.

c) If Assertion is true statement but Reason is false.

d) If both Assertion and Reason are false statements.

14. **Assertion (A):** Addition of HCl on  is faster than  . **[1]**

Reason (R): Alkene that can form more stable carbocation they have higher rate of addition with HX.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

15. **Assertion (A):** Threshold frequency is a characteristic for a metal. **[1]**

Reason (R): Threshold frequency is the maximum frequency required for the ejection of electrons from the metal surface.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

16. **Assertion (A):** The balancing of chemical equations is based on the law of conservation of mass. **[1]**

Reason (R): Total mass of reactants is equal to the total mass of products.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

Section B

17. At 500 K, equilibrium constant, K_c, for the following reaction is 5. **[2]**

$\frac{1}{2}H_2(g) + \frac{1}{2}I_2(g) \rightleftharpoons HI(g)$

What would be the equilibrium constant K_c for the reaction?

$2HI(g) \rightleftharpoons H_2(g) + I_2(g)$

18. The electronic configuration of an element is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1$. Locate the element in the periodic table. **[2]**

19. What will be the mass of one ^{12}C atom in g? **[2]**

20. Unsaturated compounds undergo addition reactions. Why? **[2]**

OR

Explain why the system are not aromatic.

21. Give the number of electrons in the species: H_2^+, H_2 and O_2^+. **[2]**

Section C

22. Arrange the following sets of molecules in the decreasing order of bond angle. **[3]**

i. SF_6, CCI_4, H_2O, NH_3

ii. CH_4, NH_3, H_2O, BF_3

iii. H_2O, BEH_2, $AICI_3$, BeH_2 H_2S

23. **Answer:** **[3]**

(i) Two liters of an ideal gas at a pressure of 10 atm expands isothermally at 25 °C into a vacuum until its total volume is 10 liters. How much heat is absorbed and how much work is done in the expansion? **[1]**

(ii) What is the enthalpy change for an adiabatic process? **[1]**

(iii) Predict the sign of ΔS for the following reaction: $CaCO_3(s) \xrightarrow{\Delta} CaO(s) + CO_2(g)$ **[1]**

24. 1 g of graphite is burnt in a bomb calorimeter in excess of oxygen at 298 K and 1 atmospheric pressure according to the equation C (graphite) + O2(g) $\longrightarrow$ CO_2 (g). During the reaction, temperature rises from 298 K to 299 K. If the heat capacity of the bomb calorimeter is 20.7 kJ / K, what is the enthalpy change for the above reaction at 298 K and 1 atm? **[3]**

25. Identify the substances oxidised reduced oxidizing agent and reducing the agent for each of the following reactions: **[3]**

i. $2AgBr(s) + C_6H_6O_2(aq) \longrightarrow 2Ag(s) + 2HBr(aq) + C_6H_4O_2(aq)$

ii. $HCHO(l) + 2[Ag(NH_3)_2]^+(aq) + 3OH^-(aq) \longrightarrow 2Ag(s) + HCOO^-(aq) + 4NH_3(aq) + 2H_2O(l)$

iii. $HCHO(l) + 2Cu^{2+}(aq) + 50H^-(aq) \longrightarrow Cu_2O(s) + HCOO^-(aq) + 3H_2O(I)$

26. Which of the following sets of orbitals are degenerate and why? **[3]**

1. 1s, 2s and 3s in Mg atom
2. $2p_x$, $2p_y$ and $2p_z$ in C atom
3. 3s, $3p_x$ and 3d orbitals in H atom

27. Give the properties of the oxides in a particular period. **[3]**

28. What is the difference between molality and molarity? **[3]**

Section D

29. **Read the text carefully and answer the questions:** **[4]**

IUPAC (International Union of Pure and Applied Chemistry) system of nomenclature. Common names are useful and in many cases indispensable, particularly when the alternative systematic names are lengthy and complicated. A systematic name of an organic compound is generally derived by identifying the parent hydrocarbon and the functional group(s) attached to it. By using prefixes and suffixes, the parent name can be modified to obtain the actual name. In a branched-chain compound, small chains of carbon atoms are attached at one or more carbon atoms of the parent chain. The small carbon chains (branches) are called alkyl groups. An alkyl group is derived from a saturated hydrocarbon by removing a hydrogen atom from carbon. Abbreviations are used for some alkyl groups. For example, methyl is abbreviated as Me, ethyl as Et, propyl as Pr and butyl as Bu.

(i) Draw the structure of 3-Ethyl-4,4-dimethylheptane.

OR

Why CH_4 after becoming-CH_3 called a methyl group?

(ii) How is the numbering in branched chain hydrocarbon done?

(iii) Derive the structure of 2-Chlorohexane.

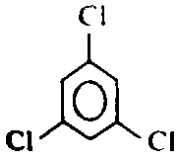
30. **Read the text carefully and answer the questions:** **[4]**

Covalent molecules formed by heteroatoms bound to have some ionic character. The ionic character is due to shifting of the electron pair towards A or B in the molecule AB. Hence, atoms acquire small and equal charge

but opposite in sign. Such a bond which has some ionic character is described as a polar covalent bond. Polar covalent molecules can exhibit a dipole moment. The dipole moment is equal to the product of charge separation, q and the bond length, d for the bond. The unit of dipole moment is Debye. One Debye is equal to 10^{-18} esu cm.

The dipole moment is a vector quantity. It has both magnitude and direction. Hence, the dipole moment of molecules depends upon the relative orientation of the bond dipole, but not the polarity of bonds alone. The symmetrical structure shows a zero dipole moment. Thus, a dipole moment help to predict the geometry of the molecules. Dipole moment values can be used to distinguish between cis- and trans-isomers; ortho-, meta- and para-forms of a substance, etc. The percentage of ionic character of a bond can be calculated by the application of the following formula:

% ionic character = $\frac{\text{Experimental value dipole moment}}{\text{Theoretical value of dipole moment}} \times 100$

(i) Out of  and  which compounds have zero dipole moments?

(ii) A diatomic molecule has a dipole moment of 1.2D. If the bond length is 1.0×10^{-8}cm, what fraction of charge does exist on each atom?

(iii) The dipole moment of NF_3 is very much less that of NH_3. Why?

OR

A covalent molecule, x-y, is found to have a dipole moment of 1.5×10^{-29} cm and a bond length 150 pm. What will be the percentage of ionic character of the bond?

Section E

31. **Attempt any five of the following:** **[5]**

(i) What is Huckel rule? **[1]**

(ii) How is alkene produced by vicinal dihalide? **[1]**

(iii) Write the general formula for alkynes. **[1]**

(iv) Suggest the name of a Lewis acid other than anhydrous aluminium chloride which can be used during ethylation of benzene. **[1]**

(v) Classify the hydrocarbons according to the carbon-carbon bond. **[1]**

(vi) What are benzenoids? **[1]**

(vii) Write IUPAC name: $CH_3 - CH = CH - CH_2 - CH = CH - \underset{\underset{C_2H_5}{|}}{C}H - CH_2 - CH = CH_2$ **[1]**

32. The pH of milk, black coffee, tomato juice, lemon juice, and egg white are 6.8, 5.0, 4.2, 2.2 and 7.8 respectively. Calculate corresponding hydrogen ion concentration in each. **[5]**

OR

Describe the effect of:

a. addition of H_2

b. addition of CH_3OH

c. removal of CO

d. removal of CH_3OH

On the equilibrium of the reaction: $2H_2(g) + CO(g) \rightleftharpoons CH_3OH(g)$

33. **Answer:** **[5]**

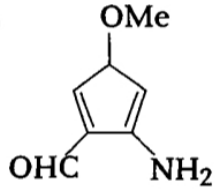
(i) i. 0.3780 g of an organic chlorine compound gave 0.5740 g of silver chloride in Carius estimation. Calculate the percentage of chlorine present in the compound. **[2.5]**

ii. Why does SO_3 act as an electrophile? **[2.5]**

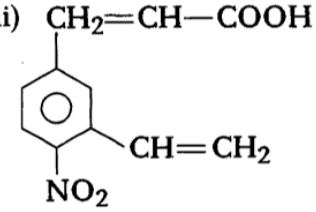
OR

i. Identify the functional groups present in the following compounds. **[2.5]**

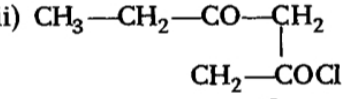
(i)



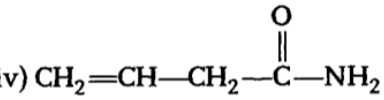
(ii)



(iii)



(iv)



ii. Discuss the chemistry of Lassaigne's test. **[2.5]**

Solution

Section A

1. **(a)** a chemical reaction takes place
   Explanation: In a chemical reaction there is simultaneous ,
   * bond breaking of the reagents
   * bond formation in products &
   * rearrangement of atoms
   resulting into appearance / yield of products .

2. **(a)** $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^{10}$
   Explanation: Number of electron (29) = Number of protons (29)
   So electronic configuration = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^{10}$

3. **(a)** zero
   Explanation: By definition, the enthalpy of formation of elements in their standard state is taken as zero. Therefore, The enthalpies of all elements in their standard states is zero irrespective of the element.

4. **(d)**
   - n = 1, 2, 3..
   - l = 0, 1,.. n-1;
   - ml = -l,-l+1, ..0,1..l-1, l

   Explanation: n (Principal quantum number) value tell about the shell to which the electro belong, Ex, If n=1 electron belongs to the first shell (K) around the nucleus
   l (Azimuthal quantum number) tell about angular momentum, and shape of the orbitals, and it designates the subshells to which the electron belongs to. For a given value of **'n', 'l'** can have a value ranging from 0 to n-1. Ex, If **n**=2 then, the value of **'l'** will be 0 and 1 (0 to n-1).
   m_l (Magnetic orbital quantum number) determines the number of preferred orientations of the orbitals in the subshell, which are defined by given 'l' value.
   Ex if 'l'= 2 then m_l = 2l+1 =2*2 +1= 5 m value ie., m=+2,+1,0,-2,-1.

5. **(d)** one mole of bonds completely to obtain atoms in the gas phase.
   Explanation: Enthalpy of atomization is the enthalpy change that takes place on breaking one mole of bonds completely of a compound or an element, to obtain atoms in the gas phase.

6. **(a)** +2, +1, 0, -1, -2
   Explanation: The magnetic quantum number gives the number of orbitals in a particular subshell within a principal energy level.
   The possible values range from $+l$ through 0 to $-l$, a total of $2l + 1$ values.

7. **(c)** +8
   Explanation: Oxidation number change = +4-(-4) = +8

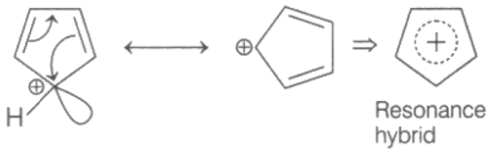
8. **(b)** *CH_3 - CH_2 - Cl
   Explanation: Cl is most electronegative amongst Cl, Br and I and has more -I (inductive electron withdrawing) effect. So it causes the asterisk marked to have the maximum partial positive charge.

9.

(b) 

Explanation:

Aromaticity of a compound can be decided by Huckel's rule. In cyclopentadienyl cation (b), resonance takes place as follows:



Hence,

 is an anti-aromatic does not follow

Huckel's rule as it has conjugated 4 π-electron (4nπ, n = 1) system. Rest of the species are aromatic as each of them belongs to 6π-electron [(4n + 2) π, n = 1] system.

10.

(c) Period 4, group 6

Explanation: n = 4 hence, element lies in 4th period.

Group = ns + (n - 1)d = 1 + 5 = 6

11.

(b) heat and its transformations to and from other forms of energy.

Explanation: Thermodynamics deals with heat and its transformation from one form to another. The branch of physical science that deals with the relations between heat and other forms of energy (such as mechanical, electrical, or chemical energy) and by extension of the relationships between all forms of energy.

12.

(c) Toluene

Explanation: Methyl group is electron donating group, hence it increases the electron density in benzene ring thereby increasing the reactivity of the ring towards electrophilic substitution.

13.

(d) If both Assertion and Reason are false statements.

Explanation: Cis−1,3-dihydroxy cyclohexane exists in the chair form and shows H−bonding in chair form.

14. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation: Both A and R are true and R is the correct explanation of A.

15.

(c) A is true but R is false.

Explanation: The threshold frequency is the minimum frequency required for the emission of electrons from the metal surface.

16. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation: According to law of conservation of mass, in a chemical reaction total mass of the products is equal to the mass of the reactants.

Section B

17. For the reaction, $\frac{1}{2}H_2(g) + \frac{1}{2}I_2(g) \rightleftharpoons HI(g)$

$K_c = \frac{[HI]}{[H_2]^{1/2}[I_2]^{1/2}} = 5$

Thus for the reaction, 2HI(g) $\rightleftharpoons$ H_2(g) + I_2(g)

$K_{c_1} = \frac{[H_2][I_2]}{[HI]^2} = (\frac{1}{K_c})^2 = (\frac{1}{5})^2 = (\frac{1}{25}) = 0.04$

18. The element lies in Group 1 and 4th Period of the modern periodic table.

19. Since,

the number of atoms in 1 mol of ^{12}C atoms = 6.022×10^{23} atoms = Atomic mass of carbon - 12 in gms. = 12 g

Thus, 6.0022×10^{23} atoms of ^{12}C have mass = 12 g

$\therefore$ 1 atom of ^{12}C will have mass = $\frac{12}{6.022 \times 10^{23}} g$

= 1.9927×10^{-23} g

20. Unsaturated hydrocarbon compounds undergo addition reactions because they contain carbon-carbon double or triple bonds. By addition reactions, these unstable π-bonds get broken and makes stable saturated hydrocarbons.

OR

For the given compound, the number of π-electrons is 8.

By Huckel's rule,

$\Rightarrow 4n + 2 = 8$

$\Rightarrow 4n = 6$

$\Rightarrow n = 3/2$

For a compound to be aromatic, the value of n must be an integer (n = 0, 1, 2…).

This is not true for the given compound as it is a fraction. Hence, it is not aromatic in nature.

21. H_2^+ = one

H_2 = two

O_2^+ = 15

Section C

22. i. $\underset{Tetrahedral}{CCI_4(109.5^\circ)}, \underset{Pyramidal}{NH_3\ (107^\circ)}, \underset{Angular}{H_2O(104.5^\circ\ )}, \underset{Octahedral}{SF_6\ (90^\circ)}$

ii. $\underset{Planar}{BF_3(120^\circ)}, \underset{Tetrahedral}{CH_4(109.5^\circ)}, \underset{Pyramidal}{NH_3(107^\circ)}, \underset{Angular}{H_2O\ (104.5^\circ)}$

iii. $\underset{Linear}{BeH_2(180^\circ)}, \underset{Planar}{AICI_3(120^\circ\ )}, \underset{Angular}{H_2O(104.5^\circ)}, \underset{\substack{Angular\ but\ S\ is\ less \\ electronegative\ Than\ O}}{H_2S(100^\circ)},$

23. Answer:

(i) We have q = – w = p_{ex} (10 – 2) = 0(8) = 0 No work is done; no heat is absorbed.

(ii) For an adiabatic process,

$\Delta H = 0$

(iii) Reaction:

$CaCO_3(s) \xrightarrow{\Delta} CaO(s) + CO_2(g)$

As gas is formed, the sign of ΔS is positive.

24. Suppose q is the quantity of heat from the reaction mixture and C_v is the heat capacity of the calorimeter, then the quantity of heat absorbed by the calorimeter.

$q = Cv \times \Delta T$

Quantity of heat from the reaction will have the same magnitude but opposite sign because the heat lost by the system (reaction mixture) is equal to the heat gained by the calorimeter.

$q = - C_v \times \Delta T = - 20.7\ kJ/K \times (299 - 298)\ K$

= - 20.7 kJ

(Here, the negative sign indicates the exothermic nature of the reaction). Thus, ΔU for the combustion of the 1g of graphite = - 20.7 kJ K^{-1}

For combustion of 1 mol of graphite,

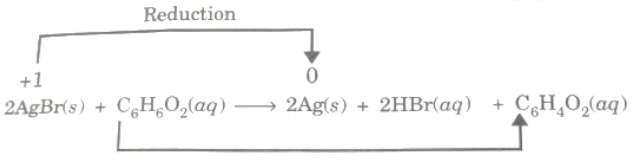
$= \frac{12.0 g\ mol^{-1} \times (-20.7 kJ)}{1g}$

= $- 2.48 \times 10^2$ kJ mol^{-1}

Since $\Delta n_g = 0$

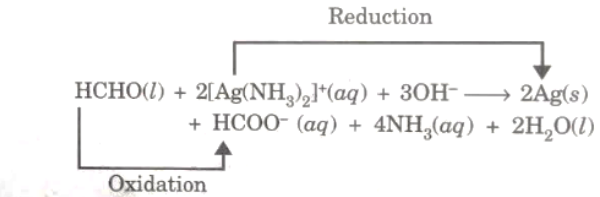
$\Delta H = \Delta U = - 2.48 \times 10^2$ kJ mol^{-1}

25. i.



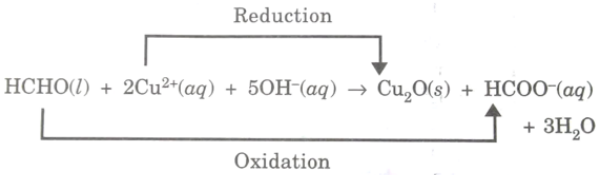
AgBr : reduced, $C_6H_6O_2$ (aq) : oxidised
AgBr : Oxidising agent, $C_6H_6O_2$ (aq) : reducing agent

ii.



$[Ag(NH_3)_2]^+$ (aq) : reduced, HCHO(l) : oxidised
$[Ag(NH_3)_2]^+$ (aq) : oxidising agent, HCHO(l) : reducing agent

iii.



Cu^{2+} (aq) : reduced, HCHO(l) : oxidised
Cu^{2+} (aq) : oxidising agent, HCHO(l) : reducing agent

Reduction

26. 1. 1s, 2s and 3s orbitals in Mg atom are not degenerate because these have different values of n i.e 1, 2 and 3 respectively.
    2. $2p_x$, $2p_y$ and $2p_z$ orbitals in C atom are degenerate because these belong to the same subshell and n=2 for each orbital.
    3. 3s, $3p_x$ and 3d orbitals in H atom are degenerate.The 3 in each of these orbitals is its "principal" quantum number. It seems that these three different designations, s, p, and d, as describing the different shapes of their orbitals while they all have the same energy when there is only one electron at the "3" level, such as in the hydrogen atom where there is only one electron.

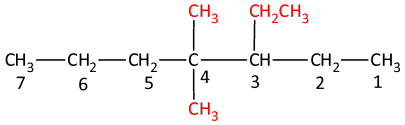
27. Elements on extremes ends of a period easily combines with oxygen to form oxides. The elements present on the extreme left of a period are metals and formed basic oxides (e.g. Na_2O, MgO, CaO, K_2O etc.) with ionic nature whereas the element present on extreme right are non- metals formed the most acidic oxides (e.g. Cl_2O_7 , CO_2, SO_2, N_2O_3 etc.). The non-metallic oxides are covalent in nature. Oxides of middle elements of a period are however amphoteric in nature (eg. Al_2O_3) or neutral (eg. CO).

28. Molarity: It is denoted by M. It is defined as the number of moles of solute present in 1 litre of the solution.
    Thus, Molarity (M) $= \frac{\text{No. of moles of solute}}{\text{Volume of solution in litres}}$
    Molality: It is defined as the number of moles of solute present in 1 kg of solvent. It is denoted by m.
    Thus, Molality (m) = $\frac{No \text{ of moles of solute}}{Mass \text{ of solvent in kg}}$
    Molality does not depend on temperature while molarity does. Similarly, it is useful to prepare molal solution as compared to molar because with temperature molarity changes.

Section D

29. **Read the text carefully and answer the questions:**
    IUPAC (International Union of Pure and Applied Chemistry) system of nomenclature. Common names are useful and in many cases indispensable, particularly when the alternative systematic names are lengthy and complicated. A systematic name of an organic compound is generally derived by identifying the parent hydrocarbon and the functional group(s) attached to it. By using prefixes and suffixes, the parent name can be modified to obtain the actual name. In a branched-chain compound, small chains of carbon atoms are attached at one or more carbon atoms of the parent chain. The small carbon chains (branches) are called alkyl groups. An alkyl group is derived from a saturated hydrocarbon by removing a hydrogen atom from carbon. Abbreviations are used for some alkyl groups. For example, methyl is abbreviated as Me, ethyl as Et, propyl as Pr and butyl as Bu.

    (i)



OR

CH_4 after becoming-CH_3 called a methyl group because an alkyl group is named by substituting 'yl' for 'ane' in the corresponding alkane.

(ii) The numbering is done in such a way that the branched carbon atoms get the lowest possible numbers.

(iii)'Hexane' indicates the presence of 6 carbon atoms in the chain. The functional group chloro is present at carbon 2. Hence, the structure of the compound is $CH_2CH_2CH_2CH_2CH(Cl)CH_3$.

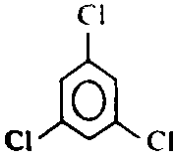
30. **Read the text carefully and answer the questions:**

Covalent molecules formed by heteroatoms bound to have some ionic character. The ionic character is due to shifting of the electron pair towards A or B in the molecule AB. Hence, atoms acquire small and equal charge but opposite in sign. Such a bond which has some ionic character is described as a polar covalent bond. Polar covalent molecules can exhibit a dipole moment. The dipole moment is equal to the product of charge separation, q and the bond length, d for the bond. The unit of dipole moment is Debye. One Debye is equal to 10^{-18} esu cm.

The dipole moment is a vector quantity. It has both magnitude and direction. Hence, the dipole moment of molecules depends upon the relative orientation of the bond dipole, but not the polarity of bonds alone. The symmetrical structure shows a zero dipole moment. Thus, a dipole moment help to predict the geometry of the molecules. Dipole moment values can be used to distinguish between cis- and trans-isomers; ortho-, meta- and para-forms of a substance, etc. The percentage of ionic character of a bond can be calculated by the application of the following formula:

% ionic character = $\frac{\text{Experimental value dipole moment}}{\text{Theoretical value of dipole moment}} \times 100$

(i)

Both the molecules have zero dipole moments since both  and  shows symmetrical structure.

(ii) Fraction of electronic charge = $\frac{1.2\times10^{-10}}{4.8\times10^{-10}} = 0.25$

(iii)Because of different direction of moment of N-H and N-F bonds.

OR

% ionic character = $\frac{1.5\times10^{-29}}{2.4\times10^{-29}} \times 100$ = 62.5

Section E

31. Attempt any five of the following:

(i) Huckel rule states that a compound is said to be aromatic if it has (4n + 2) πelectrons delocalized where n = an integer 0, 1, 2, 3, ...

(ii) Alkene are produced from Vicinal dihalide by the process of dehalogenations. Vicinal dihalide on treatment with Zn metal lose a molecule of ZnX_2 to from an alkene.

$CH_2Br\text{-}CH_2Br + Zn \rightarrow CH_2{=}CH_2 + ZnBr_2$.

(iii)General formula of alkynes is C_nH_{2n-2}

(iv)Anhydrous Ferric Chloride $(FeCl_3)$ is another Lewis acid which can be used.

(v) Hydrocarbons are categorized into three categories according to the carbon-carbon bond that exists between them:

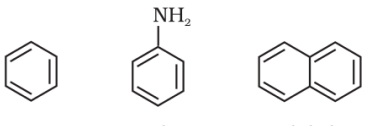
a. Saturated hydrocarbon (In which carbon-carbon single bond are present)

b. Unsaturated hydrocarbon (In which carbon-carbon double and triple bonds are present)

c. Aromatic hydrocarbon (In which alternate single and double bond and (4n+2)π electrons are present)

(vi)**Benzenoids:** Aromatic hydrocarbon compound containing benzene ring are known as benzenoids.

Examples for benzenoids are:



Benzene Aniline Naphthalene

(vii)

$$\overset{10}{CH_3} - \overset{9}{CH} = \overset{8}{CH} - \overset{7}{CH_2} - \overset{6}{CH} = \overset{5}{CH} - \overset{4}{\underset{\underset{C_2H_5}{|}}{C}}H - \overset{3}{CH_2} - \overset{2}{CH} = \overset{1}{CH_2}$$

32. We can calculate the hydrogen ion concentration by applying the formula, pH = –log [H+]

i. pH of milk = 6.8

Since, pH = –log $[H^+]$

$\Rightarrow$ 6.8 = –log $[H^+]$

$\Rightarrow$ log $[H^+]$ = –6.8

By taking antilog of both the sides, we get

$\Rightarrow$ $[H^+]$ = antilog (–6.8)

$\Rightarrow$ $[H^+]$= 1.5$\times$19–7 M

ii. pH of black coffee = 5.0

Since, pH = –log $[H^+]$

$\Rightarrow$5.0 = –log $[H^+]$

$\Rightarrow$log $[H^+]$ = –5.0

By taking antilog of both the sides, we get

$\Rightarrow$$[H^+]$ = antilog (–5.0)

$\Rightarrow$$[H^+]$ = 10^{-5} M

iii. pH of tomato juice = 4.2

Since, pH = –log $[H^+]$

$\Rightarrow$ 4.2 = –log $[H^+]$

$\Rightarrow$ log $[H^+]$ = –4.2

By taking the antilog of both the sides, we get

$\Rightarrow$ $[H^+]$ = antilog (–4.2)

$\Rightarrow$ $[H^+]$= 6.31$\times$$10^{-5}$ M

iv. pH of lemon juice = 2.2

Since, pH = –log $[H^+]$

$\Rightarrow$2.2 = –log $[H^+]$

$\Rightarrow$log [H+] = –2.2

By taking the antilog of both the sides, we get

$\Rightarrow$$[H^+]$ = antilog (–2.2)

$\Rightarrow$$[H^+]$= 6.31$\times$$10^{-3}$ M

v. pH of egg white = 7.8

Since, pH = –log $[H^+]$

$\Rightarrow$7.8 = –log $[H^+]$

$\Rightarrow$log $[H^+]$ = –7.8

By taking the antilog of both the sides, we get

$\Rightarrow$$[H^+]$ = antilog (–7.8)

$\Rightarrow$$[H^+]$=1.58$\times$$10^{-8}$ M

OR

$2H_2(g) + CO(g) \rightleftharpoons CH_3OH$

According to Le-Chatelier's principle:

When any system at equilibrium for a long period of time is subjected to a change in concentration, temperature, volume, or pressure, the system changes to a new equilibrium. This change partly counteracts the applied change.

i. On addition of H_2 (increase in the concentration of reactants), equilibrium will be shifted in the forward direction (more products are formed).
ii. On addition of CH_3OH (increase in concentration or product), equilibrium will be shifted in the backward direction.
iii. On removal of CO , equilibrium will be shifted in the backward direction.
iv. On removal of CH_3OH, Equilibrium will be shifted in the forward direction.

33. Answer:

(i)

i. According to the question, 0.3780 g of an organic chlorine compound gave 0.5740 g of silver chloride in Carius estimation.

$\%$ of chlorine $= \frac{35.5}{143.5} \times \frac{\text{mass of AgCl formed}}{\text{mass of substance taken}} \times 100$

$= \frac{35.5}{143.5} \times \frac{0.5740}{0.3780} \times 100$

$= 37.566\%$

ii. SO_3 acts as an electrophile because three highly electronegative oxygen atoms are attached to Sulphur atom in SO_3 which makes sulphur atom electron deficient.

OR

i. i. Functional groups are -NH_2 (amino), -OMe (methoxy) and -CHO (aldehydic)

ii. Carbon-carbon double bond, -NO_2 (nitro) and -COOH (carboxylic)

iii. -CO- (keto), -COCl (acylchloride)

iv. $-\overset{|}{C} = \overset{|}{C}-$ ((carbon-carbon double bond), $-\overset{O}{\overset{||}{C}} - NH_2$ (acitamide).

ii. **Lassaigne's test :** Nitrogen, sulphur, halogens and phosphorous present in an organic compound are detected by Lassaigne's test.

First of all compounds are converted to ionic form by fusing the compound with sodium metal.

$\mathrm{Na + C + N \xrightarrow{\Delta} NaCN}$

$\mathrm{2Na + S \xrightarrow{A} Na_2S}$

$\mathrm{Na + X \xrightarrow{A} NaX}$ **[x=cl,Br,I]**

Cyanide, sulphide or halide of sodium are extracted from the fused mass by boiling it with distilled water. This extract is known as sodium fusion extract.