Previous IPE

SOLVED PAPERS

MARCH -2025(TS)

PREVIOUS PAPERS

IPE: MARCH-2025(TS)

Time : 3 Hours   **SR. CHEMISTRY**   **Max.Marks : 60**

SECTION-A

I. Answer ALL questions :   **10 × 2 = 20**

1. State Faraday's first law of electrolysis.

2. What is Vulcanization of rubber?

3. What are antiseptics? Give example.

4. What is blister copper? Why is it so called?

5. What are food preservatives? Give example.

6. Aqueous Cu^{2+} ions are blue in colour, whereas Aqueous Zn^{2+} ions are colourless.

7. What is Ziegler-Natta catalyst?

8. Ammonia is a good complexing agent - explain with an example.

9. Calculate the mole fraction of H_2SO_4 in a solution containing 98% H_2SO_4 by mass.

10. Write equations for carbylamine reaction of any one aliphatic amine.

SECTION-B

II. Answer any SIX of the following Questions.   **6 × 4 = 24**

11. Derive Bragg's equation.

12. Giving examples to differentiate roasting and calcination.

13. What is relative lowering of vapour pressure? How is it useful to determine the molar mass of a solute?

14. Explain the denaturation of proteins.

15. Explain the structures of   (a) XeF_6 and (b) $XeOF_4$

16. What are lyophilic and lyophobic sols? Compare the two terms in terms of stability and reversibility.

17. Explain Werner's theory of coordination compounds with suitable examples.

18. a) What are ambident nucleophiles? b) What are Enantiomers?

SECTION-C

III. Answer any two of the following Questions.   **2 × 8 = 16**

19. Give a detailed account of the collision theory of reaction rates of bimolecular gaseous reactions.

20. How is chlorine prepared in the laboratory? How does it react with the following?
    a. Iron   b. hot. con. NaOH   c. $Na_2S_2O_3$.

21. With a suitable example write equations for the followings:
    a) Kolbe's reaction   b) Williamson ether synthesis
    c) Cannizzaro reaction   d) Decarboxylation

IPE TS MARCH-2025
SOLUTIONS

SECTION-A

1. **State Faraday's first law of electrolysis.**

A: **Faraday's first law:** "The 'amount of substance deposited or liberated' at the electrode is directly proportional to the 'quantity of current' passing through the electrolyte".

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2. **What is vulcanization of rubber?**

A: 1) **Vulcanization:** It is the process of 'heating raw rubber with sulphur' at 373-415K to improve its physical properties.

2) Addition of sulphur introduces 'sulphur bridges' between polymer chains.
This causes more tensile strength, elasticity and resistance to **abrassive nature.**

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3. **What are antiseptics? Give example.**

A: 1) **Antiseptics :** These are the drugs used 'to kill or prevent the growth of harmful micro organisms'. They are applied externally in living organisms to prevent infection.
2) **Ex:** Dettol, Bithional, Tincture of iodine.

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4. **What is blister copper? Why is it so called?**

A: 1) **Blister Copper:** It is the copper obtained after bessemerisation of matte. It is 97-98% pure.
2) Dissolved SO_2 produces blisters on the metal surface. So it is called blister copper.

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5. **What are food preservatives? Give example.**

A: 1) **Food preservatives:** These are the chemical substances used 'to protect food' against bacteria, yeasts and moulds.
2) **Ex:** Table salt, Sugar syrup.

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6. **Aqueous Cu^{2+} ions are blue in colour, where as Aqueous Zn^{2+} ions are colourless. Why?**

A: Electronic configuration of Cu^{+2} is $[Ar] 4s^0 3d^9$.

It contains one unpaired electron. Hence it exhibits blue colour in aqueous solution.

Electronic configuration of Zn^{+2} is $[Ar] 4s^0 3d^{10}$.

It contains no unpaired electron, hence it is colourless in aqueous solution.

7. What is Ziegler-Natta catalyst?

A: 1) Triethylaluminium and titanium tetrachloride $((C_2H_5)_3Al + TiCl_4)$ is known as Ziegler -Natta catalyst.

2) It is used in the preparation of high density polythene.

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8. Ammonia is a good complexing agent - explain with an example.

A: The presence of lone pair of electrons on the nitrogen of the ammonia molecule makes it a lewis base.

It donates the electron pair and forms the complexes with metal ions.

Hence ammonia is a good complexing agent makes it useful in the detection of certain metal ions.

$$Cu^{+2}_{(aq)} + 4NH_{3(aq)} \rightleftharpoons [Cu(NH_3)_4]^{2+}_{(aq)}$$

(blue)   Deep blue

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9. Calculate the mole fraction of H_2SO_4 in a solution containing 98% H_2SO_4 by mass.

A: **1)** Mole Fraction $X = \dfrac{\text{No. of moles of one component}}{\text{Total no. of moles of all the components}}$

2) 98% H_2SO_4 by mass means 98 gm of H_2SO_4 is present in 100gm of solution

Mass of solute (H_2SO_4) = 98 gm   No. of moles of H_2SO_4, $n_A = \dfrac{98}{98} = 1$

Mass of H_2O = 2gm   No. of moles of H_2O, $n_B = \dfrac{2}{18} = \dfrac{1}{9}$

3) Mole fraction of H_2SO_4 is $X_A = \dfrac{n_A}{n_A + n_B} = \dfrac{1}{1 + (1/9)} = \dfrac{9}{10} = 0.9$

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10. Write equations for carbylamine reaction of any one aliphatic amine.

A: **1) Carbylamine Test:** Aniline when heated with alcoholic potash and chloroform, gives Ethyl carbylamine with offensive smelling.

2) $C_2H_5NH_2 + CHCl_3 + 3KOH \xrightarrow[\Delta]{\text{alc.}} C_2H_5NC + 3\ KCl + 3H_2O$

     Ethanamine   Ethyl carbylamine

SECTION-B

11. Derive <u>Bragg's equation</u>.

A: 1) Suppose two X-rays of wavelength λ are incident on **two parallel planes** of a crystal surface.

2) They both undergo **diffraction**.

3) First x-ray is diffracted from point 'A' in the first plane.

Second ray is diffracted from 'B' in the second plane.

4) Here, the second X-ray travels some **extra distance** than the first X-ray.

The extra distance (path difference) travelled by the second X-ray = CB + BD

5) When two waves undergo constructive interference then according to Bragg, the path difference must be an **integral multiple of the wave length(λ)**.

   $\therefore$ CB + BD = nλ .....(i).   Here n = 1, 2, 3…. is known as order of diffraction.

6) If θ **is the angle of incidence** and 'd' be the distance between the parallel planes then

from ΔABC, $\sin\theta = \dfrac{CB}{AB} = \dfrac{CB}{d} \Rightarrow CB = d\sin\theta$.....(ii)

In ΔABD, $\sin\theta = \dfrac{BD}{AB} = \dfrac{BD}{d} \Rightarrow BD = d\sin\theta$.....(iii)

$\therefore$ from (ii) & (iii), CB + BD = d$\sin\theta$ + d$\sin\theta$ = 2d$\sin\theta$

$\therefore$ from (i), **nλ = 2d$\sin\theta$**

This is known as Bragg's equation.

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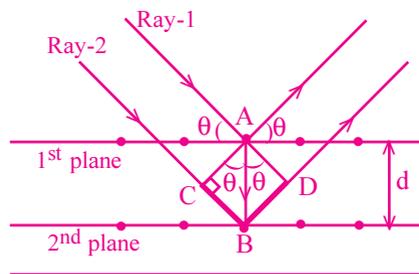
12. Giving examples to differentiate roasting and calcination.

A:

Roasting	**Calcination**
1) In this process, ore is heated in the presence of air (or) oxygen.	1) In this process, ore is heated in the absence of air (or) oxygen.
2) This method is used for sulphide ores.	2) This method is used for carbonate ores.
3) Sulphide ores are roasted to get oxides.	3) Carbonate ores are calcined to get oxides.
4) **Ex:** $2ZnS + 3O_2 \xrightarrow{\text{Heat}} 2ZnO + 2SO_{2(g)}$	4) **Ex:** $CaCO_3 \longrightarrow CaO + CO_2$

13. **What is <u>relative lowering of vapour pressure</u>? How is it useful to determine the molar mass of a solute?**

A: **1) Lowering of Vapour Pressure(LVP):** It is the difference between the vapour pressure of pure solvent (p^o) and the vapour pressure of the solution (p^s) .

Thus, $\Delta p = p^o - p^s$

2) Relative Lowering of Vapour Pressure(RLVP): It is the ratio between lowering of vapour pressure ($p^o - p^s$) and vapour pressure of pure solvent (p^o).

Thus, $\text{R.L.V.P} = \dfrac{p^o - p^s}{p^o}$

3) According to Raoult's law, RLVP = mole fraction of the solute χ_s.

$$\therefore \chi_s = \frac{p^o - p^s}{p^o} = \frac{w_s}{M_s} \times \frac{M_o}{w_o}$$

4) From the above relation, molar mass of the given solute is $M_s = \dfrac{w_s \times M_o \times p^o}{(p^o - p^s) w_o}$

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14. **Explain the denaturation of proteins.**

A: **1) Denaturation:** The <u>loss of Biological activity of proteins</u> is known as Denaturation of proteins.

2) It is due to breaking of Hydrogen bonds in 2° and 3° structure.

3) It is carried out by the change in pH (or) by addition of chemicals.

4) Ex: Curdling of milk, coagulation of egg by boiling.

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15. **Explain the structures of (a) XeF_6 and (b) $XeOF_4$**

A: **a) Structure of XeF_6:**

    i) In XeF_6, the central atom Xe undergoes sp^3d^3 hybridisation and forms seven sp^3d^3 hybrid orbitals.

    ii) It forms six σ bonds with six fluorine atoms

    iii) It has six bond pairs and one lone pair.

    iv) As per VSEPR theory, the shape of XeF_6 is distorted octahedral
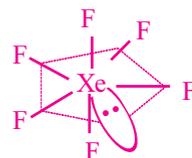
b) Structure of $XeOF_4$:

    i) In $XeOF_4$, the central atom Xe undergoes **sp^3d^2 hybridisation** to form **six sp^3d^2 hybrid** orbitals.

    ii) It forms **four σ bonds** with four fluorine atoms and **one σ** and **one π bond** with oxygen atom.

    iii) It has **five bond pairs** and **one lone pair.**

    iv) According to VSEPR theory, the shape of $XeOF_4$ is **square pyramidal.**

    v) So, the bond angle is **90°.**
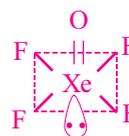
16. What are lyophilic and lyophobic sols? Compare the two terms in terms of stability and reversibility.

A: Depending upon the nature of interaction between the dispersed phase and the dispersion medium, colloidal sols are divided into two categories, namely, lyophilic and lyophobic.

Lyophilic colloids: The word lyophilic means solvent loving. Colloidal sols directly formed by mixing substances like gum, gelatine, starch, rubber, etc with a suitable dispersion medium are called lyophilic sols.

An important characteristic of these sols is that, the dispersion medium is separated from the dispersed phase (say by evaporation). The sol can be reconstituted by simply remixing the dispersed phase with the dispersion medium. That is why these sols are also called reversible sols. These sols are quite stable and are not easily coagulated.

Lyophobic colloids: The word lyophobic means solvent hating.

Substances like metals, their sulphides etc when simply mixed with dispersion medium do not form the colloidal sol. Their colloidal sols can be prepared only by special methods. Such sols are called lyophobic sols. These sols are readily precipitated on the addition of small amounts of electrolytes, or by heating or by shaking and hence, are not stable.

Further, once precipitated, they do not give back the colloidal sol by simple addition of the dispersion medium.

Hence, these sols are also called irreversible sols. Lyophobic sols need stabilizing agents for their preservation.

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17. Explain Werner's theory of coordination compounds with suitable examples.

A: **1) Werner's theory:** This theory explains the structures of 'coordination compounds'.

In co-ordination compounds the central metal atom shows two types of valencies,

a) Primary valency   b) Secondary valency.

2) Primary Valency:
   i) It is equal to the oxidation number of the central atom.
   ii) It is satisfied only by the negative ions.
   iii) It is ionisable.
   iv) It is non-directional and it is represented by dotted lines.

3) Secondary Valency:
   i) It is equal to the co-ordination number of the central atom.
   ii) It is satisfied by negative ions, neutral molecues and rarely by positive ions.
   iii) It is non-ionisable.
   iv) It is directional and it is represented by solid lines. It exhibits isomerism.

4) Example: Hexaammine cobalt (III) chloride-$[Co(NH_3)_6]Cl_3$:
   i) Here, primary valency of Co is 3.
      It is satisfied by 3 Cl^- ions.
   ii) Secondary valency of Co is 6.
      It is satisfied by 6 NH_3 molecules.
   iii) Shape of complex is Octahedral.

$[Co(NH_3)_6]Cl_3$
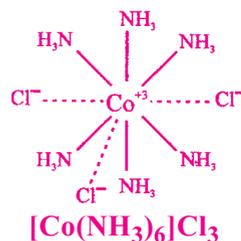
18.   **a) What are ambident nucleophiles? b) What are Enantiomers?**

A: **a) Ambident nucleophiles:**

     1)   These are the <u>nucleophiles with two donor atoms</u>.

     2)   **Ex:** Cyanide ion, Nitrite ion

   b) Enantiomers:

     1)   These are a 'pair of stereo isomers' which are <u>mirror images</u> to each other.

       These are 'non-super imposable' compounds.

     2)   **Ex:** d-Lactic acid & *l*-Lactic acid

SECTION-C

19. **Give a detailed account of <u>Collision theory</u> of reaction rates of bimolecular gaseous reactions.**

A: **Collision Theory:**

1) It is based on **kinetic theory** of gases.

2) All collisions do not lead to the formation of products.

3) A reaction takes place only when **reactant molecules collide with 'proper orientation'**.

4) The colliding molecules should posses a **minimum energy** to produce products. Such minimum energy is called **'Threshold energy' (E_T)**

5) Molecules having threshold energy are called **activated molecules.**

6) The difference between the threshold energy (E_T) and the energy of the molecules in the normal state(E_R) is called **'activation energy'(E_a).** $E_a = E_T - E_R$.

7) **Activated collisions only** lead to the formation of products.

8) Collision frequency $Z = \pi\sigma_{AB}^2\sqrt{\dfrac{8KT}{\pi\mu}}n_A n_B$, σ_{AB} = Collision diameter, μ = reduced mass

9) Specific rate $k = A.e^{-Ea/RT}$

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20. **How is chlorine prepared in the laboratory? How does it react with the following?**
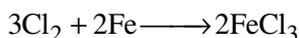**a) Iron   b) hot. con. NaOH   c) $Na_2S_2O_3$.**

A: **Preparation of Chlorine in the laboratory:**

Chlorine is prepared in the laboratory by heating a mixture of sodium chloride, manganese dioxide and conc. H_2SO_4.
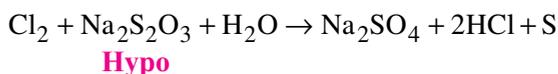
$4NaCl + 4H_2SO_4 + MnO_2 \rightarrow 4NaHSO_4 + MnCl_2 + 2H_2O + Cl_2$

Reactions of Chlorine:

a) Cl_2 reacts with **iron** to form **Ferric chloride.**

$$3Cl_2 + 2Fe \longrightarrow 2FeCl_3$$

b) **Chlorine** reacts with **hot and conc. NaOH** to form **NaCl and $NaClO_3$.**

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

c) Cl_2 reacts with Hypo to form **Na_2SO_4**

$$Cl_2 + Na_2S_2O_3 + H_2O \rightarrow Na_2SO_4 + 2HCl + S$$
$\quad\quad$ **Hypo**

21. **With a suitable example write equations for the followings:**

  a) **Kolbe's reaction**   **b)** **Williamson ether synthesis**

  c) **Cannizzaro reaction**   **d)** **Decarboxylation**

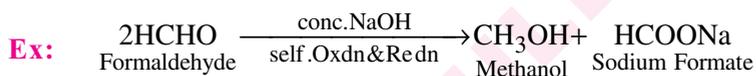**A:** **a)** **Kolbe Reaction:** Sodium phenoxide is heated with Carbon dioxide at 398K to form Salicyclic acid.

Ex:

$$\underset{\text{Sodium phenoxide}}{\text{(C}_6\text{H}_5\text{ONa)}} + CO_2 \xrightarrow[\text{398K}]{\text{4--6 atm}} \underset{\text{Salicylic acid}}{\text{(C}_6\text{H}_4(\text{OH})\text{COOH)}}$$
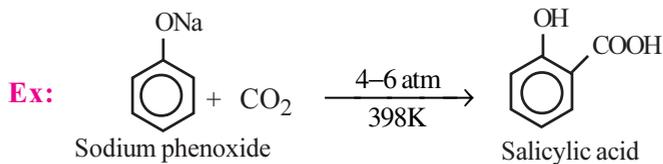
  b) **Williamson's synthesis:**

  Ethyl Iodide is heated with **Sodium Ethoxide** to form **Diethyl Ether.**

Ex: $\underset{\text{Ethyl Iodide}}{C_2H_5I} + \underset{\text{Sodium Ethoxide}}{C_2H_5ONa} \xrightarrow{\Delta} \underset{\text{Diethyl Ether}}{C_2H_5-O-C_2H_5} + NaI$
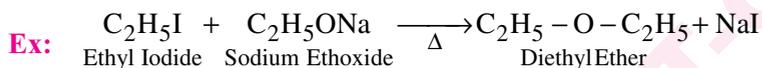
  c) **Cannizzaro Reaction:** Formaldehyde in the presence of conc. NaOH undergo self oxidation and reduction to form Methanol and Sodium Formate.

Ex: $\underset{\text{Formaldehyde}}{2HCHO} \xrightarrow[\text{self.Oxdn\&Redn}]{\text{conc.NaOH}} \underset{\text{Methanol}}{CH_3OH} + \underset{\text{Sodium Formate}}{HCOONa}$

  d) **Decarboxylation :** **Sodium Ethanoate** is heated with **Sodalime** to form **Methane.**

$$\underset{\text{Sodium Ethanoate}}{CH_3COONa} + \underset{\text{Soda lime}}{NaOH} \xrightarrow[\Delta]{CaO} \underset{\text{Methane}}{CH_4} + Na_2CO_3$$