Previous IPE

SOLVED PAPERS

MARCH -2023 (AP)

PREVIOUS PAPERS

IPE: MARCH-2023(AP)

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

SECTION-A

I. Answer all questions : $10 \times 2 = 20$

1. What is Cryoscopic constant?
2. What are pseudo first order reactions? Give one example.
3. What is the role of cryolite in the metallurgy of aluminium?
4. What happens when white phosphorus is heated with conc. NaOH solution in an inert atmosphere of CO_2?
5. SO_2 can be used as an anti-chlor. Explain.
6. Why Zn^{2+} is diamagnetic whereas Mn^{2+} is paramagnetic?
7. What is Ziegler-Natta catalyst?
8. What is PHBV? How is it useful to man?
9. What are artificial sweetening agents? Give example.
10. What is the difference between a soap and a synthetic detergent?

SECTION-B

II. Answer any six of the following Questions. $6 \times 4 = 24$

11. Derive Bragg's equation.
12. Vapour pressure of water at 293K is 17.535mm Hg. Calculate the vapour pressure of the solution at 293K when 25g of glucose is dissolved in 450g of water.
13. What is catalysis? How is catalysis classified? Give two examples for each type of catalysis.
14. Explain the purification of sulphide ore by froth floatation method.
15. Explain the structures of (a) XeF_6 and (b) $XeOF_4$
16. Explain Werner's theory of coordination compounds with suitable examples.
17. What are hormones? Give one example for each.
    (i) Steroid hormones (ii) Poly peptide hormones and (iii) Amino acid derivatives.
18. a) What are ambident nucleophiles? b) What are Enantiomers?

SECTION-C

III. Answer any two of the following Questions: $2 \times 8 = 16$

19. a) State and explain Kohlrausch's law of independent migration of ions.
    b) What is 'molecularity' of a reaction? How is it different from the 'order' of a reaction? Name one bimolecular and one trimolecular gaseous reactions.
20. a) How does ozone react with the following : (a) Pbs (b) KI (c) Hg (d) Ag
    b) Write balanced equations for the following
    a) NaCl is heated with conc. H_2SO_4 in the presence of MnO_2.
    b) Chlorine is passed into a solution of NaI in water.
21. Describe the following :
    a) Kolbe reaction b) Aldol condensation c) Carbyl amine reaction d) Williamson Synthesis

IPE AP MARCH-2023

SOLUTIONS

SECTION-A

1. **What is Cryoscopic constant?**

A: **Cryoscopic constant (K_f) :** It is the **depression in the freezing point** observed when one mole of non-volatile solute is dissolved in 1kg of solvent.

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2. **What are pseudo first order reactions? Give one example.**

A: **1) Pseudo first order reactions:** It is a reaction which is not truly of first order but under certain conditions becomes a first order reaction .

2) Ex: Inversion of cane sugar is a bimolecular reaction but it is a first order reaction when concentration of H_2O is large.

$$\underset{\text{Canesugar}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{H^+} \underset{\text{glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6} \text{ ;rate} = K[C_{12}H_{22}O_{11}]$$

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3. **What is the role of cryolite in the metallurgy of aluminium?**

A: **Role of cryolite :**

1)Cryolite increases the 'conductivity of alumina' .

2) It decreases the melting point of molt.

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4. **What happens when white phosphorus is heated with conc. NaOH solution in an inert atmosphere of CO_2?**

A: When white phosphorus is heated with conc.NaOH solution in an inert atmosphere of CO_2, phosphine gas is liberated.

$$P_4 + 3NaOH + 3H_2O \longrightarrow 3NaH_2PO_2 + PH_3 \uparrow$$

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5. **SO_2 can be used as an anti-chlor. Explain.**

A: **1)** SO_2 removes excess of chlorine. So, SO_2 is used as an anti-chlor.

2) It reduces Cl_2 to HCl.

$$Cl_2 + SO_2 + 2H_2O \rightarrow 2HCl + H_2SO_4$$

6. Why Zn^{2+} is diamagnetic whereas Mn^{2+} is paramagnetic?

A: 1) Electronic configuration of $Zn^{+2}$is[Ar] $4s^0 3d^{10}$.

It has paired d electrons. So it is diamagnetic.

2) Electronic configuration of Mn^{+2} is [Ar]$4s^0 3d^5$

It has five unpaired electrons. So it is paramagnetic.

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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. What is PHBV? How is it useful to man?

A: **1) PHBV:** Poly β-hydroxy butyrate –co–β–hydroxy valerate .

2) This biogdegradable polymer is useful to man in the following ways

(i) manufacture of capsules (ii) packing of orthopaedic devices.

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9. What are artificial sweetening agents? Give example.

A: **1) Artificial Sweetening Agent:** These are low calorie sweetners used as sugar substitutes.

2) Ex: Saccharin, aspartame, Sucrolose etc.

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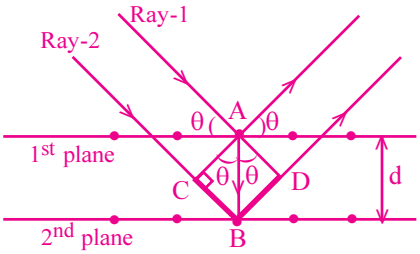
10. What is the difference between a soap and a synthetic detergent?

A: 1)Soap is used in soft water only.

2) But detergent can be used in both soft and hard water.

SECTION-B

11. **Derive Bragg's equation.**



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

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

$\therefore$ from (ii) & (iii), CB+BD = dsinθ + dsinθ = 2dsinθ

$\therefore$ from (i), **nλ = 2dsinθ**

This is known as Bragg's equation.

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12. Vapour pressure of water at 293K is 17.535mm Hg. Calculate the vapour pressure of the solution at 293K when 25g of glucose is dissolved in 450g of water.

A: P^o=17.535 mm

Wt. of glucose = a= 25 g

Molar mass of glucose = M=180 $g.mol^{-1}$

Wt. of water = b = 450 g

Molar mass of water = W = 18 $g.mol^{-1}$

Applying the relation, $\frac{P^o - P^s}{P^o} = X_{solute}$

$$\frac{P^o - P^s}{P^o} = \frac{a}{M} \times \frac{W}{b} \Rightarrow \frac{17.535 - P^s}{17.535} = \frac{25}{180} \times \frac{18}{450} \Rightarrow 1 - \frac{P^s}{17.535} = \frac{1}{180} \Rightarrow \frac{179}{180} = \frac{P^s}{17.535}$$

P^s = 17.44 mm Hg

13. What is catalysis? How is catalysis classified? Give two examples for each type of catalysis.

A: **1) Catalysis:** It is the process of speeding up of reaction by adding catalyst .

It is classified into two types.

2) Homogeneous catalysis: It is the catalytic process in which the reactants and the catalyst are in the same phase.

Ex 1: $2SO_2(g) + O_2(g) \xrightarrow{NO(g)} 2SO_3(g)$

Ex 2: $CH_3COOCH_3\ (l) + H_2O\ (l) \xrightarrow{H^+} CH_3COOH(aq) + CH_3OH(aq)$

3) Heterogeneous catalysis: It is the catalytic process in which the reactants and the catalyst are in different phases.

Ex 1: $2SO_{2(g)} + O_{2(g)} \xrightarrow{Pt(s)} 2SO_{3(g)}$

Ex 2: $N_{2(g)} + 3H_{2(g)} \xrightarrow{Fe} 2NH_{3(g)}$

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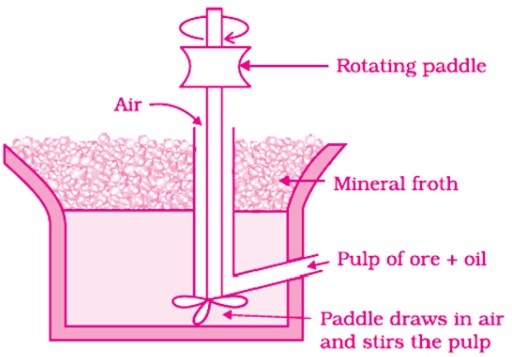
14. Explain the purification of sulphide ore by froth floatation method.

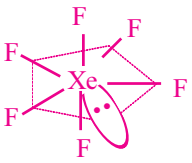
A: **Froth Floatation method:**

1) This method is used for **removing gangue from sulphide ores.**
2) First a **suspension of the powdered ore** is made with water.
3) To this suspension, froth collectors(pine oil) and stabilizers(cresols) are added.
4) Then **'ore is wetted by oil'** and **'gangue is wetted by water'**.
5) A rotating paddle is used to agitate the suspension and air is blown into it.
6) The mixture agitated and air is blown into it.
7) As a result, froth is formed which carries the mineral particles.
8) The froth is light and is skimmed off.
9) The sulphide ore particles are then obtained from the froth.



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

A: a) Structure of XeF_6:



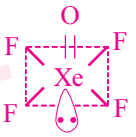
i) In XeF_6, the central atom Xe undergoes sp^3d^3 hybridisation and forms seven sp^3d^3 hybrid orbitals.

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°.**

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16. 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-$[Co(NH_3)_6]Cl_3$:

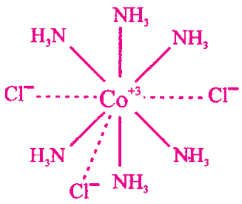
i) Here, primary valency of Co is 3.

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.



$[Co(NH_3)_6]Cl_3$

17. What are hormones? Give an example for each of the following:

a) Steroid hormones b) Polypeptide hormones c) Amino acid derivatives

A: 1) Hormones : These are the molecules which act as intracellular messengers . They transfer biological information from one group of cells to distant tissues (or) target organs. These are produced by Endocrine glands. They are directly released into blood.

2) On the basis of their chemical nature, hormones are classified into three types.

i) Steroid hormones. Ex: Estrogens, androgens.

ii) Protein hormones. Ex: Insulin, endorphins

iii) Amino acid derivatives. Ex: Thyroxine, epinephrine, norepinephrine

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

A: (a) Ambident nucleophiles: These are the nucleophiles with two donor atoms.

Ex: Cyanide ion, Nitrite ion

b) Enantiomers: These are a 'pair of stereo isomers' which are mirror images to each other. These are 'non-super imposable' compounds.

Ex: d-Lactic acid & l-Lactic acid

SECTION-C

19. a) State and explain Kohlrausch's law of independent migration of ions.

b) What is 'molecularity' of a reaction? How is it different from the 'order' of a reaction? Name one bimolecular and one trimolecular gaseous reactions.

A: 1) Kohlrausch law: The limiting molar conductivity (Λ_m^0) of an electrolyte is equal to the sum of the limiting molar conductivities of cations (λ_+^0) and anions (λ_-^0) of the electrolyte, at infinite dilution.

2) Formula: $\Lambda_m^0 = \lambda_+^0 + \lambda_-^0$

3) Ex: For the electrolyte NaC*l*, we have $\Lambda^0_{(NaCl)} = \lambda^0_{Na^+} + \lambda^0_{Cl^-}$

4) Applications: Kohlrausch's law is used to calculate the following

(i) Limiting molar conductivities (Λ^0) of weak electrolytes.

(ii) Degree of dissociation (α) of weak electrolytes $\alpha = \frac{\Lambda_m}{\Lambda_m^o}$

(iii) Dissociation constant (K) of weak electrolytes $K = \frac{C\alpha^2}{1-\alpha}$

1) Molecularity: The 'number of atoms, ions or molecules' participating in the 'rate determining step' of a chemical reaction is called molecularity of that reaction.

2) Order of a reaction: The 'sum of powers of concentration terms' of the reactants in the 'rate equation' is called order of reaction.

3) Differences between Molecularity and Order :

Molecularity	Order
i) It is determined **theoretically**.	i) It is determined **experimentally**.
ii) It can have **integral values** only.	ii) It can have **fractional values** also.
iii) It can be unimolecular,bimolecular....	iii) It can be zero order, first order....
iv) It is applicable only to **elementary reactions**.	iv) It is applicable to **elementary and complex reactions.**

4) Bimolecular reaction: Dissociation of hydrogen iodide into H_2 and I_2 .

$2HI \rightarrow H_2 + I_2$

5) Trimolecular reaction: Formation of NO_2 from NO and O_2

$2NO + O_2 \rightarrow 2NO_2$

20. a) How does ozone react with the following :

(a) Pbs (b) KI (c) Hg (d) Ag

b) Write balanced equations for the following

a) NaCl is heated with conc. H_2SO_4 in the presence of MnO_2.

b) Chlorine is passed into a solution of NaI in water.

Sol: (a) Reactions of Ozone:

(a) **Ozone** oxidises black leadsulphide to **white leadsulphate.**

$$4O_3 + PbS \longrightarrow PbSO_4 + 4O_2$$

(b) **Ozone** oxidises moist Potassium Iodide to **Iodine.**

$$O_3 + 2KI + H_2O \longrightarrow 2KOH + I_2 + O_2$$

(c) **Ozone** oxidises Mercury to **Mercurous oxide.**

(This reaction is called as **'Tailing of Mercury'**.)

$$O_3 + 2Hg \longrightarrow Hg_2O + O_2$$

(d) **Reaction with Ag :** Ozone oxidises silver to **silver oxide.**

$$2Ag + O_3 \longrightarrow Ag_2O + O_2$$

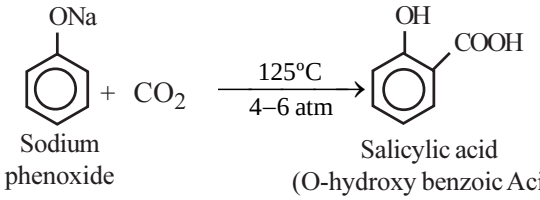
21. Describe the following :

a) Kolbe reaction **b) Aldol condensation**

c) Carbyl amine reaction **d) Williamson Synthesis**

A: **(a)Kolbe Reaction:** Sodium salt of phenol is heated with carbon dioxide at 125°C and under 4-6 atm pressure to form Salicyclic acid.

Ex:



(b) Aldol condensation Reaction: Aldehydes and ketones having atleast one α-hydrogen 'undergo condensation' in the presence of dilute NaOH to form Aldol.

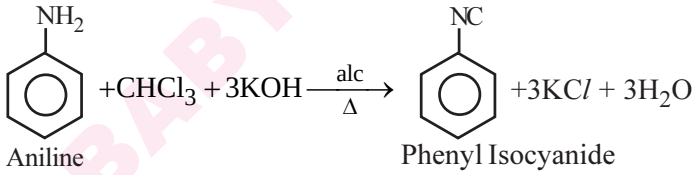
Ex: $2CH_3CHO \xrightleftharpoons{\text{dil NaOH}} CH_3-\underset{\underset{OH}{|}}{CH}-CH_2-CHO$

Acetaldehyde

3-hydroxy butanal(aldol)

(c) Carbylamine reaction: Aniline is heated with ethanolic KOH and chloroform to give **Phenyl isocyanide.**

Ex:



(d) Williamson's synthesis: Alkyl halides react with **sodium alkoxide** to give **ether**.

Ex: Methyl iodide reacts with **sodium Ethoxide** to give **methoxyethane.**

$$CH_3I + C_2H_5ONa \longrightarrow CH_3-O-C_2H_5 + NaI$$