Previous IPE

SOLVED PAPERS

MARCH-2024 (TS)

PREVIOUS PAPERS

IPE: MARCH-2024(TS)

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

SECTION-A

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

1. Define molarity.
2. State Faraday's first law of electrolysis.
3. What is the role of cryolite in the metallurgy of aluminium?
4. Write any two uses of argon.
5. Write 'spin only' formula to calculate the magnetic moment of transition metal ions.
6. What is PHBV? How is it useful to man?
7. What are non-narcotic analgesics? Give example.
8. What are tranquilizers? Give example.
9. What is Ziegler-Natta catalyst?
10. Write equations for carbylamine reaction of any one aliphatic amine.

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 are lyophilic and lyophobic sols? Compare the two terms in terms of stability and reversibility.
14. Explain the extraction of zinc from zinc blende.
15. What is a tailing of mercury? How is it removed?
    How is chlorine manufactured by Deacon's method?
16. Using IUPAC norms write the formulas for the following :
    (i) Tetrahydroxozincate (II) ion (ii) Hexaaminecobalt (III) sulphate
    (iii) Potassium tetrachloropalladate(II) (iv) Potassium trioxalatochromate(III)
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. Give a detailed account of the collision theory of reaction rates of bimolecular gaseous reactions.
20. How is ammonia manufactured by Haber's process? Explain the reactions of ammonia with
    (a) $ZnSO_{4(aq)}$ (b) $CuSO_{4(aq)}$ (c) $AgCl_{(s)}$
21. With a suitable example write equations for the followings:
    i) Kolbe's reaction ii) Williamson ether synthesis
    iii) Cannizzaro reaction iv) Decarboxylation

IPE TS MARCH-2024

SOLUTIONS

SECTION-A

1. Define molarity.

A: Molarity (M): It is the number of moles of the solute dissolved in one litre of the solution.

Molarity, $M = \frac{w}{GMW} \times \frac{1000}{V(mL)}$

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2. 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 electroly

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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. Write any two uses of argon. **[TS 24]**

A: Uses of Argon:

i) Argon is used mainly to provide an inert atmosphere in high temperature metallurgical processes and for filling electric bulbs.

ii) It is used in the laboratory for handling air-sensitive substances.

iii) Argon is used in radio valves and rectifiers.

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5. Write 'spin only' formula to calculate the magnetic moment of transition metal ions.

A: 'Spin only' formula is $\mu = \sqrt{n(n+2)}$ BM

BM = Bohr magneton.

n = No. of unpaired electrons

6. 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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7. What are non-narcotic analgesics? Give example.

A: **Non-narcotic analgesics:** These are the drugs used to reduce pain without acting on central nervous system.

Ex: Aspirin, Ibuprofen.

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8. What are tranquilizers? Give example. **[TS 16,24]**

A: **Tranquilizers:** Tranquilizers are drugs mainly used in the management or treatment of psychoses and neuroses.

Ex: Luminal, Seconal, Barbituric acid.

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9. What is Ziegler-Natta catalyst?

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

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

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

SECTION-B

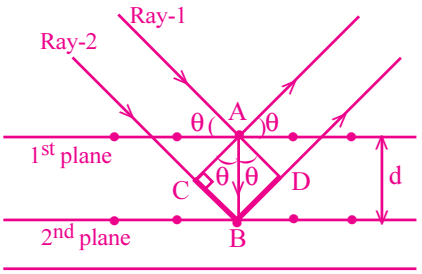
11. Derive Bragg's equation.

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).**

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

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

∴ from (ii) & (iii), CB+BD = dsinθ + dsinθ = 2dsinθ

∴ 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. [TS 24][AP 19,23]

A: P^o = 17.535 mm, Wt. of glucose = w_s = 25 g

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

Wt. of water = w_o = 450 g

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

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

$$\frac{P^o - P^s}{P^o} = \frac{w_s}{M_s} \times \frac{M_o}{w_o} \Rightarrow \frac{17.535 - P^s}{17.535} = \frac{25}{180} \times \frac{18}{450}$$

$$\Rightarrow 1 - \frac{P^s}{17.535} = \frac{1}{180} \Rightarrow \frac{179}{180} = \frac{P^s}{17.535}$$

P^s = 17.44 mm Hg

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

A: Lyophilic sols (solvent - loving colloidal solutions): The colloidal solutions in which much affinity exists between dispersed phase and dispersion medium are known as lyophilic sols.

Ex: Starch sol, Gelatin, High molecular weight organic compounds in water.

Lyophobic sols (solvent-hating colloidal solutions): The colloidal solutions in which not much affinity exists between dispersed phase and dispersion medium are known as lyophobic sols.

Ex: Smoke, Gold Sol, Metal hydroxides etc.,

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14. Explain the extraction of zinc from zinc blende.

A: Extraction of zinc from zinc blende(ZnS):

1) **Concentration:** First, the bauxite ore is powdered and then concentrated by froth floatation process.

Then, concentrated ore is formed.

2) **Roasting:** The concentrated ore is roasted in the presence of excess of air. Then, zinc oxide is formed.

$$\underset{\text{Zinc blende}}{2ZnS} + 3O_2 \xrightarrow{1200K} \underset{\text{Zinc oxide}}{2ZnO} + 2SO_2$$

3) **Heating at 1673K:** Zinc oxide is mixed with powdered coke and heated to 1673K in a fire clay retort.

Then, zinc oxide is reduced to zinc metal.

$$ZnO + C \xrightarrow{1673K} Zn + CO$$

4) **Electrolytic refining:** Zinc metal on electrolyis gives pure zinc metal on the cathode.

EXTRACTION OF ZINC

Zinc blende ZnS

↓ Concentration by froth floatation

Concentrated ore

↓ Roasting in air

ZnO

↓ Heating at 1673 K

Zinc

↓ Electrolysis

Pure Zinc Metal

☞ **No need to draw this in Exam**

15. (a) What is tailing of mercury? How is it removed?

A: **1) Tailing of mercury:** When ozone gas is passed through liquid mercury, the mercury loses its meniscus nature and sticks to the glass surface.This is called tailing of mercury.

2) It is removed by 'shaking with water'.

3) **Reaction:** $O_3 + 2Hg \rightarrow Hg_2O + O_2$

(b) How is chlorine manufactured by Deacon's method?

A: **1) Deacon's process:** **Hydrogen chloride gas** reacts with atmospheric oxygen in the presence of $CuCl_2$ catalyst at 723K to form **Chlorine**.

2) $4HCl + O_2 \xrightarrow[723K]{CuCl_2} 2Cl_2 + 2H_2O$

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16. Using IUPAC norms write the formulas for the following :

(i) Tetrahydroxozincate (II) ion **(ii) Hexaamminecobalt (III) sulphate**

(iii) Potassium tetrachloropalladate(II) **(iv) Potassium tri(oxalato)chromate(III)**

A: i) $[Zn(OH)_4]^{-2}$ ii) $[Co(NH_3)_6]_2(SO_4)_3$

iii) $K_2[PdCl_4]$ iv) $K_3[Cr(C_2O_4)_3]$

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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

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. Give a detailed account of Collision theory 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 $Z = \pi\sigma_{AB}^2\sqrt{\frac{8KT}{\pi\mu}}n_A n_B$, σ_{AB} = Collision diameter, μ = reduced mass

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

20. How is ammonia manufactured by Haber's process?

A: Manufacture of Ammonia by Haber's process:

1) **Formation of Ammonia:** On a large scale, Ammonia is manufactured by the direct union of N_2 and H_2 in 1:3 ratio.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g);\ \Delta H = -92.3kJ$$

2) The above reaction is reversible, exothermic and it leads to a **decrease in volume**.

3) So, **Le-Chatelier principle** is applicable.

4) **Effect of Temperature:** As the reaction is exothermic, low temperature is favoured.

5) **Effect of Pressure:** As the reaction leads to decrease in volume, high pressure is favoured.

6) **Optimum Conditions:**

a) Low Temperature: **725-775 K**

b) High Pressure: **200-300 atm**

c) High concentrations: **Pure N_2 and H_2** .

7) Catalyst: **Finely divided iron;** Promoter: **Mo**

8) **Process:**

i) Mixture of N_2 and H_2 is passed through the compressor at 300atm pressure

ii) It is then sent to catalyst chamber at 500ºC in the presence of iron catalyst.

iii) Liquified ammonia is collected at the receiver and unreacted N_2 and H_2 is sent to pump.

(b) How does ammonia react with (i) $ZnSO_{4(aq)}$ (ii) $CuSO_{4(aq)}$ (iii) $AgCl_{(s)}$

A: Reactions of Ammonia:

i) Ammonia solution on reaction with Zinc sulphate gives **white precipitate of Zinchydroxide**

$$ZnSO_4 + 2NH_4OH \longrightarrow Zn(OH)_2 + (NH_4)_2SO_4 \text{(Ammonium sulphate)}$$

ii) Ammonia solution on reaction with Copper sulphate gives **deep blue complex compound**

$$CuSO_{4(aq)} + 4NH_3 \rightleftharpoons [Cu(NH_3)_4]SO_{4(aq)} \text{ (Tetraaminecopper(II)Sulphate)}$$

iii) Ammonia solution on reaction with Silverchloride gives a **complex compound**.

$$\underset{\text{white ppt}}{AgCl} + \underset{(aq)}{2NH_3} \longrightarrow \underset{\text{colourless}}{[Ag(NH_3)_2]}\ \underset{(aq)}{Cl}$$

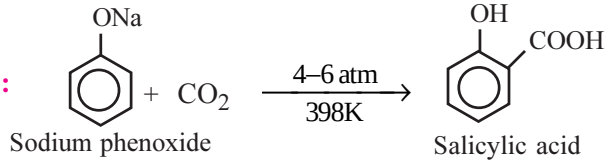
21. Describe the following :

i) Kolbe's reaction **ii) Williamson ether synthesis**

iii) Cannizzaro reaction **iv) Decarboxylation**

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

Ex:



Sodium phenoxide — Salicylic acid

(ii) Williamson's synthesis:

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

Ex: $C_2H_5I + C_2H_5ONa \xrightarrow{\Delta} C_2H_5-O-C_2H_5 + NaI$

Ethyl Iodide — Sodium Ethoxide — Diethyl Ether

(iii) Cannizzaro Reaction: Formaldehyde in the presence of conc. NaOH undergo self oxidation and reduction to form Methanol and Sodium Formate.

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

Formaldehyde — Methanol — Sodium Formate

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

Ex: $CH_3COONa + NaOH \xrightarrow[\Delta]{CaO} CH_4 + Na_2CO_3$

Sodium Ethanoate — Soda lime — Methane