Previous IPE

SOLVED PAPERS

MARCH -2020 (TS)

PREVIOUS PAPERS

IPE: MARCH-2020(TS)

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

SECTION-A

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

1. State Raoult's law.
2. State Faraday's law.
3. Write any two ores with formulae of the following metals: a. Aluminium b. Iron
4. What is lanthanoid contraction?
5. What are polymers? Give example.
6. What is Vulcanization of rubber?
7. What are antacids? Give example.
8. What is tincture of Iodine? What is its use?
9. What are Enantiomers?
10. What are ambident nucleophiles?

SECTION-B

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

11. Derive Bragg's equation.
12. Define molarity. Calculate the molarity of a solution containing 5 g of NaOH in 450 ml solution.
13. What are different types of adsorption? Give any four differences between characteristics of these different types.
14. Explain the purification of sulphide ore by froth floatation method.
15. Explain the terms (i) Ligand (ii) Coordination number (iii) Coordination entity (iv) Central metal atom/ ion
16. How are XeF_2, XeF_4 prepared? Give their structure.
17. What are hormones? Give one example for each.
    (i) steroid hormones (ii) Poly peptide hormones and (iii) amino acid derivatives.
18. Write the IUPAC Names of the following compounds.
    (a) $NH_2–CH_2–CH=CH_2$ (b) $C_2H_5 - \underset{\underset{C_2H_5}{|}}{N} - CH_2 - CH_2 - CH_2 - CH_3$

    (c) (d)

SECTION-C

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

19. (i) What are galvanic cells? Explain the working of a galvanic cell with a neat sketch taking Daniel cell as example.
    (ii) What are fuel cells? How are they different from galvanic cells? Give the construction of H_2, O_2, fuel cell.
20. (i) How is ammonia manufactured by Haber's process?
    (ii) How is ozone prepared from oxygen? Explain its reaction with
    (a) C_2H_4 (b) KI (c) Hg (d) PbS
21. Explain the following reactions with equations:
    (a) Hell-Volhard -Zelinsky reaction (HVZ) (ii) Decarboxylation
    (iii) Aldol condensation (iv) Gatterman-Koch reaction

IPE TS MARCH-2020
SOLUTIONS

SECTION-A

1. **State Raoult's law.**

A: Raoult's law: The **R**elative **L**owering of **V**apour **P**ressure of a dilute solution containing 'non-volatile solute' is equal to 'mole fraction(X)of the solute'.

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2. State Faraday's law.

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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3. Write any two ores with formulae of the following metals:

a. Aluminium b. Iron

A: (a)Aluminium: Bauxite($Al_2O_3.2H_2O$) **(b)Iron:** Haematite(Fe_2O_3),Siderite($FeCO_3$)

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4. What is lanthanide contraction?

A: Lanthanide Contraction: It is the steady decrease in the atomic and ionic radii with increase in atomic numbers from Lanthanum to Lutetium.

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5. What are polymers? Give example.

A: Polymer: Polymer is a high molecular mass macromolecule consisting of repeating structural joned by covalent bonds units derived from monomers.

Ex: Polythene, Nylon 6,6etc.

6. 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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7. What are antacids? Give example.

A: **1) Antacids:** These are the drugs used 'to remove the excess acid' in the stomach and maintain the normal P^H level .

2) Ex : Omeprazole, Lansoprazole.

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8. What is tincture of Iodine? What is its use?

A: 2-3% solution of iodine in alcohol and water is called tincture of iodine. It is a powerful antiseptic. It is applied on wounds.

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9. What are Enantiomers?

A: **1) Enantiomers:** These are a 'pair of stereo isomers' which are mirror images to each other. These are 'non-super imposable' compounds.

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

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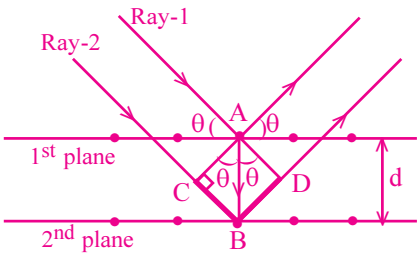
10. What are ambident nucleophiles?

A: **1) Ambident nucleophiles:** These are the nucleophiles with two donor atoms.

2) Ex: Cyanide ion, Nitrite ion

SECTION-B

1. 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=dsinθ.....(ii)

In ΔABD, $\sin\theta = \frac{BD}{AB} = \frac{BD}{d} \Rightarrow$ BD=dsinθ.....(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. Define Molarity.
Calculate the molarity of a solution containing 5g of NaOH in 450ml of solution.

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

1) Given weight of NaOH solute w = 5g

2)GMW of NaOH = 23 + 16 + 1 = 40

3)Given Volume of the solution V = 450 mL

4) Molarity $M = \frac{w}{GMW} \times \frac{1000}{V(mL)} = \frac{\cancel{5}}{\cancel{40}} \times \frac{\cancel{1000}}{\cancel{450}} = \frac{5}{18} = 0.278\ M$

13. Define adsorption.

Discuss the differences between Physical adsorption and Chemical adsorption.

A: **I) Adsorption:** It is the accumulation of gas or liquid molecules on solid or liquid surface.

Ex: Paints on various surfaces, Corrosion of metals, Adsorption of H_2 on charcoal.

II) Physical Adsorption Vs Chemical Adsorption:

Physical adsorption	Chemical adsorption
1) It is due to weak vander Waals forces.	1) It is due to strong chemical bonds.
2) It is reversible	2) It is irreversible
3) It occurs at low temperature	3) It occurs at high temperature
4) It decreases with rise in temperature.	4) It increases with rise in temperature.
5) Enthalpy of adsorption is low.	5) Enthalpy of adsorption is high.
Ex 1: Paints on various surfaces.	**Ex 1:** Corrosion of Metals.
Ex 2: Adsorption of H_2 on charcoal.	**Ex 2:** Adsorption of H_2 on Nickel

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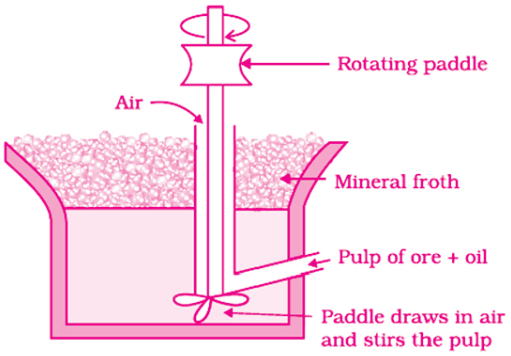
14. Explain the purification of sulphide ore by froth floatation method.

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 terms (i) Ligand (ii) Coordination number (iii) Coordination Entity (iv) Central metal atom/ ion

A: i) **Ligand:** The ions or molecules bound to the central atom / ion in the coordination entity by donating lone pair of electrons. are called ligands. These may be

a) simple ions such as Cl^-

b) small molecules such as H_2O.

c) large molecules such as $H_2N–CH_2–CH_2–NH_2$

d) macro molecules such as proteins.

On the basis of number of donor atoms available for coordination, the ligands can be classified as

A) **Unidentate:** One donor atom. **Ex:** $:NH_3$

B) **Bidentate:** Two donor atoms **Ex:** $\ddot{N}H_2 - \ddot{N}H_2$

C) **Polydentate**:more than two donor atoms. **Ex:** EDTA

ii) **Coordination number**: The coordination number (CN) of metal ion in a complex can be defined as the number of ligands or donor atoms to which the metal is directly bonded.

Ex: $[Pt\ Cl_6]^{-2}$, C.N of Pt = 6

$[Ni(NH_3)_4]^{+2}$, C.N of Ni = 4

iii) **Coordination entity:** A central metal atoms or ion bonded to a fixed number of molecules or ions (ligands) is known as coordination entity.

Ex: $[COCl_3(NH_3)_3]$, $[Ni(CO)_4]$

iv) **Central metal atom /ion:** The atom / ion to which a fixed number of ions/groups are bound in a definite geometrical arrangement is called central metal atom or ion.

Ex: $K_4[Fe(CN)_6] \rightarrow$ 'Fe' is central metal.

16. How are XeF_2, XeF_4 prepared? Give their structure.

A: I) Preparation :

1) Preparation of XeF_2:

A mixture of Xenon and Fluorine is heated in the molar ratio of 2:1 to form XeF_2.

$$Xe_{(g)} + F_{2(g)} \xrightarrow{673K,\ 1\ bar} XeF_{2(s)}$$

2) Preparation of XeF_4 :

A mixture of Xenon and Fluorine is heated in the molar ratio of 1:5 to form XeF_4 .

$$Xe_{(g)} + 2F_{2(g)} \xrightarrow{873K,\ 7\ bar} XeF_{4(s)}$$

3) Preparation of XeF_6 :

Xenon and fluorine (1:20 ratio) reacts at 573K, 60-70 bar gives XeF_6.

$$Xe_{(g)} + 3F_{2(g)} \xrightarrow{573K,\ 60-70\ bar} XeF_{6(s)}$$

II) Structures:

1) Structure of XeF_2:

i) In XeF_2, the central atom Xe undergoes sp^3d hybridisation and forms five sp^3d hybrid orbitals.

ii) It forms two σ bonds with two fluorine atoms

iii) It has two bond pairs and three lone pair.

iv) As per VSEPR theory, the shape of XeF_2 is linear.

2) Structure of XeF_4:

i) In XeF_4, the central atom Xe undergoes sp^3d^2 hybridisation and forms six sp^3d^2 hybrid orbitals.

ii) It forms four σ bonds with four fluorine atoms.

iii) It has four bond pair and two lone pairs.

iv) As per VSEPR theory, the shape of XeF_4 is square planar.

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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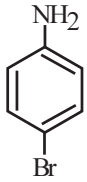
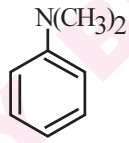
18. Write the IUPAC Names of the following compounds.

(a) $NH_2–CH_2–CH=CH_2$ **(b)** $C_2H_5-\underset{\underset{C_2H_5}{|}}{N}-CH_2-CH_2-CH_2-CH_3$

(c)



(d)



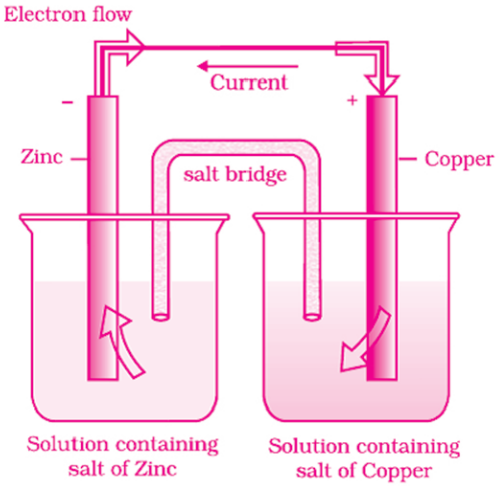
A: (a) Prop-2-en-1 amine (b) N,N - Diethyl 1- Butanamine

(c) 4-BromoAniline (d) N,N- Dimethyl Aniline

SECTION-C

19. (i) What are galvanic cells? Explain the working of a galvanic cell with a neat sketch taking Daniel cell as example.

A: A galvanic cell is a device which makes the use of a spontaneous redox reaction for the generation of electrical energy from chemical energy.



Construction and working: Daniel cell consists of two half cells i) anode half cell and ii) cathode half cell. The two half cells are connected by a salt bridge containing a saturated solution of KNO_3 in agar-agar gel. The anode half cell consists of zinc rod dipped in $ZnSO_4$ solution and the cathode half cell consists of a copper plate dipped in $CuSO_4$ solution.

When the two half cells are connected externally through a voltmeter, current flows out from the cell due to potential difference.

The reactions taking place are.

At anode : $Zn \rightarrow Zn^{+2} + 2e^-$ (oxidation)

At cathode: $Cu^{+2} + 2e^- \rightarrow Cu$ (reduction)

Net cell reaction: $Zn_{(s)} + Cu^{+2}_{(aq)} \rightarrow Zn^{+2}_{(aq)} + Cu_{(s)}$

(ii) What are fuel cells? How are they different from galvanic cells? Give the construction of H_2, O_2, fuel cell.

A fuel cell is a device that converts the energy from combustion of fuel into electrical energy. The fuel cell like any other electrochemical cell has two electrodes and an electrolyte. However, the fuel and the oxidizing agents are supplied continuously to the electrodes, at which they undergo reaction.

Oxidation of fuel occurs at the anode:

Fuel $\rightarrow$ oxidation product $+ ne^-$

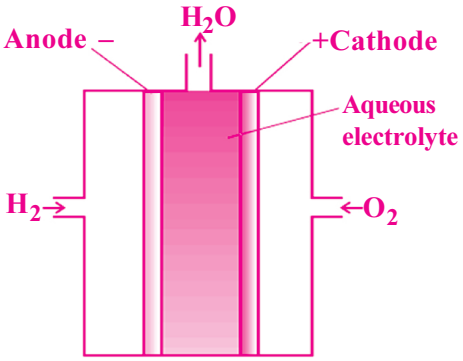
The oxidant gets reduced at the cathode:

Oxidation $+ ne^- \rightarrow$ Reduction product.

The fuel cell different from conventional galvanic cell with respect to following.

a. In a fuel cell, reactants are fed into the cell and products removed from the cell. These do not form integral part of cell as in a conventional cell.

b. Chemical energy is not stored in a fuel cell, rather conversion of chemical energy into electrical energy takes place.



H_2–O_2 fuel cell: This fuel cell consists of porous carbon electrodes suspended in concentrated NaOH solution.

Catalysts like finely divided platinum or palladium is incorporated into the electrodes for increasing the rate of electrode reactions.

H_2 and O_2 gases are bubbled at the surface of the electrodes.

The electrode reactions are

at cathode: $O_{2(g)} + 2H_2O + 4e^- \rightarrow 4OH^-_{aq}$

at anode: $2H_{2(g)} + 4OH^-_{aq} \rightarrow 4H_2O_{(Cl)} + 4e^-$

overall reaction: $2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(Cl)}$

20. (i) 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 500°C 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.

(ii) How is ozone prepared from oxygen? Explain its reaction with

(a) C_2H_4 (b) KI (c) Hg (d) PbS

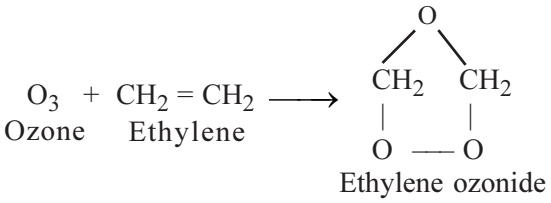
Sol: a) Preparation of Ozone:

Ozone is prepared when a slow dry stream of pure, cold oxygen is subjected to a **silent electrical discharge** in ozonizer.

$$3O_2 \rightarrow 2O_3;\quad \Delta H = +142\ kJ\ mol^{-1}.$$

(b) Reactions of Ozone:

i) Ozone reacts with Ethylene to give **Ethylene ozonide.**



Ethylene ozonide

ii) **Ozone** oxidises moist Potassium Iodide to **Iodine.**

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

iii) **Ozone** oxidises Mercury to **Mercurous oxide.**

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

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

iv) **Ozone** oxidises black leadsulphide to **white leadsulphate.**

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

21. Explain the following reactions with equations:

(a) Hell-Volhard -Zelinsky reaction (HVZ) (ii) Decarboxylation

(iii) Aldol condensation (iv) Gatterman-Koch reaction

A: **(i) H.V.Z Reaction:** Carboxylic acids halogenated at the α-position on treatment with chlorine (or) bromine in the presence of red phosphorus to form α-halo carboxylic acids.

Ex: $R-CH_2-COOH \xrightarrow[(ii)\ H_2O]{(i)\ x_2/Red phosphorus} R-\underset{\underset{X}{|}}{CH}-COOH$

where, X=C*l*, Br

α-hydrocarboxylic acid

(ii) Decarboxylation : Sodium Ethanoate is heated with **sodalime** to form **Methane.**

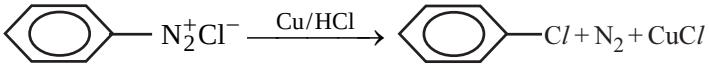
$$CH_3COONa + NaOH \xrightarrow[\Delta]{CaO} CH_4 + Na_2CO_3$$

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

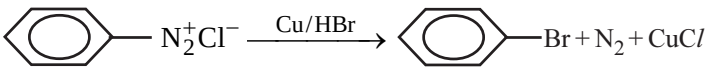
Ex: $\underset{\text{Acetaldehyde}}{2CH_3CHO} \xrightleftharpoons{\text{dil NaOH}} CH_3-\underset{\underset{OH}{|}}{CH}-CH_2-CHO$

3-hydroxy butanal(aldol)

(iv) Gattermann's reaction: Benzene diazonium chloride reacts with Cu/HC*l* (or) Cu/HBr to form chlorobenzene (or) bromobenzene .

Ex: 

Benzene diazonium Chloride — Chlorobenzene



Benzene diazonium Chloride — Bromo benzene