Previous IPE

SOLVED PAPERS

MARCH -2023 (TS)

PREVIOUS PAPERS

IPE: MARCH-2023(TS)

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

SECTION-A

I. Answer ALL questions : **10x2 =20**

1. What are isotonic solutions?
2. Explain the terms gangue and slag.
3. Calculate the 'spin only' magnetic moment of $Fe^{2+}_{(aq)}$ ion.
4. What are food preservatives? Give example.
5. NH_3 forms hydrogen bonds but PH_3 does not - why?
6. What is addition polymer? Give example.
7. What are antacids? Give example.
8. What is metallic corrosion? Give one example.
9. What is Ziegler-Natta catalyst?
10. Write the IUPAC names of the following compounds and classify into primary, secondary and tertiary amines. (i) $CH_3(CH_2)_2NH_2$ (ii) $(CH_3CH_2)_2NCH_3$.

SECTION-B

II. Answer any SIX of the following Questions. **6x4 =24**

11. Derive Bragg's equation.
12. Explain the terms (i) Ligand (ii) Coordination number
    (iii) Coordination entity (iv) Central metal atom/ ion
13. Give the sources of the following vitamins and the name the diseases causes by their deficiency
    (a) A (b) D (c) E and (d) K
14. A solution of glucose in water is labeled as 10% w/w. What would be the molarity of the solution?
15. Explain the formation of micelles with a neat sketch.
16. Explain the extraction of zinc from zinc blende.
17. Explain the structures of (a) XeF_6 and (b) $XeOF_4$
18. a) What are Enantiomers? b) What are ambident nucleophiles?

SECTION-C

III. Answer any two of the following Questions. **2x8 =16**

19. (i) State and explain Kohlrausch's law of independent migration of ions.
    (ii) 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. How is ozone prepared from oxygen? Explain its reaction with
    a) C_2H_4 b) KI c) Hg d) PbS
21. Describe the following:
    i) Acetylation ii) Cannizzaro reaction
    iii) Cross aldol condensation iv) Decarboxylation

BABY BULLET-Q

IPE TS MARCH-2023

SOLUTIONS

SECTION-A

1. What are isotonic solutions ?

A: **1) Isotonic solutions:** These are the solutions having the same osmotic pressure at a given temperature .

2) Ex: Blood is isotonic with saline .(0.9% w/v of NaCl)

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2. Explain the terms gangue and slag.

A: **Gangue:** The earthy and silicious impurities associated with the ores are called gangue.

Slag: A slag is an easily fusible material which is formed when gangue combines with the flux. For example, in the metallurgy of iron, CaO (flux) combines with silica gangue to form easily fusible calcium silicate ($CaSiO_3$) slag.

$CaCO_3 \rightarrow CaO + CO_2$. $\quad CaO + SiO_2 \rightarrow CaSiO_3$(slag)

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3. Calculate the 'spin only' magnetic moment of $Fe^{+2}_{(aq)}$ ion.

A: 1) Electronic configuration of $Fe^{+2} = [Ar]\ 3d^6 4s^0$

2) Number of unpaired electrons in it is n=4

3) 'Spin only' magnetic moment $\mu = \sqrt{n(n+2)} = \sqrt{4(4+2)} = \sqrt{24} = 4.9$ BM

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4. 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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5. NH_3 forms Hydrogen bonds but PH_3 does not. Why?

A: 1) Nitrogen atom has small size and high electronegativity when compared to Phosporus atom.

2) So, NH_3 forms Hydrogen bonds but not PH_3 .

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6. What is addition polymer? Give example.

A: Polymers formed by the repeated addition of monomer molecules possessing double or triple bonds are called addition polymers.

Ex: Polyethene.

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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 metallic corrosion? Give one example.

A: 1) **Metallic corrosion:** It is the gradual destruction of metals by the reaction with moisture in atmosphere.It forms undesirable compounds like oxides, sulphides on the surface of metals.

2) Ex: Rusting of Iron.

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9. 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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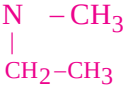
10. Write the IUPAC names of the following compounds and classify into primary, secondary and tertiary amines. (i) $CH_3(CH_2)_2NH_2$ (ii) $(CH_3CH_2)_2NCH_3$.

A: (ii) $CH_3–CH_2–CH_2–NH_2$ 1-Propanamine Primary amine

(iii)  N-ethyl-N-Methyl-ethanamine Tertiary amine

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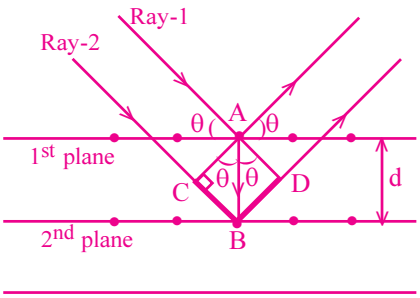
SECTION-B

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=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.

BABY BULLET-Q

12. 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.

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13. Name the sources and diseases caused by the deficiency of the vitamins
(1) A (2) D (3) E (4) K

A:

Sl.No.	Vitamin	Sources	Deficiency diseases
1.	Vitamin A	Fish liver oil, carrots, butter and milk	Night blindness, Xerophthalmia
2.	Vitamin D	Sunlight, fish and egg yolk	Rickets (bone deformities in children) and osteo-malacia (soft bones and joint pains in adults)
3.	Vitamin E	Vegetable oils like Sunflower oil, wheat germ oil.	Increased fragility of RBC's and muscular weakness.
4.	Vitamin K	Green leafy vegetables	Increased blood clotting time.

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14. A solution of sucrose in water is labeled as 20% w/w. What would be the mole fraction of each component in the solution ?

A: 20% w/w sucrose solution means 20g of sucrose present in 100g of solution.

Mass of sucrose = 20g

Molar mass of sucrose = 342 g mol^{-1}.

Mass of solution = 100g

Mass of solvents = 100–20 = 80g

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

No. of moles of sucrose, $n_A = \frac{20}{342} = 0.0585$

No. of moles of water, $n_B = \frac{80}{18} = 4.4445$

Mole fraction of sucrose, $\chi_A = \frac{n_A}{n_A + n_B} = \frac{0.0585}{0.0585 + 4.4445} = \frac{0.0585}{4.503} = 0.013$

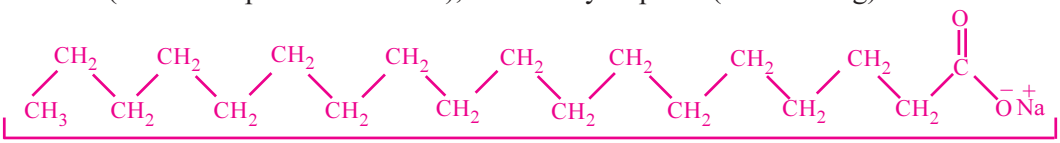
Mole fraction of water, $\chi_B = 1 - \chi_A = 1 - 0.013 = 0.987$

BABY BULLET-Q

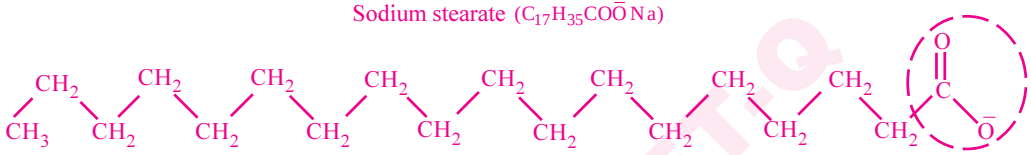
15. Explain the formation of micelles with a neat sketch. **[TS 23]**

A: Mechanism of micelle formation:

Micelles formation is explained by taking soap solution. Soap is sodium or potassium salt of higher fatty acid and may be represented as $RCOO^-Na$(eg. sodium stearate $CH_3(CH_2)_{16}COO^-Na^+$, which is a major component of many bar soaps). When dissolved in water, it dissociates into $RCOO^-$ and Na^+ ions. The $RCOO^-$ ions, however, consists of two parts, a long hydrocarbon chain R (also called non-polar 'tail') which is hydrophobic (water repelling), and a polar group COO^- (also called polar-ionic 'head'), which is hydrophilic (water loving).



Sodium stearate ($C_{17}H_{35}COO^-Na^+$)



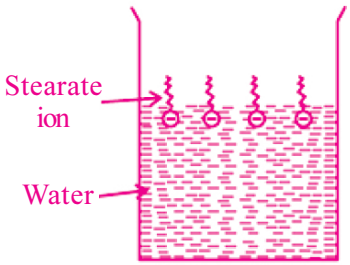
Hydrophobic tail
Stearate ion

Hydrophillic
head

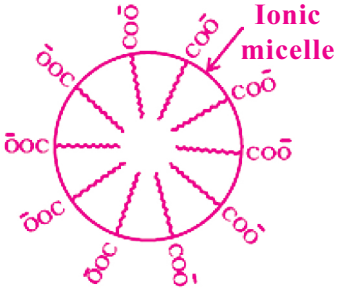
Hydrophillic head

Hydrophobic tail

The $RCOO^-$ ions are, therefore, present on the surface with their COO^- groups in water and the hydrocarbon chains(R) staying away from it and remain at the surface. But at critical micelle concentration, the COO^- ions are pulled into the bulk of the solution and are aggregated to form a spherical shape with their hydrocarbon chains pointing towards the centre of the sphere with COO^- part remaining outward on the surface of the sphere. The aggregate thus formed is known as 'ionic micelle'. These micelles may contain as many as 100 simple molecules.



Arrangement of stearate ions on the surface of water at low concentrations of soap



Arrangement of stearate ions inside the bulk of water (ionic micelle) at critical miscelle concentrations of soap.

Similarly, in case of detergents for example, sodium laurylsulphate, $CH_3(CH_2)_{11}SO_3^-Na^+$, the polar group is $-SO_3^-$ along with the long hydrocarbon chain. Hence, the mechanism of micelle formation here also is same as that of soaps.

BABY BULLETIQ

16. 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**

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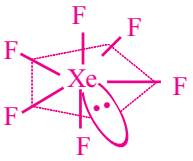
17. Explain the structures of (a) XeF_6 and (b) $XeOF_4$

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

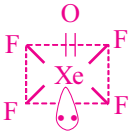
iii) It has six bond pairs and one lone pair.

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°.**

BABY BULLET-Q

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

BABY BULLET-Q

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

$2NO + O_2 \rightarrow 2NO_2$

BABY BULLET-Q

20.(a) How is Ozone prepared?

(b) How does it react with (i) C_2H_4 (ii) KI (iii) Hg (iv) PbS

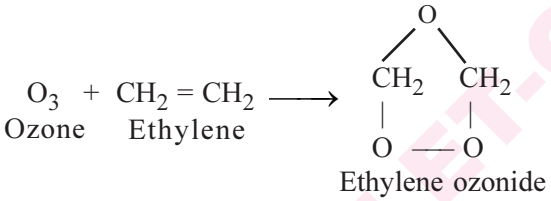
A: (a) Preparation of Ozone:

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

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

(b) Reactions of Ozone:

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

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

RAJY BULLET-Q

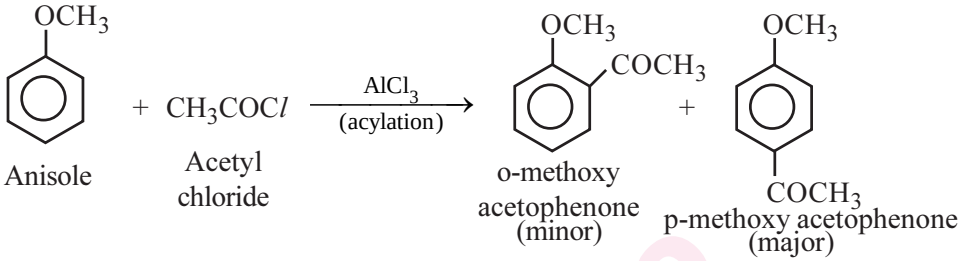
21. Describe the following:

i) Acetylation **ii) Cannizzaro reaction**

iii) Cross aldol condensation **iv) Decarboxylation**

A: i) Friedel Crafts Acylation: Anisole reacts with acetylchloride in the presence of anhydrous $AlCl_3$, to form a mixture of o-methoxy acetophenone and p-methoxyacetophenone.

Ex:



Anisole — Acetyl chloride — o-methoxy acetophenone (minor) + p-methoxy acetophenone (major)

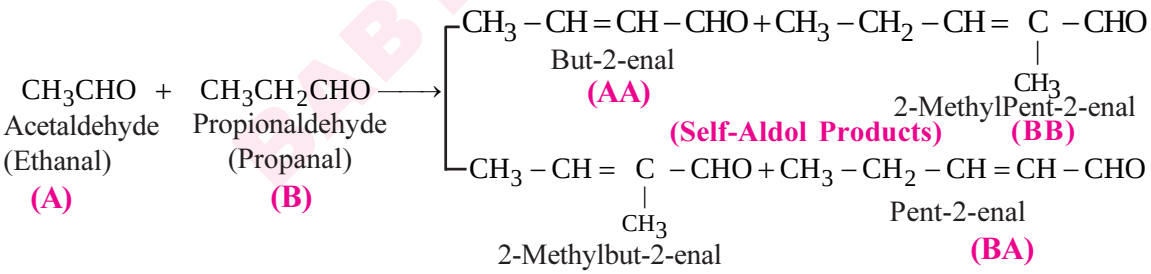
ii) Cannizzaro Reaction: Aldehydes without having 'α' hydrogen in the presence of conc. NaOH undergo self oxidation and reduction to form a mixture of alcohol and salt of acid.

Ex:

Formaldehyde — Methanol Sodium formate

iii) Cross Aldol Condensation: The 'condensation of two different carbonyl compounds' (one must have an α-hydrogen) in the presence of alkali is called cross aldol condensation.

Condensation of two different halides in the presence of alkali gives four products.



Acetaldehyde (Ethanal) **(A)** + Propionaldehyde (Propanal) **(B)**

But-2-enal **(AA)**

2-MethylPent-2-enal **(BB)**

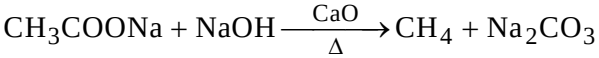
(Self-Aldol Products)

2-Methylbut-2-enal **(AB)**

Pent-2-enal **(BA)**

(Cross Aldol Products)

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



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