Class : 12

Register Number

COMMON HALF YEARLY EXAMINATION-2024-25

Time Allowed : 3.00 Hours] **CHEMISTRY** **[Max. Marks : 70**

PART – I

I. Choose the correct answer. **15x1=15**

1. Wolframite Ore is separated from Tinstone by the process of
   a) Smelting b) Calcination
   c) Roasting d) Electromagnetic Separation
2. The Geometry at which Carbon atom in diamond are bonded to each other is
   a) Tetrahedral b) Hexagonal c) Octahedral d) None of these
3. Most easily liquefiable gas is
   a) Ar b) Ne c) He d) Kr
4. **Assertion** : Ce^{4+} is used as an Oxidising agent in Volumetric Analysis.
   Reason : Ce^{4+} has the tendency of attaining +3 Oxidation states.
   a) Both assertion and reason are true and reason is the correct explanation of assertion.
   b) Both assertion and Reason are true but reason is not the correct explanation of assertion
   c) Assertion is True but reason is False d) Both assertion and reason are False.
5. Which among the following is a coloured complex due to d - d transition
   a) $[Zn(CN_4)]^{2-}$ b) $[Sc(H_2O)_6]^{3+}$ c) $[Ti(H_2O)_6]^{3+}$ d) All the above
6. Potassium has a bcc structure with nearest neighbour distance 4.52 Å, its atomic weight is 39, its density will be
   a) 915 kg m^{-3} b) 2142 Kg m^{-3} c) 452 Kg m^{-3} d) 390 Kg m^{-3}
7. After 2 hours, a radioactive substance becomes (1/16) th of original amount. Then the half life is
   a) 60 minutes b) 120 minutes c) 30 minutes d) 15 minutes
8. The P^H of an aqueous solution is zero. The solution is
   a) Slightly acidic b) strongly acidic c) neutral d) basic
9. **Among the following cells**
   I. Lalanche cell **II.** Nickel - Cadmium cell
   III. Lead storage battery **IV.** Mercury cell
   Primary cells are
   a) I and IV b) I and III c) III and IV d) II and III
10. Colloid used as eye lotion is
    a) Milk of Magnesia b) Penicillin c) Colloidal gold d) Argyol
11. Which of the following compounds on reaction with Methyl Magnesium Bromide will give tertiary alcohol
    a) Benzaldehyde b) Propanoic acid c) Methyl propanoate d) Acetaldehyde
12. Which one of the following reduces tollens reagent
    a) Formic Acid b) Acetic Acid c) Benzophenone d) None of these
13. Secondary Nitroalkanes react with nitrous acid to form
    a) Red Solution b) Blue Solution c) Green solution d) Yellow solution
14. Complete hydrolysis of Cellulose gives
    a) L - Glucose b) D- Fructose c) D - Ribose d) D - Glucose
15. Haloperidol is alan ----------
    a) Antacid b) Analgesic c) Tranquilizer d) Antibiotic

PART - II

II. Answer any six questions of the following. Question No. 24 is compulsory. **6x2=12**

16. Give the basic requirement for Vapour Phase refining?
17. Give the uses of Silicons.

18. What is ionisation isomerism? Give an example?
19. Define Impurity Defects
20. Write the expression for the Solubility product of $Hgcl_2$
21. What is the difference between Homogenous and Hetrogenous Catalysis?
22. Write a note on Clemmensen Reduction?
23. Why Carbohydrates are Generally optically active?
24. $C_6H_5NO_2 \xrightarrow{Fe/HCl} (A) \xrightarrow[273K]{NaNO_2/HCl} (B)$

    Identify A and B

PART - III

III. Answer any six questions of the following. Question No. 33 is compulsory. **6x3=18**

25. How is Potash Alum Prepared?
26. Write a note on Chromyl chloride Test.
27. What are the Limitations of VB theory?
28. Write the Difference between rate and rate constant.
29. Write the Mechanism of Aldol condensation Reaction.
30. Give any Three difference between DNA and RNA.
31. Write a note on Vulcanization of Rubber.
32. Explain Ultrafiltration.
33. Is it possible to store copper Sulphate in an iron vessel for a long time?

    Given : $E^o_{cu2+/cu} = 0.34V$ and $E^o_{Fe2+/Fe} = -0.44V$

PART - IV

IV. Answer all the questions. **5x5=25**

34. (a) (i) Explain the Electrometallurgy of Aluminium. **(5)**

    (OR)

    (b) i) Why Fluorine is more reactive than other Halogens. **(2)**

    ii) Give two equations to illustrate the Chemical behaviour of Phosphine. **(3)**

35. (a) i) Write any two conditions for Catenation . **(2)**

    ii) Describe the Preparation of Potassium Dichromate. **(3)**

    (OR)

    (b) Write the main Assumptions of VBT.

36. (a) Calculate the percentage efficiency of Packing in case of body centered Cubic Crystal. **(5)**

    (OR)

    (b) i) Write any two examples for I order reaction. **(2)**

    ii) Explain about Standard Hydrogen Electrode. **(3)**

37. (a) Derive the expression for Ostwald's dilution law.

    (OR)

    (b) i) Write Libermann's Nitroso test. **(2)**

    ii) How do you prepare the following compounds from Benzene diazonium Chloride? **(3)**

    a) Bipheneyl b) Fluoro Benzene

38. (a) i) What are Food Preservatives? **(2)**

    ii) What are the functions of Lipids in Living Organism? **(3)**

    (OR)

    (b) Compound 'A' of Molecular formula C_6H_5Cl on Treatment with NaOH at 633K and 300 bar pressure gives compound 'B'. 'B' on heating with 'Zn' dust to form 'C'. Compound 'B' on heating with ammonia in presence of Anhydrous Zinc Chloride to form D. Identify A, B, C and D, and Write the Equations. **(5)**

SACRED HEART MATRICULATION HIGHER SECONDARY SCHOOL

SHOLINGANALLUR, CHENNAI – 600119.

COMMON HALF YEARLY EXAM – DECEMBER 2024

STD: **12** **CHEMISTRY ANSWERKEY**

TIME: **180 MINUTES** MAXIMUM MARKS: **70**

PART – A

I. ***Answer all the questions. Choose the correct answer from the given four alternatives and write the option code and the corresponding answer.*** **(15x1=15)**

1. d) Electromagnetic Separation
2. a) Tetrahedral
3. c) He
4. a) Both assertion and reason are true and reason is the correct explanation of assertion
5. c) $[Ti(H_2O)_6]^{3+}$
6. a) 915 kg m^{-3}
7. c) 30 minutes
8. b) Strongly Acidic
9. a) I and IV
10. d) Argyol
11. c) Methyl Propanoate
12. a) Formic Acid
13. b) Blue Solution
14. d) D-Glucose
15. c) Tranquilizer

PART – B

II. ***Answer any six questions of the following. Question No.24 is compulsory.*** **(6x2=12)**

16. Give the basic requirement for Vapour Phase Refining?

- The metal should form a volatile compound with a suitable reagent.
- The volatile compound is decomposed to give the pure metal.

17. Give the uses of Silicones?

- Silicones are used for low temperature lubrication and in vacuum pumps, high temperature oil baths etc.
- They are used for making water proofing clothes.
- They are used as insulting material in electrical motor and other appliances
- They are mixed with paints and enamels to make them resistant towards high temperature, sunlight, dampness and chemicals.

18. What is Ionisation Isomerism? Give an example?

Ionisation isomerism arises when an ionisable counter ion (simple ion) itself can act as a ligand. The exchange of such counter ions with one or more ligands in the coordination entity will result in ionisation isomerism. Its will give different ions in solution.

For example, $[Pt(en)_2Cl_2]Br_2$ and $[Pt(en)_2Br_2]Cl_2$.

19. Define Impurity Defects.

A general method of introducing defects in ionic solids is by adding impurity ions. If the impurity ions are in different valance state from that of host, vacancies are created in the crystal lattice of the host.

For example, addition of $CdCl_2$ to AgCl yields solid solutions where the divalent cation Cd^{2+} occupies the position of Ag^+. This will disturb the electrical neutrality of the crystal. In order

to maintain the same, proportional number of Ag^+ ions leaves the lattice. This produces a cation vacancy in the lattice, such kind of crystal defects are called impurity defects.

20. Write the expression for the Solubility Product of Hg_2Cl_2.

$Hg_2Cl_2 \rightleftharpoons Hg_2^{2+} + 2Cl^-$

S S 2S

$K_{sp} = [Hg_2^{2+}][Cl^-]^2 = (S)(2S)^2 = (S)(4S^2) = \mathbf{4S^3}$.

21. What is the difference between Homogeneous and Heterogeneous Catalysis?

S.NO.	HOMOGENEOUS	HETEROGENEOUS
1	In a homogeneous catalysed reaction, the reactants, products and catalyst are present in the same phase.	In a homogeneous catalysed reaction, the reactants, products and catalyst are present in the different phase.
2	Their separation is difficult.	Their separation is easy.
3	They have high activity.	They have low activity.
4	Expensive and difficult to recycle.	Readily regenerated and recycled.
5	Homogeneous catalysis explained by Intermediate Compound Formation Theory.	Heterogeneous catalysis explained by Adsorption Theory.
6	**Ex:** Hydrolysis of cane sugar with a mineral acid as catalyst. $C_{12}H_{22}O_{11(l)} + H_2O_{(l)} \xrightarrow{H_2SO_{4(l)}} C_6H_{12}O_{6(l)} + C_6H_{12}O_{6(l)}$ (Sucrose → Glucose + Fructose)	**Ex:** Oxidation of ammonia is carried out in presence of platinum gauze. $4NH_{3(g)} + 5O_{2(g)} \xrightarrow{Pt_{(s)}} 4NO_{(g)} + 6H_2O_{(g)}$

22. Write a note on Clemmensen Reduction?

Aldehydes and Ketones when heated with zinc amalgam and concentrated hydrochloric acid gives hydrocarbons.

$CH_3-\underset{\underset{O}{\|}}{C}-H + 4(H) \xrightarrow[\text{Con HCl}]{\text{Zn - Hg}} CH_3-CH_3 + H_2O$

Acetaldehyde → Ethane

$CH_3-\underset{\underset{O}{\|}}{C}-CH_3 + 4(H) \xrightarrow[\text{Con HCl}]{\text{Zn - Hg}} CH_3CH_2CH_3 + H_2O$

Acetone → Propane

23. Why Carbohydrates are Generally Optically Active?

Almost all carbohydrate are optically active as they have one or more chiral carbon. Chirality results in optical activity.

The number of optical isomers = 2^n

Where *n* = the total number of chiral carbons.

24. Identify A and B

$C_6H_5NO_2 \xrightarrow{Fe\ /\ HCl} A \xrightarrow{NaNO_2\ /\ HCl\ /\ 273K} B$

A → $C_6H_5NH_2$ **B** → $C_6H_5N_2Cl$

PART – C

III. *Answer any six questions. Question No.33 is compulsory.* **(6x3=18)**

25. How is Potash Alum Prepared?

The alunite the alum stone is the naturally occurring form and it is $K_2SO_4.Al_2(SO_4)_3.4Al(OH)_3$. When alum stone is treated with excess of sulphuric acid, the aluminium hydroxide is converted to aluminium sulphate.

A calculated quantity of potassium sulphate is added and the solution is crystallised to generate potash alum. It is purified by recrystallisation.

$$K_2SO_4.Al_2(SO_4)_3.4Al(OH)_3 + 6H_2SO_4 \longrightarrow K_2SO_4 + 3Al_2(SO_4)_3 + 12\ H_2O$$

$$K_2SO_4 + Al_2(SO_4)_3 + 24\ H_2O \longrightarrow K_2SO_4.Al_2(SO_4)_3.24\ H_2O$$

26. Write a note on Chromyl Chloride Test.

- When potassium dichromate is heated with any chloride salt in the presence of Conc.H_2SO_4, orange red vapours of chromyl chloride (CrO_2Cl_2) is evolved.
- This reaction is used to confirm the presence of chloride ion in inorganic qualitative analysis.

$$K_2Cr_2O_7 + 4NaCl + 6H_2SO_4 \longrightarrow 2KHSO_4 + 4NaHSO_4 + \underset{\text{Chromyl chloride}}{2CrO_2Cl_2}\uparrow + 3H_2O$$

- The chromyl chloride vapours are dissolved in sodium hydroxide solution and then acidified with acetic acid and treated with lead acetate. A yellow precipitate of lead chromate is obtained.

$$CrO_2Cl_2 + 4NaOH \longrightarrow Na_2CrO_4 + 2NaCl + 2H_2O$$

$$Na_2CrO_4 + (CH_3COO)_2Pb \longrightarrow \underset{\substack{\text{Leadchromate}\\(\text{Yellowprecipitate})}}{PbCrO_4}\downarrow + 2CH_3COONa$$

27. What are the Limitations of VB Theory?

- It does not explain the colour of the complex
- It considers only the spin only magnetic moments and does not consider the other components of magnetic moments.
- It does not provide a quantitative explanation as to why certain complexes are inner orbital complexes and the others are outer orbital complexes for the same metal. For example, $[Fe(CN)_6]^{4-}$ is diamagnetic (low spin) whereas $[FeF_6]^{4-}$ is paramagnetic (high spin).

28. Write the Difference between rate and rate constant.

S. NO.	RATE OF A REACTION	RATE CONSTANT OF A REACTION
1	It is measured as decrease in the concentration of the reactants or increase in the concentration of products.	It is equal to the rate of reaction, when the concentration of each of the reactants is unity
2	It depends on the initial concentration of reactants.	It does not depend on the initial concentration of reactants.
3	It generally decreases with the progress of reaction	It does not depend on the progress of reaction
4	Its unit is mol $L^{-1}cm^{-1}$.	It changes according to order of reaction.

29. Write the Mechanism of Aldol Condensation Reaction.

The carbon attached to carbonyl carbon is called α - carbon and the hydrogen atom attached to α - carbon is called α - hydrogen.

$$CH_3-\underset{\underset{O}{\|}}{\overset{\overset{H}{|}}{C}} + H-CH_2-CHO \xrightarrow{\text{dil.NaOH}} CH_3-\underset{OH}{\overset{|}{CH}}-CH_2-CHO$$

Acetaldehyde — Acetaldol (3 - Hydroxy butanal)

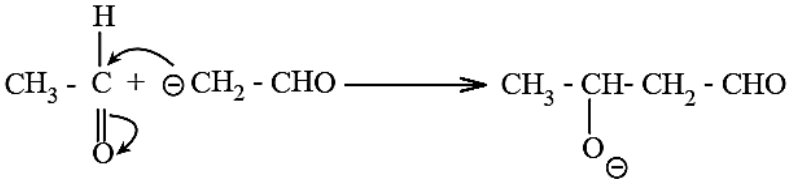
Mechanism

The mechanism of aldol condensation of acetaldehyde takes place in three steps.

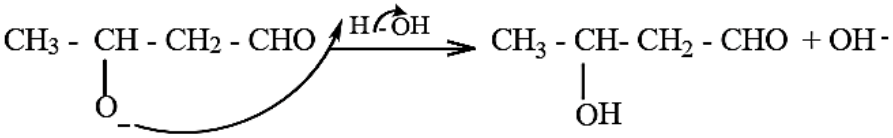
Step 1 : The carbanion is formed as the α - hydrogen atom is removed as a proton by the base.

$$HO^- + H-CH_2-CHO \longrightarrow {}^{\ominus}CH_2-CHO + H_2O$$

Step 2 : The carbanion attacks the carbonyl carbon of another unionized aldehyde to form an alkoxide ion.

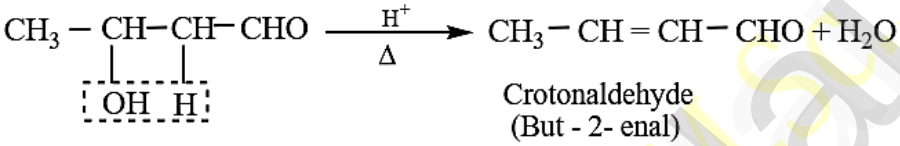


Step 3 : The alkoxide ion formed is protonated by water to form aldol.



3-Hydroxy butanal

The aldol rapidly undergoes dehydration on heating with acid to form α - β unsaturated aldehyde.



Crotonaldehyde
(But - 2- enal)

30. Give any three difference between DNA and RNA.

DNA	RNA
It is mainly present in nucleus, mitochondria and chloroplast	It is mainly present in cytoplasm, nucleolus and ribosomes
It contains deoxyribose sugar	It contains ribose sugar
Base pair A = T. G ≡ C	Base pair A = U. C ≡ G
Double stranded molecules	Single stranded molecules
It's life time is high	It is Short lived
It is stable and not hydrolysed easily by alkalis	It is unstable and hydrolyzed easily by alkalis
It can replicate itself	It cannot replicate itself. It is formed from DNA.

31. Write a note on Vulcanization of Rubber.

- The process of mixing natural rubber with sulphur is called vulcanization.
- Natural rubber is mixed with 3-5% sulphur and heated at 100-150°C causes cross linking of the cis-1,4-polyisoprene chains through disulphide (-S-S-) bonds.
- The physical properties of rubber can be altered by controlling the amount of sulphur that is used for vulcanization.
- In sulphur rubber, made with about 1 to 3% sulphur is soft and stretchy.
- When 3 to 10% sulphur is used the resultant rubber is somewhat harder but flexible.

32. Explain Ultrafilration.

The pores of ordinary filter papers permit the passage of colloidal solutions. In ultrafiltrations, the membranes are made by using collodion cellophane or visiking. When a colloidal solution is filtered using such a filter, colloidal particles are separated on the filter and the impurities are removed as washings. This process is quickened by application of pressure. The separation of sol particles from electrolyte by filteration through an ultrafilter is called ultrafiltration.

Example, Collodion is 4% solution of nitrocellulose in a mixture of alcohol and water.

33. Is it possible to store Copper Sulphate in an Iron Vessel for a long time?

Given: $E^{\circ}_{Cu^{2+}/Cu}$ = 0.34V and $E^{\circ}_{Fe^{2+}/Fe}$ = -0.44V

$(E^{\circ}_{ox})_{\frac{Fe}{Fe^{2+}}}$ = 0.44V and $(E^{\circ}_{red})_{\frac{Cu^{2+}}{Cu}}$ = 0.34V

These +ve emf values shows that iron will oxidise and copper will get reduced i.e., the vessel will dissolve. Hence it is not possible to store copper sulphate in an iron vessel.

PART – D

IV. *Answer all the questions.* **(5x5=25)**

34.(a) Explain the Electrometallurgy of Aluminium.

Cathode : Iron tank lined with carbon **Anode** : Carbon blocks

Electrolytes: 20% solution of alumina, obtained from the bauxite ore is mixed with molten cryolite and is taken in the electrolysis chamber. About 10%, calcium chloride is also added to the solution. Here calcium chloride helps to lower the melting point of the mixture.

Temperature : Above 1270 K.

The chemical reactions involved in this process are as follows:

Ionisation of alumina: $Al_2O_3 \rightarrow 2Al^{3+} + 3O^{2-}$

Reaction at cathode: $2Al^{3+}$ (melt) + $3e^- \rightarrow Al_{(l)}$

Reaction at anode: $2O^{2-}$ (melt) $\rightarrow O_2 + 3e^-$

- Since carbon acts as anode the following reaction also takes place on it.

$$C_{(s)} + O^{2-} \text{ (melt)} \rightarrow CO + 2e^-$$

$$C_{(s)} + 2O^{2-} \text{ (melt)} \rightarrow CO_2 + 4e^-$$

- Due to the above two reactions, anodes are slowly consumed during the electrolysis.
- The pure aluminium is formed at the cathode and settles at the bottom.
- The net electrolysis reaction can be written as follows:

$$4Al^{3+} \text{ (melt)} + 6O^{2-} \text{ (melt)} + 3C_{(s)} \rightarrow 4A_{(l)} + 3CO_{2(g)}$$

(OR)

(b) i) Why Fluorine is more reactive than other Halogens? (2)

Fluorine is the most reactive element among halogen. This is due to the minimum value of F – F bond dissociation energy. Hence fluorine is more reactive than other halogens.

ii) Give two equations to illustrate the Chemical behaviour of Phosphine. (3)

- Phosphine reacts with halogens to give phosphorous penta halides.

$$PH_3 + 4Cl_2 \rightarrow PCl_5 + 3HCl$$

- Phosphine forms coordination compound with lewis acids such as boron trichloride.

$$BCl_3 + PH_3 \rightarrow [Cl_3B \leftarrow :PH_3]$$

- Phosphine precipitates some metal from their salt solutions.

$$3AgNO_3 + PH_3 \rightarrow Ag_3P + 3HNO_3$$

35.(a) i) Write any two conditions for Catenation. (2)

- Catenation is an ability of an element to form chain of atoms.
- The following conditions are necessary for catenation.

(i) the valency of element is greater than or equal to two,

(ii) element should have an ability to bond with itself

(iii) the self bond must be as strong as its bond with other elements

(iv) kinetic inertness of catenated compound towards other molecules.

- Carbon possesses all the above properties and forms a wide range of compounds with itself and with other elements such as H, O, N, S and halogens.

ii) Describe the Preparation of Potassium Dichromate. (3)

- **Important Ore:** $K_2Cr_2O_7$ is prepared from chromite–Iron ore, or Chromite ore.
- **Concentration method:** The ore is converted by gravity separation
- Conversion of chromite iron ore into sodium chromate.

$$4\,FeCr_2O_4 + 8\,Na_2CO_3 + 7\,O_2 \xrightarrow{900 - 1000^0C} 8\,Na_2CrO_4 + 2\,Fe_2O_3 + 8\,CO_2\uparrow$$

- Conversion of sodium chromate into sodium dichromate:

$$\underset{\text{sodium chromate (yellow)}}{2\,Na_2CrO_4} + H_2SO_4 \longrightarrow \underset{\text{sodium dichromate (orange red)}}{Na_2Cr_2O_7} + Na_2SO_4 + H_2O$$

- Conversion of sodium dichromate into potassium dichromate :

$$\underset{\text{sodium dichromate (orange red)}}{Na_2Cr_2O_7} + 2KCl \longrightarrow \underset{\text{potassium dichromate (orange red)}}{K_2Cr_2O_7} + 2NaCl$$

(OR)

(b) Write the main assumptions of Valence Bond Theory (VBT)?

- The ligand → metal bond in a coordination complex is covalent in nature. It is formed by sharing of electrons (provided by the ligands) between the central metal atom and the ligand.
- Each ligand should have at least one filled orbital containing a lone pair of electrons.
- In order to accommodate the electron pairs donated by the ligands, the central metal ion present in a complex provides required number (coordination number) of vacant orbitals.
- These vacant orbitals of central metal atom undergo hybridisation, the process of mixing of atomic orbitals of comparable energy to form equal number of new orbitals called hybridised orbitals with same energy.
- The vacant hybridised orbitals of the central metal ion, linearly overlap with filled orbitals of the ligands to form coordinate covalent sigma bonds between the metal and the ligand.
- The hybridised orbitals are directional and their orientation in space gives a definite geometry to the complex ion.

Coordination number	Hybridisation	Geometry	Examples
2	sp	Linear	$[CuCl_2]^-$, $[Ag(CN)_2]^-$
3	sp^2	Trigonal planar	$[HgI_3]^-$
4	sp^3	Tetrahedral	$[Ni(CO)_4]$, $[NiCl_4]^{2-}$
4	dsp^2	Square planar	$[Ni(CN)_4]^{2-}$, $[Pt(NH_3)_4]^{2+}$
5	dsp^3 ($d_{x^2-y^2}$ orbital is involved)	Trigonal bipyramidal	$Fe(CO)_5$

6	d^2sp^3 (d_{z^2} and $d_{x^2-y^2}$ orbitals of inner shell are involved)	Octahedral	$[Ti(H_2O)_6]^{3+}$, $[Fe(CN)_6]^{2-}$, $[Fe(CN)_6]^{3-}$, $[Co(NH_3)_6]^{3+}$ (Inner orbital complexes)
6	sp^3d^2 (d_{z^2} and $d_{x^2-y^2}$ orbitals of the outer shell are involved)	Octahedral	$[FeF_6]^{4-}$,$[CoF_6]^{4-}$, $[Fe(H_2O)_6]^{2+}$ (Outer orbital complexes)

- In the octahedral complexes, if the *(n-1)d* orbitals are involved in hybridisation, then they are called inner orbital complexes or low spin complexes or spin paired complexes. If the *nd* orbitals are involved in hybridisation, then such complexes are called outer orbital or high spin or spin free complexes. Here n represents the principal quantum number of the outermost shell.
- The complexes containing a central metal atom with unpaired electron(s) are paramagnetic. If all the electrons are paired, then the complexes will be diamagnetic.
- Ligands such as CO, CN^-, en, and NH_3 present in the complexes cause pairing of electrons present in the central metal atom. Such ligands are called strong field ligands.
- Greater the overlapping between the ligand orbitals and the hybridised metal orbital, greater is the bond strength.

36.(a) Calculate the percentage efficiency of Packing in case of Body centered Cubic Crystal.

In body-centered cubic arrangement the spheres are touching along the leading diagonal of the cube as shown in the,

In ΔABC

$$AC^2 = AB^2 + BC^2$$

$$AC = \sqrt{AB^2 + BC^2}$$

$$AC = \sqrt{a^2 + a^2} = \sqrt{2a^2} = \sqrt{2}\ a$$

In ΔACG

$$AG^2 = AC^2 + CG^2$$

$$AG = \sqrt{AC^2 + CG^2}$$

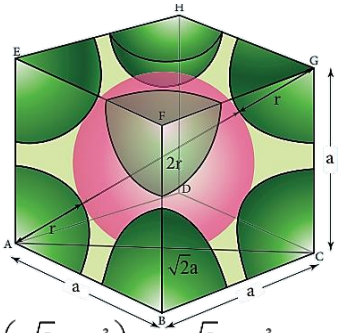
$$AG = \sqrt{\left(\sqrt{2}a\right)^2 + a^2}$$

$$AG = \sqrt{2a^2 + a^2} = \sqrt{3a^2}$$

$$AG = \sqrt{3}\ a$$

i.e., $\sqrt{3}a = 4r$

$$r = \frac{\sqrt{3}}{4}a$$



∴ Volume of the sphere with radius 'r'

$$= \frac{4}{3}\pi r^3$$

$$= \frac{4}{3}\pi\left(\frac{\sqrt{3}}{4}a\right)^3$$

$$= \frac{\sqrt{3}}{16}\pi a^3 \quad ...(1)$$

Number of spheres belong to a unit cell in bee arrangement is equal to two and hence the total volume of all spheres

$$= 2 \times \left(\frac{\sqrt{3}\ \pi\ a^3}{16}\right) = \frac{\sqrt{3}\ \pi\ a^3}{8}$$

Dividing (2) by (3)

$$\text{Packing fraction} = \frac{\left(\frac{\sqrt{3}\ \pi\ a^3}{8}\right)}{\left(a^3\right)} \times 100$$

$$= \frac{\sqrt{3}\ \pi}{8} \times 100$$

$$= \sqrt{3}\ \pi \times 12.5$$

$$= 1.732 \times 3.14 \times 12.5$$

$$= 68\ \%$$

i.e., 68% of the available volume is occupied. The available space is used more efficiently than in simple cubic packing.

(OR)

(b) i) Write any two examples for I[st] order reaction. (2)

(i) Decomposition of dinitrogen pentoxide $N_2O_5(g) \longrightarrow 2NO_2(g) + \frac{1}{2}O_2(g)$

(ii) Decomposition of sulphurylchloride; $SO_2Cl_2(l) \longrightarrow SO_2(g) + Cl_2(g)$

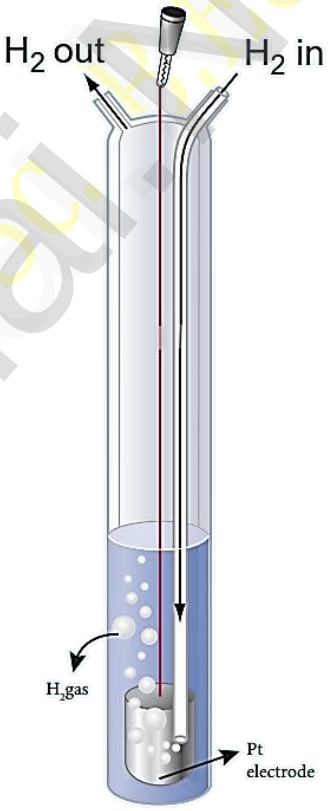
(iii) Decomposition of the H_2O_2 in aqueous solution; $H_2O_2(aq) \longrightarrow H_2O(l) + \frac{1}{2}O_2(g)$

(iv) Isomerisation of cyclopropane to propene.

ii) Explain about Standard Hydrogen Electrode. (3)

The overall redox reaction can be considered as the sum of two half reactions i.e., oxidation and reduction. Similarly, the emf of a cell can be considered as the sum of the electrode potentials at the cathode and anode,

$$E_{cell} = (E_{ox})_{anode} + (E_{red})_{cathode} \quad \text{---------(1)}$$



Here, $(E_{ox})_{anode}$ represents the oxidation potential at anode and $(E_{red})_{cathode}$ represents the reduction potential at cathode. It is impossible to measure the emf of a single electrode, but we can measure the potential difference between the two electrodes (E_{cell}) using a voltmeter. If we know the emf of any one of the electrodes which constitute the cell, we can calculate the emf of the other electrode from the measured emf of the cell using the expression. Hence, we need a reference electrode whose emf is known.

For that purpose, Standard Hydrogen Electrode (SHE) is used as the reference electrode. It has been assigned an arbitrary emf of exactly zero volt. It consists of a platinum electrode in contact with 1M HCl solution and 1 atm hydrogen gas. The hydrogen gas is bubbled through the solution at 25°C as shown in the figure. SHE can act as a cathode as well as an anode. The Half cell reactions are given below.

If SHE is used as a cathode, the reduction reaction is

$2H^+(aq,1M) + 2e^- \rightarrow H_2(g, 1\ atm)$ $\quad E^\circ = 0$ volt ---------(2)

If SHE is used as an anode, the oxidation reaction is

$H_2(g,1\ atm) \rightarrow 2H^+(aq, 1M) + 2e^-$ $\quad E^\circ = 0$ volt ---------(3)

37.(a) Derive the expression for Ostwald's Dilution Law.

The dissociation of acetic acid can be represented as

$$CH_3COOH \rightleftharpoons H^+ + CH_3COO^-$$

The dissociation constant of acetic acid is,

$$k_a = \frac{[H^+][CH_3COO^-]}{[CH_3COOH]}$$

	CH_3COOH	H^+	CH_3COO^-
Initial number of moles	1	-	-
Degree of dissociation of CH_3COOH	α	-	-
Number of moles at equilibrium	$1-\alpha$	α	α
Equilibrium concentration	$(1-\alpha)\,C$	$\alpha\,C$	$\alpha\,C$

Substituting the equilibrium concentration in equation

$$k_a = \frac{(\alpha C)(\alpha C)}{(1-\alpha)C}$$

$$k_a = \frac{\alpha^2 C}{1-\alpha}$$

We know that weak acid dissociates only to a very small extent. Compared to one, α is so small and hence in the denominator (1 - α) ≈ 1. The above expression now becomes,

$$K_a = \alpha^2 C$$

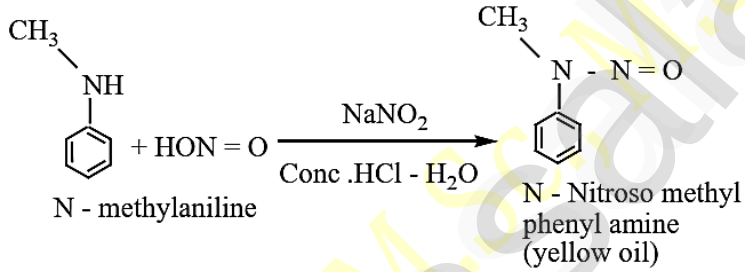
$$\Rightarrow \alpha^2 = \frac{K_a}{C}$$

$$\alpha = \sqrt{\frac{K_a}{C}}$$

(OR)

(b) i) Write Libermann's Nitroso Test. (2)

Alkyl and aryl secondary amines react with nitrous acid to give N – nitroso amine as yellow oily liquid which is insoluble in water.

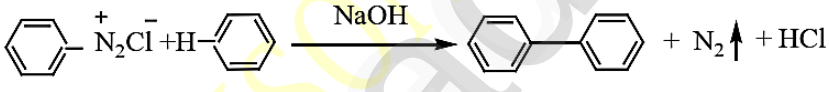


This reaction is known as Libermann's nitroso test.

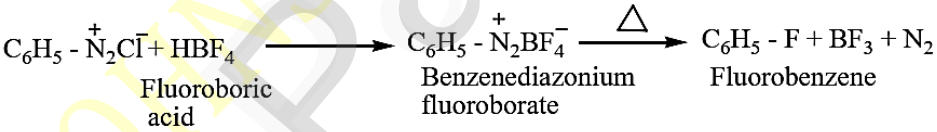
ii) How do you prepare the following compounds from Benzene Diazonium Chloride? (3)

a) Bipheneyl b) Fluoro Benzene

a)



b)



38.(a) i) What are Food Preservatives? (2)

Preservatives are capable of inhibiting, retarding or arresting the process of fermentation, acidification or other decomposition of food by growth of microorganisms.

Example, Acetic acid is used mainly as a preservative for the preparation of pickles and for preserved vegetables. Sodium metasulphite is used as preservatives for fresh vegetables and fruits.

ii) What are the Functions of Lipids in Living Organism? (3)

- Lipids are the integral component of cell membrane. They are necessary of structural integrity of the cell.
- The main function of triglycerides in animals is as an energy reserve. They yield more energy than carbohydrates and proteins.
- They act as protective coating in aquatic organisms.
- Lipids of connective tissue give protection to internal organs.

- Lipids help in the absorption and transport of fat soluble vitamins.
- They are essential for activation of enzymes such as lipases.
- Lipids act as emulsifier in fat metabolism.

(OR)

(b) Compound 'A' of Molecular formula C_6H_5Cl on Treatment with NaOH at 633K 300bar pressure gives compound 'B'. 'B' on heating with 'Zn' dust to form 'C'. Compound 'B' on heating with ammonia in presence of Anhydrous Zinc Chloride to form D. Identify A, B, C and D, and Write the Equations.

$$\underset{\text{A}}{C_6H_5Cl} + NaOH \xrightarrow{633K\ /\ 300bar} \underset{\text{B}}{C_6H_5OH} + NaCl$$

$$\underset{\text{B}}{C_6H_5OH} + Zn \xrightarrow{\Delta} \underset{\text{C}}{C_6H_6} + ZnO$$

$$\underset{\text{B}}{C_6H_5OH} + NH_3 \xrightarrow{\Delta\ /\ Anhydrous\ ZnCl_2} \underset{\text{D}}{C_6H_5NH_2} + H_2O$$

A	C_6H_5Cl	*Chlorobenzene*
B	C_6H_5OH	*Phenol*
C	C_6H_6	*Benzene*
D	$C_6H_5NH_2$	*Aniline*

PREPARED BY,

Mr. S.JOHNSON., M.Sc., M.Sc., B.Ed.,

PGT – CHEMISTRY

SACRED HEART MAT. HR. SEC. SCHOOL,

SHOLINGANALLUR, CHENNAI – 600119.

Merry Christmas

&

Happy New Year -2025