12 P

Time : 3.00 Hrs.

20.12.24

Half Yearly Examination- 2024

CHEMISTRY

Register No.

Marks : 70

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முதுகலை வேதியியல் ஆசிரியர்

PART - I

15 x 1 = 15

Answer all the questions.

BB 1. Bauxite has the composition
a) Al_2O_3 (b) $Al_2O_3\,nH_2O$ c) $Fe_2O_3\,2H_2O$ d) None of these

BB 2. Which among the following is not a borane?
a) B_2H_6 (b) B_3H_6 c) B_4H_{10} d) None of these

BB 3. The basicity of pyrophosphorous acid ($H_4P_2O_5$) is
a) 4 (b) 2 c) 3 d) 5

BB 4. Which of the following oxidation states is most common among the Lanthanides?
a) +4 b) +2 c) +5 (d) +3

BB 5. Which type of isomerism is exhibited by [Pt $(NH_3)_2$ $C\ell_2$]?
a) Coordination isomerism b) Linkage isomerism c) Optical isomerism (d) Geometrical isomerism

BB 6. The crystal with a metal deficiency defect is
a) NaCℓ (b) FeO c) ZnO d) KCℓ

BB 7. The addition of a catalyst during a chemical reaction alters which of the following quantities?
a) Enthalpy (b) Activation energy c) Entropy d) Internal energy

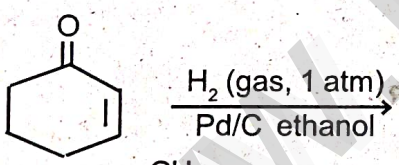
BB 8. The pH of 10^{-5} m KOH solution will be
(a) 9 b) 5 c) 19 d) none of these

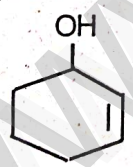
BB 9. The number of electrons that have a total charge of 9650 coulombs is
a) 6.22×10^{23} b) 6.022×10^{24} (c) 6.022×10^{22} d) 6.022×10^{-34}

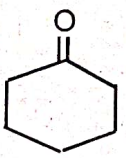
BB 10. Fog is colloidal solution of
a) solid in gas b) gas in gas (c) liquid in gas d) gas in liquid

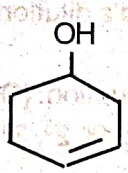
Int 11. The number of –COOH group in picric acid is
(a) 0 b) 1 c) 2 d) 3

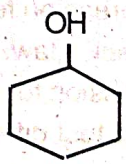
BB 12. The correct structure of the product 'A' formed in the reaction.



a) 

(b) 

c) 

d) 

BB 13. Which one of the following will ot undergo Hofmann bromamide reaction?
(a) $CH_3CONHCH_3$ b) $CH_3CH_2CONH_2$ c) CH_3CONH_2 d) $C_6H_5CONH_2$

BB 14. Which one given below is a non-reducing sugar.
a) Glucose (b) Sucrose c) Maltose d) Lactose

BB 15. Nylon is an example of
(a) polyamide b) polythene c) polyester d) poly saccharide

1 mark Answers:
1. b
2. b
3. b
4. d
5. d
6. b
7. b
8. a
9. c
10. c
11. a
12. b
13. a
14. b
15. a

BB - 14
Int - 1
15

PART - II

Answer any six questions. Q.Number 24 is compulsory. **6 x 2 = 12**

16. What are the difference between minerals and ores? F-3-1
17. What is inert pair effect? F-37-1
18. Write the uses of oxygen. F-79-83
19. Define unit cell. F-99-1
20. Define half life of a reaction. F-117-3
21. What is common ion effect? F-135-9
22. How is phenol prepared from Dow's process? F-204-12
23. Write a short note on peptide bond. F-295-6
24. Write the IUPAC name and co-ordination number of the given compound. $[Cu^{+2}(NH_3)_2^0 Cl_2^{-2}]^0$ F-92-1 (iii) diammine dichloride copper(II)

PART - III

Answer any six questions. Question number 33 is compulsory. **6 x 3 = 18**

25. Describe briefly the catenation property of carbon. F-23-16
26. What are interstitial compounds? Write their properties. F-55-7, F-61-21
27. Explain pseudo first order reaction with an example. F-118-9
28. Describe the construction of Daniel cell. Write the cell reaction. F-166-2
29. Describe adsorption theory of catalysis. F-192-4
30. How do you prepare Acrolein? F-221-12
31. How will you prepare Malachite green? F-239-viii
32. What are antacids? Give an example. F-321-21
33. Identify A, B, C in the following reaction : $C_6H_5N_2Cl \xrightarrow{CuCN} A \xrightarrow{H_2O/H^+} B \xrightarrow{NH_3} C$ (C_6H_5CN, C_6H_5COOH, $C_6H_5CONH_2$) F-267-(ii)

PART - IV

Answer all the questions. **5 x 5 = 25**

34. a) i) Explain Zone refining process. F-5-6
    ii) Give the limitations of Ellingham diagram. F-7-12
    (OR)
    b) i) Write a note on zeolites. F-22-13
    ii) What are the uses of borax? F-20-2
35. a) i) Justify the position of lanthanoids and Actinoids in the periodic table. F-54-4
    ii) What is lanthanoid contraction? **(OR)** F-64-2
    b) Write the postulates of Werner's theory. F-85-2
36. a) Explain Schottky defect and Frenkel defect with an example. **(OR)** F-100-6, F-101-13
    b) i) Derive an expression for Ostwald's dilution law. F-142-2
    ii) Define Kohlrausch's law. F-157-3 (a)
37. a) Derive an expression for Nernst equation. **(OR)** F-166-3
    b) i) Explain Lucas test differentiating 1^0, 2^0, 3^0 alcohols. F-216-2
    ii) Explain Kolbe's reaction. F-205-13
38. a) i) Explain the mechanism of aldol condensation. F-249-5
    ii) Write about Clemension reduction. **(OR)** F-243-23
    b) i) Write Gabriel phthalimide synthesis. F-269-6 (c)
    ii) What are Hormones? F-297-13

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Half Yearly Exam DEC-2024

Tiruppur +2 EM Chemistry Answerkey

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Part-I

15×1=15

1 marks:

1. b) $Al_2O_3 . nH_2O$
2. b) B_3H_6
3. b) 2
4. d) +3
5. d) Geometrical isomerism
6. b) FeO
7. b) Activation Energy
8. a) 9
9. c) 6.022×10^{22}
10. c) liquid in gas
11. a) O
12. b) 
13. a) $CH_3CONHCH_3$
14. b) Sucrose
15. a) Polyamide

Part-II

6×2=12

2 Marks:

16.

Minerals	ores
1. A Naturally occuring substance obtained by mining which contains the metal in free state (or) in the form of compounds.	The minerals that contains a high Percentage of metal from which metal can be extracted conveniently and economically.
eg: Bauxite and China clay are minerals of Aluminium.	eg: Bauxite is an ore of Al.
2. All minerals are not ores	All ores are minerals.

17. **Inert pair effect:**
In heavier post transition metal, the outer s e⁻s (ns) have tendency to remain inert and show unwillingness to take part in the bonding.

18. **Uses of oxygen:**
* The essential component for the survival of living organisms
* It is used in welding (oxyacetylene welding.
* Liquid Oxygen is used as fuel in rockets etc.....

19. **Unitcell:** A basic repeating structural unit of a crystalline solid.

20. **Half life : ($t_{1/2}$)**

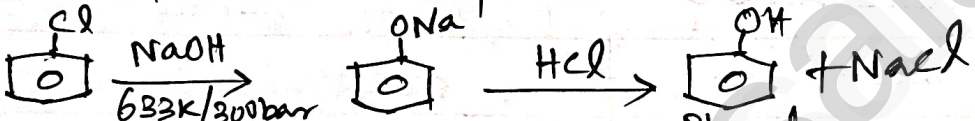
The time required for the reactant concentration to reach one half of its initial value.

($t_{1/2} = 0.693/k$)

21. **Common ion effect:** The dissociation of weak acid is suppressed in the presence of a salt containing an ion common to the weak electrolyte.

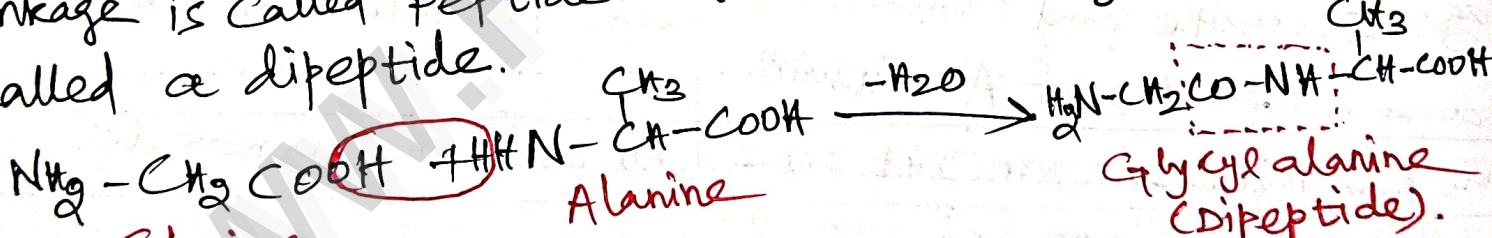
eg: The dissociation of CH_3COOH is suppressed in the presence of CH_3COONa containg CH_3COO^- act as a common ion.

22. **Dow's Process : (Preparation of phenol):**



23. **Peptide bond:**

The Carboxyl group of the first amino acid reacts with the amino group of the second amino acid to give an amide linkage between these amino acids. This amide linkage is called peptide bond. The resulting compound is called a dipeptide.



24. **[Compulsory:]** $[Cu^{+2}(NH_3)_2^{0}Cl_2^{-2}]^0$

IUPAC Name: diammine dichlorido Copper (II)

Coordination Number } → 4

3 Marks: Part-III 6x3=18

25. **Catenation Property of Carbon :-**

* Catenation is an ability of an element to form chain of atoms.

The following conditions are necessary for catenation:

* The valency of element is greater than (or) equal to two
* element should have an ability to bond with itself.
* The self bond must be as strong as its bond with other elements.
* 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.

26. **Interstitial compounds:**

An interstitial compound (or) alloy is a compound that is formed when small atoms like H, B, C (or) N are trapped in the interstitial holes in a metal lattice. They are non-stochiometric compounds. eg: TiC, $ZrH_{1.92}$, Mn_4N.

Properties Of Interstitial Compounds:

* They are hard and show electrical band thermal conductivity
* They have high melting points higher than those of pure metals
* Transition metal hydrides are used as a powerful reducing agents.
* Metallic carbides are chemically inert.

27. **Pseudo first order reaction**: A second order reaction can be altered to first order by taking one of the reactant in large excess. eg: Acid hydrolysis of an ester.

$$CH_3COOCH_3 + H_2O \xrightarrow{H^+} CH_3COOH + CH_3OH$$

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28. **Daniel cell:**

It consists of 2 half cells.

Oxidation half cell: A metallic Zn strip that dips into an aqueous solution of $ZnSO_4$.

Reduction half cell: A copper strip that dips into an aqueous solution of $CuSO_4$.

Joining the half cells:-

1. The Zn and Cu strips are exteornally connected using a wire through a switch (k) and a Volt meter.
2. The electrolytic solution present in the cathodic and anodic compartment are connected using an inverted U-tube containing a agar-agar gel mixed with an inert electrolyte such as KCl and Na_2SO_4.
3. When the switch (k) closes the circuit, the e^-s flows from Zn strip to Cu strip.

Anodic oxidation:

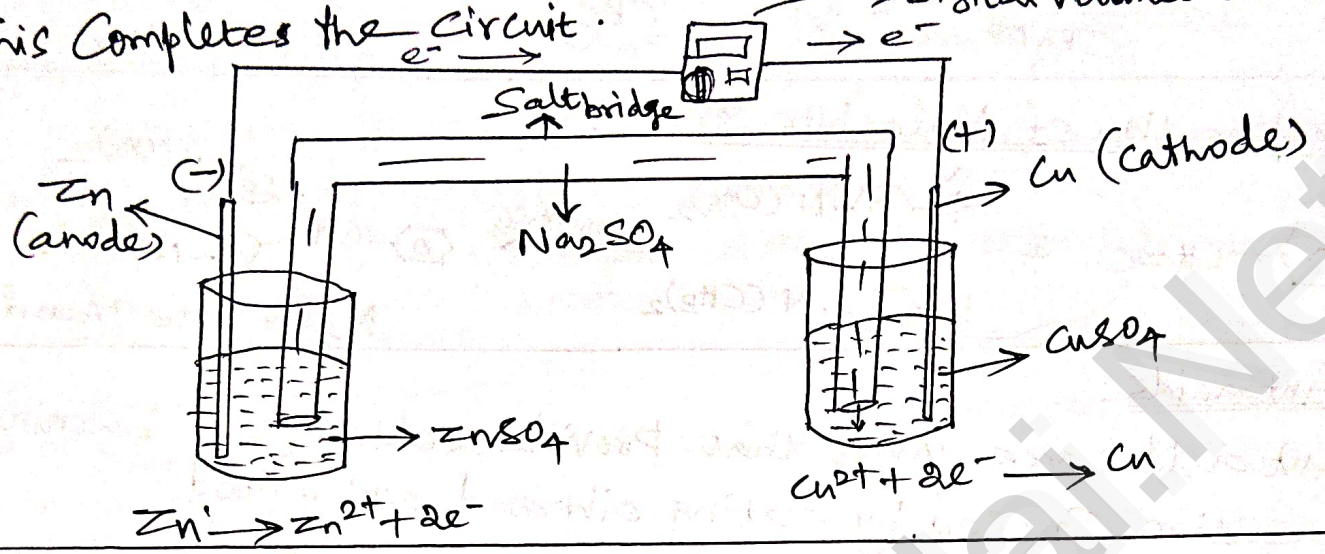
1. In Daniel cell, the oxidation takes place at Zn electrode
2. In Zn^{2+} ions enters the solution and the electrons enter the Zn metal. $Zn \longrightarrow Zn^{2+} + 2e^-$

Cathodic Reduction: The electrons flow through the circuit from Zn to Cu, where the Cu^{2+} ions get reduced to Cu and the same get deposited on the electrode

$Cu^{2+} + 2e^- \longrightarrow Cu$

Salt bridge: The electrolyte present in 2 half cells are connected using a salt bridge. To maintain the electrical neutrality in both the compartments, the non reactive anions Cl^- move from the salt bridge and enter into anodic compartment at the same time some of the cations K^+ ions move from the salt bridge into the cathodic compartment.

Completion of circuit: Electrons flow from Zn into the Copper through the external wire, at the same time, anions move towards anode and cations are move towards the Cathode. This Completes the circuit.



29. **Adsorption theory of Catalysis:**

* This theory explains the mechanism of Heterogeneous Catalysis.
* According to this theory, the reactants are adsorbed on the Catalyst surface to form an activated Complex which subsequently decomposes and gives the product. It is also called contact Catalysis.

Mechanism:

1. Reactant molecules diffuse from bulk to the Catalyst surface
2. The Reactant molecules are adsorbed on the surface of the Catalyst.
3. The adsorbed reactant molecules are activated and form activated complex. Which is decomposed to form the products.
4. The product molecules are desorbed.
5. The product diffuse away from the surface of the Catalyst

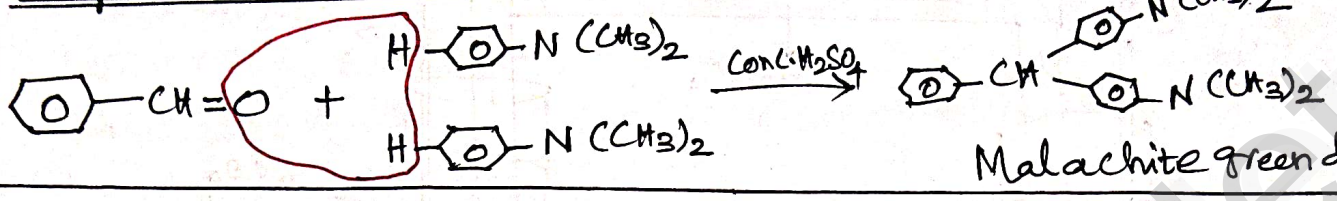
Eg: Hydrogenation of ethylene in presence of a 'Ni' catalyst

$$\underset{\text{Ethylene}}{CH_2 = CH_2} \xrightarrow{H_2/Ni} \underset{\text{Ethane}}{C_2H_6}$$

30. **Preparation of Acrolein:**

CH_2OH – $CHOH$ – CH_2OH $\xrightarrow[-H_2O]{KHSO_4}$ CH_2 = CH – CHO → Acrolein.

31. **Preparation of Malachite green:**



Malachite green dye

32. **Antacids:**

* Antacids are drugs that provide relief from burning sensation caused by eating oily and spicy food.
* Antacids are the drugs used to rectify the imbalance in the acidity in the stomach.

eg: Milk of magnesia, $NaHCO_3$, omeprazole and $Al(OH)_3$.

33. **[Compulsory] :-**

$C_6H_5N_2Cl \xrightarrow{CuCN} C_6H_5CN$ (A) $\xrightarrow{H_2O/H^+} C_6H_5COOH$ (B) $\xrightarrow{NH_3} C_6H_5CONH_2$ (C)

A → C_6H_5CN → Cyanobenzene, B → C_6H_5COOH → Benzoic acid, C → $C_6H_5CONH_2$ → Benzamide

Part - IV 5×5=25

5 Marks:

34. a) (i) **Zone refining process:** Principle:

* This method is based on the principles of fractional crystallisation.
* When an impure metal is melted and allowed to solidify, the impurities will prefer to be in the molten region. (i.e.,) impurities are more soluble in the molten state than in the solid state metal.

Experiment:

1. In this process the impure metal is taken in the form of rod. One end of the rod is heated using a mobile induction heater which results in melting of the metal on that portion of the rod.

2. When the heater is slowly moved to the other end the pure metal crystallises while the impurities will move on to the adjacent molten zone formed due to the movement of the heater.
3. As the heater moves further away, the molten zone containing impurities also moves along with it.
4. The process is repeated several times by moving the heater in the same direction again and again to achieve the desired purity level.
5. This process is carried out in an inert gas atmosphere to prevent the oxidation of metals. eg: Ge, Ga and Si are purified by this method.

34. a) (ii) Limitations of Ellingham diagram:

1. It gives information about the thermodynamic feasibility of a reaction. It does not tell anything about the rate of the reaction.
2. It does not give any idea about the possibility of other reactions that might be taking place.
3. The interpretation of ΔG is based on the assumption that the reactants are in equilibrium with the product which is not always true.

(OR)

34. b) (i) Zeolites:

1. Zeolites are 3D crystalline solids containing Al, Si and oxygen in their regular three dimensional framework.
2. They are hydrated sodium alumino silicates with general formula

$$Na_2O \cdot (Al_2O_3) \cdot X(SiO_2) \cdot Y H_2O \quad (x = 2 \text{ to } 10,\ Y = 2 \text{ to } 6)$$

Structure:

1. Zeolites have porous structure in which the monovalent Na^+ ions and H_2O molecules are loosely held.
2. The Si and Al atoms are tetrahedrally coordinated with each other through shared oxygen atoms.

3. Zeolites have three dimensional crystalline structure looks like a honeycomb consisting of a network of interconnected tunnels and cages.

4. Water molecules moves freely in and out of these pores but the Zeolite framework remains rigid and the pore/channel sizes are nearly uniform, allowing the crystal to act as a molecular sieve.

34. b) (ii) Uses of Borax:

1. Borax is used for the identification of coloured metal ions.
2. In the manufacture optical and borosilicate glass, enamels and glazes for pottery.
3. It is also used as a flux in metallurgy and acts as a good preservative.

35. a) (i) Position of Lanthanoids and actinoids in the Periodic table:

1. The actual position of Lanthanoids in the periodic table is at group number (III) and period number 6. However, after Lanthanum, the e⁻s are preferentially filled in 4f subshell and the 14 elements following Lanthanum show similar chemical properties. Therefore these elements are grouped together and placed at the bottom of the periodic table.

2. Similarly the 14 elements following Actinium resemble in their physical and chemical properties. If we place Actinoids after Lanthanum in the periodic table below 4d series, the properties of the elements belongs to a group would be different and it would affect the proper structure of the periodic table. Hence a separate position is provided to the inner transition elements in the periodic table.

3. This position can be justified as follows:

1. Lanthanoids have general electronic configuration

$[Xe]\ 4f^{1-14}\ 5d^{0-1}\ 6s^2$

Actinoids have general configuration $[Rn]\ 5f^{2-14}\ 6d^{0-2}\ 7s^2$

2. The common oxidation state of Lanthanoides and actinoids are +3.
3. All these elements have similar physical and chemical properties.

35. a)(ii) Lanthanide Contraction:

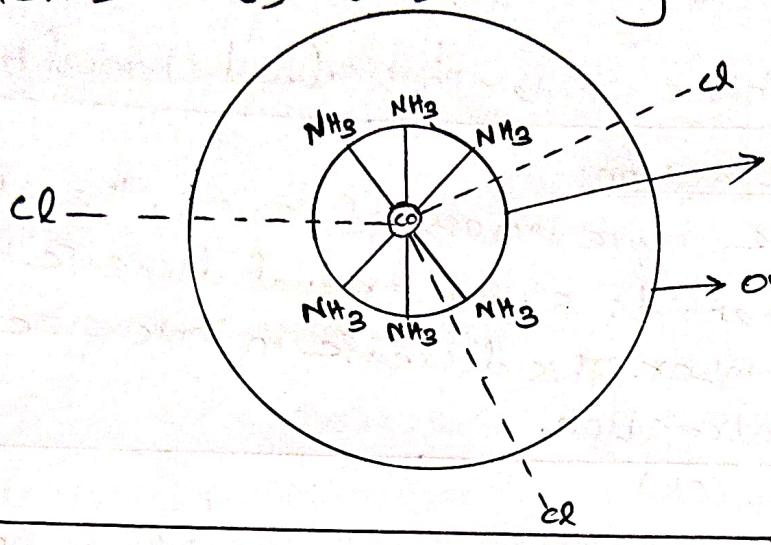
As we move across 4f series, the atomic and ionic radii of Lanthanoids show gradual decrease with increase in atomic number. This decrease in ionic size is called Lanthanoid contraction.

(OR)

35. b) Werner theory:

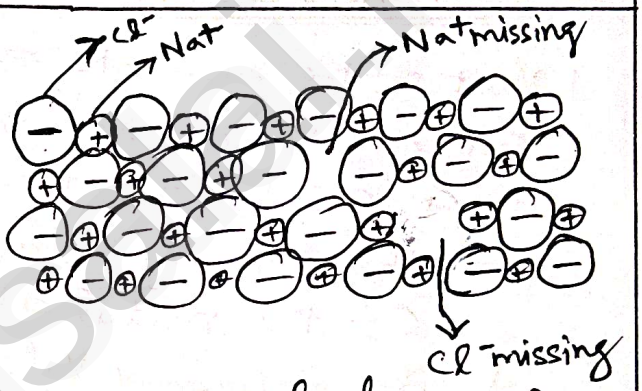
1. Most of the elements exhibit, two types of Valence namely Primary Valence and secondary Valence and each element tend to satisfy both the valences.
   * The primary Valence is referred as the oxidation state of the metal atom.
   * The secondary Valence as the coordination number.
2. The primary Valence of a metal ions in are always satisfied by negative ions.
3. The secondary Valence is satisfied by -ve ions, neutral molecules, +ve ions (or) the combination of these
4. According to Werner there are 2 spheres of attraction around a metal atom/ion in a complex.
5. The inner (or) Coordination sphere: The groups present in this sphere are firmly attached to the metal.
6. The Outer (or) ionisation sphere: The groups present in this sphere are loosely bound to the Central metal ion and hence can be separated into ions upon dissolving the complex in a suitable solvent.
7. The primary Valences are non directional while the Secondary Valences are directional.

8. The geometry of the complex is determined of the groups which satisfy the secondary valence.



36. a) Schottky defect:-

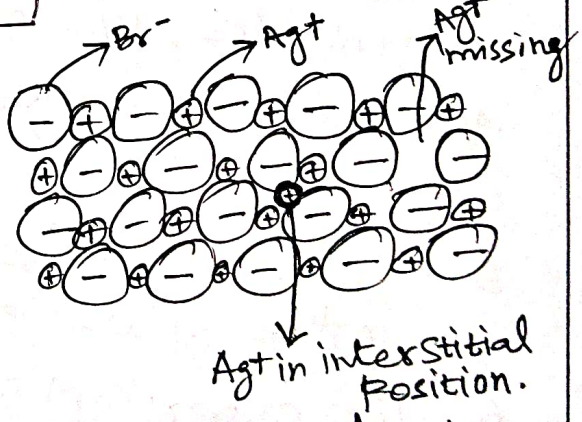
* schottky defect arises due to the missing of equal number of cations and anions from the crystal lattice.
* This effect does not change the Stoichiometry of the crystal.
* Ionic solids in which the cation and anion are of almost of similar size show schottky defect eg: NaCl
* Presence of large number of schottky defects in a crystal, lowers its density. eg: NaCl



Frenkel defect:-

* It arises due to the dislocation of ions from its crystal lattice.
* The ion which is missing from the lattice point occupies in interstitial position
* This defect is shown by ionic solids in which cation and anion differ in size.
* This defect does not affect the density of the crystal.

eg: AgBr.



(OR)

36. b)(i) **Ostwald's dilution law:**

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

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

α = degree of dissociation

	CH_3COOH	CH_3COO^-	H^+
Initial no of moles	1 mole	—	—
Degree of Dissociation of CH_3COOH	α	—	—
No. of moles at equilibrium	$1-\alpha$	α	α
Equilibrium Concentration	$C(1-\alpha)$	$C\alpha$	$C\alpha$

$$K_a = \frac{\alpha C \cdot \alpha C}{(1-\alpha)C} = \frac{\alpha^2 C^2}{(1-\alpha)C} = \frac{\alpha^2 C}{1-\alpha}, \quad \boxed{K_a = \frac{\alpha^2 C}{1-\alpha}}$$

In above equation α is too small and $(1-\alpha) \to 1$

$$K_a = \frac{\alpha^2 C}{1}, \quad K_a = \alpha^2 C, \quad \alpha^2 = \frac{K_a}{C} \quad \boxed{\alpha = \sqrt{\frac{K_a}{C}}}$$

$$[H^+] = \alpha \cdot C = \sqrt{\frac{K_a}{C}} \cdot C = \left(\frac{K_a}{C}\right)^{1/2} \cdot C^{1/2} \cdot C^{1/2} = (K_a \cdot C)^{1/2}$$

$\boxed{[H^+] = \sqrt{K_a \cdot C}}$, For weak base, $[OH^-] = \sqrt{K_b \cdot C}$, $\alpha = \sqrt{\frac{K_b}{C}}$

36. b)(ii) **Kohlrausch's law:**

At infinite dilution, the limiting molar conductivity (Λ_m°) of an electrolyte is equal to the sum of the limiting molar conductivities of its constituent ions.

eg: $(\Lambda_m^\circ)_{NaCl} = (\lambda_m^\circ)_{Na^+} + (\lambda_m^\circ)_{Cl^-}$

37. a) **Nernst equation:-**

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$$xA + yB \rightleftharpoons lC + mD$$

$$Q = \frac{[C]^l [D]^m}{[A]^x [B]^y} \quad \text{——(1)}$$

$$\Delta G = \Delta G^\circ + RT \ln Q \quad \text{——(2)}$$

The Gibbs free energy can be related to the cell emf as follows.

$\Delta G = -nFE_{cell}$; $\Delta G^\circ = -nFE^\circ_{cell}$

Substitute these values and Q from (1) in the equation (2)

$$-nFE_{cell} = -nFE^\circ_{cell} + RT \ln \frac{[C]^l [D]^m}{[A]^x [B]^y} \quad \text{---(3)}$$

Divide the equation (3) by $-nF$

$$E_{cell} = E^\circ_{cell} + \frac{RT}{-nF} \ln \frac{[C]^l [D]^m}{[A]^x [B]^y}$$

$$E_{cell} = E^\circ_{cell} - \frac{RT}{nF} \ln \frac{[C]^l [D]^m}{[A]^x [B]^y} \quad \text{---(4)}$$

$$E_{cell} = E^\circ_{cell} - \frac{2.303\,RT}{nF} \log \frac{[C]^l [D]^m}{[A]^x [B]^y} \quad (\because \ln = 2.303 \log)$$

This equation is called the Nernst equation.

(OR)

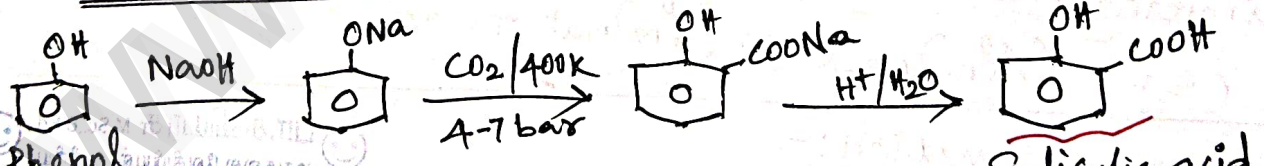
37.b)(i) **Lucas Test: (Differentiating 1°, 2°, 3° alcohols):**

3° alcohol → $(CH_3)_3C-OH \xrightarrow[anhyd.ZnCl_2]{Conc.HCl} (CH_3)_3C-Cl + H_2O$ (immediate appearance of turbidity)

2° alcohol → $(CH_3)_2CH-OH \xrightarrow[anhyd.ZnCl_2]{Conc.HCl} (CH_3)_2CH-Cl + H_2O$ (Slow appearance of turbidity)

1° alcohol → $CH_3CH_2OH \xrightarrow[anhyd.ZnCl_2]{Conc.HCl}$ No reaction at room temperature (Turbidity appears only on heating)

37.b)(ii) **Kolbe's reaction:**



38. (i) **Aldol Condensation:**

$$CH_3CHO + HCH_2CHO \xrightarrow{dil.NaOH} CH_3\underset{OH}{CH}-CH_2CHO$$

Aldol

Mechanism:

Step 1: $CH_3CHO \xrightarrow{OH^-} {}^-CH_2CHO + H_2O$

Carbanion

Step2: $CH_3\overset{\curvearrowleft}{CH}=\overset{\curvearrowright}{O} + \bar{C}H_2CHO \longrightarrow CH_3CH(O^-)-CH_2CHO$

Step3: $CH_3CH(O^-)-CH_2CHO \xrightarrow{H-OH} CH_3CH(OH)-CH_2CHO + OH^-$

Aldol.

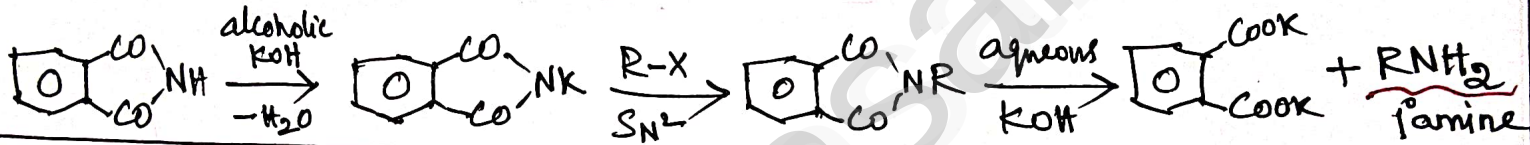
38. a)(ii) **Clemmensen reduction:**

$$CH_3COCH_3 + 4(H) \xrightarrow[\text{Conc. HCl}]{Zn/Hg} CH_3CH_2CH_3 + H_2O$$

Acetone — Propane.

(OR)

38. b)(i) **Gabriel phthalimide Synthesis:**



38. b)(ii) **Hormones:**

Hormone is an organic substance that is secreted by one tissue it limits the blood stream and induces a physiological response in other tissues. It is an intercellular signalling molecules. eg: Insulin, estrogen.

Prepared

By

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