12 P 21.11.24

திருப்பூர் மாவட்டம்

# Second Mid-Term Test - 2024

Register No. பா.கவியரசு

Time : 1.30 Hrs. CHEMISTRY Marks : 50

## PART - A

Answer Key

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I. **Answer all the questions.** 10 x 1 = 10

**Choose the correct answer.**

BB 1) A magnetic moment of 1.73 BM will be shown by one among the following.

a) $TiCl_4$ b) $[COCl_6]^{4-}$ (c) $[(Cu(NH_3)_4]^{2+}$ d) $[Ni(CN)_4]^{2-}$

BB 2) How many geometrical isomers are possible for $[Pt(Py)(NH_3)(Br)(Cl)]$?

(a) 3 b) 4 c) 0 d) 15

BB 3) How many Faradays of electricity are required for the following reaction to occur $MnO_4^- \rightarrow Mn^{2+}$ (+7 -8, 5e⁻)

(a) 5F b) 3F c) 1F d) 7F

BB 4) Which of the following electrolytic solution has the least specific conductance

a) 2 N (b) 0.002 N c) 0.02 N d) 0.2 N

BB 5) Hair cream is

a) gel (b) emulsion c) solid sol d) sol

BB 6) The phenomenon observed when a beam of light is passed through a colloidal solution is

a) cataphoresis b) electrophoresis c) coagulation (d) Tyndall effect

BB 7) Which of the following reagent can be used to convert nitrobenzene to aniline

(a) Sn/HCl b) ZnHg/NaOH c) $Zn/NH_4Cl$ d) All of these

BB 8) Secondary nitro alkanes react with nitrous acid to form

a) red solution (b) blue solution c) green solution d) yellow solution

Int 9) Write the IUPAC name of the compound $CH_3-CH(NO_2)-CH_3$ II Volume Page no : 197

a) nitro ethane b) nitro propane c) propane - 2 - nitro (d) 2 - nitro propane

Int 10) A solution of silver nitrate is electrolysed for 20 minutes with a current of 2 amperes. Calculate the mass of silveer deposited at the cathode. II Volume Page No : 55 Example

(a) 2.68 g b) 1.68 g c) 3.68 g d) 4.68 g

1 mark Answers:
1. c
2. a
3. a
4. b
5. b
6. d
7. a
8. b
9. d
10. a

BB-8
Int-2
10

## PART - B

II. **Answer any five questions and question number 18 is compulsory.** 5 x 2 = 10

11. In an octahedral crystal field, draw the figure to show splitting of d orbitals. F-73-9
12. Write the limitations of Werner's theory. F-76-3
13. Why does conductivity of a solution decrease on dilution of the solution? F-157-2
14. Which of 0.1 M HCl and 0.1 M KCl do you expect to have greater $\Lambda^0_m$ and why? F-157-6
15. Write notes on Tyndall effect. F-188-56

16. What is the difference between a sol and a gel? F-179-7
17. Write short notes on Hofmann's bromide reaction. F-269-6-a
18. Identify A and B $CH_3 - NO_2 \xrightarrow{LiAlH_4} A \xrightarrow{2CH_3CH_2Br} B$ F-273-11
A → $CH_3NH_2$
B → $CH_3-N(C_2H_5)-C_2H_5$

## PART - C

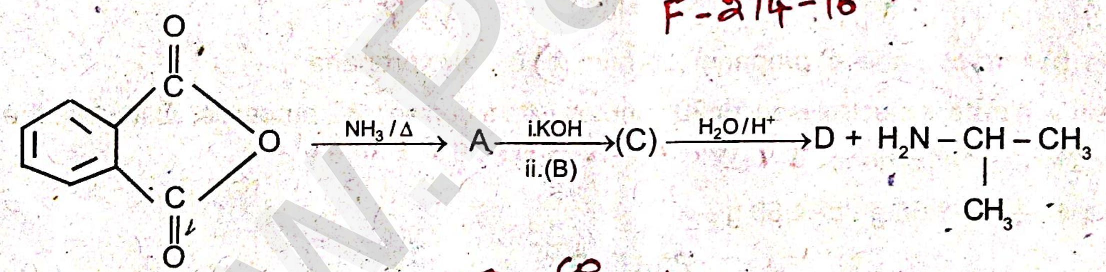
III. **Answer the following questions and question number 26 is compulsory.** **5 x 3 = 15**

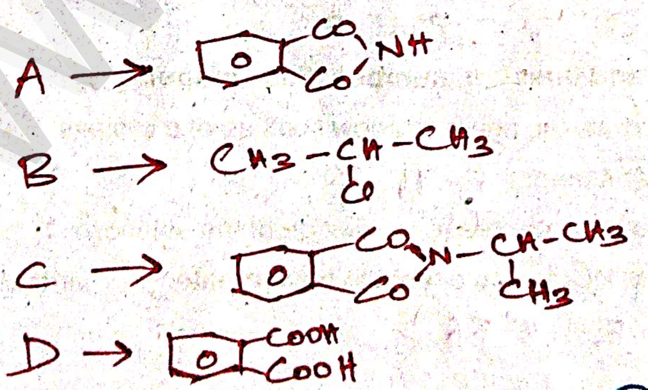
19. Write short notes on carbylamine reaction. F-269-6-e
20. How will you prepare propan - 1 - amine from i) butane nitrile ii) propanamide F-272-10
21. State Faraday's laws of electrolysis. F-157-4
22. State Kohlrausch law. F-157-3 a
23. Write any 3 methods of preparation of colloid by condensation method. II volume Page no: 90
24. Describe adsorption theory of catalysis. F-192-4
25. Discuss briefly the nature of bonding in metal carbonyls. F-85-3
26. On the basis of VB theory explain the nature of bonding in $[Co(C_2O_4)_3]^{3-}$ F-86-4

## PART - D

**Answer all the questions.** **3 x 5 = 15**

27. Write the postulates of Werner's theory. F-85-2
**(OR)**
A solution of $[Ni(H_2O)_6]^{2+}$ is green, whereas a solution of $[Ni(CN)_4]^{2-}$ is colorless - Explain. F-75-18
28. Describe the construction of Daniel cell. Write the cell reaction. F-166-2
**(OR)**
Differentiate physisorption and chemisorption. F-191-1
29. Derive an expression for Nernst equation. F-166-3
**(OR)**
Predict A, B, C and D for the following reaction. F-274-16



# II midterm +2 Em Answerkey

21.11.24

## Chemistry (Tiruppur district)

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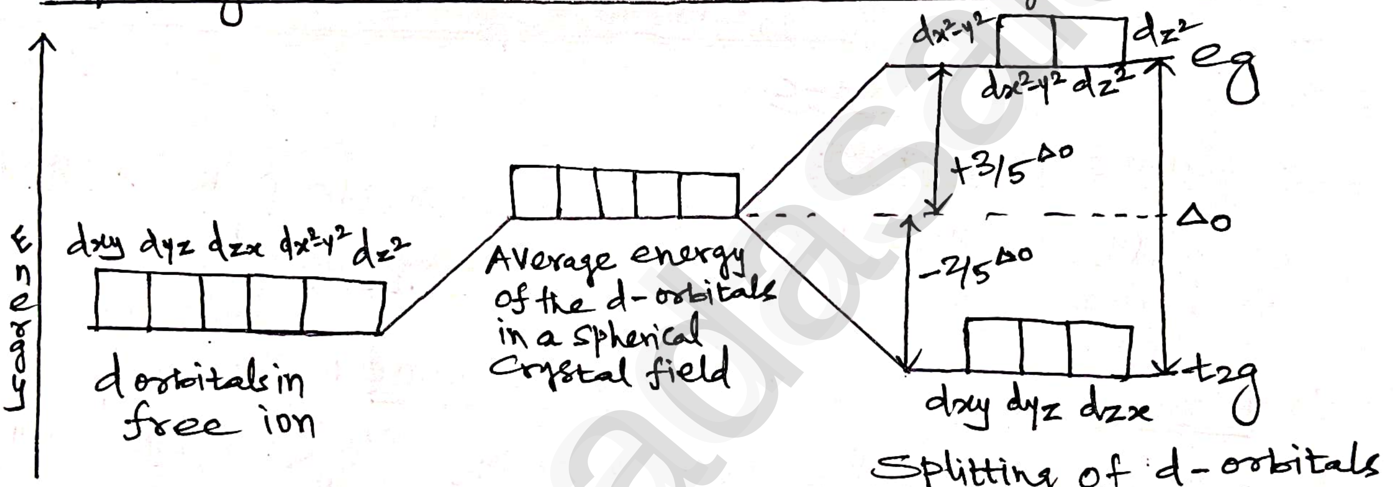
**1 marks:** Part-I (A) 10×1=10

1. c) $[Cu(NH_3)_4]^{2+}$
2. a) 3
3. a) 5F
4. b) 0.002N
5. b) Emulsion
6. d) Tyndall effect
7. a) Sn|HCl
8. b) blue solution
9. d) 2-nitro propane
10. a) 2.68g

**2 Marks:** Part-II (B) 5×2=10

11. Splitting of 'd' orbitals in octahedral crystal field:-




Splitting of d-orbitals in an octahedral crystal field.

12. Limitations of Werner's theory:-
It does not explain colour and magnetic properties of coordination complex.

13. This is due to the fact that the number of ions per unit volume that carry the current in a solution decrease on dilution.

14. 0.1 M HCl has greater molar conductance because $\Lambda_m$ value of 0.1 M HCl is $39.132 \times 10^{-3}\ Sm^2\ mol^{-1}$ but $\Lambda_m$ value of 0.1 M KCl is only $12.896 \times 10^{-3}\ Sm^2 mol^{-1}$

15. Tyndall effect: when light pass through colloidal solution, It is scattered in all directions.

| 16. Sol | Gel |
|---|---|
| 1. The liquid state of a colloidal solution | The solid (or) semisolid stage of a colloidal solution. |
| 2. Very low viscosity | Very high viscosity |
| 3. It does not have definite structure | It possesses definite structure. |

17. Hofmann's Bromide reaction:-

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$$CH_3CONH_2 \xrightarrow{Br_2/KOH} CH_3NH_2 + K_2CO_3 + KBr + H_2O$$

18. [Compulsory]:

$$CH_3NO_2 \xrightarrow{LiAlH_4} \underset{(A)}{CH_3NH_2} \xrightarrow{2C_2H_5Br} \underset{(B)}{CH_3-N(C_2H_5)-C_2H_5}$$

Ans: A → methylamine, B → N-methyl-N-methyl ethane-1-amine

3 Marks: Part-C 5×3=15

19. Carbylamine reaction:

$$\underset{\text{Ethylamine}}{C_2H_5NH_2} + CHCl_3 + 3KOH \longrightarrow \underset{\text{Ethyl isocyanide}}{C_2H_5NC} + 3KCl + 3H_2O$$

20. (i) Butane nitrile ⟶ Propan-1-amine:

$$CH_3CH_2CH_2CN \xrightarrow{H_2O} CH_3CH_2CH_2CONH_2 \xrightarrow[KOH]{Br_2} CH_3CH_2CH_2NH_2$$

(ii) Propanamide ⟶ Propan-1-amine:

$$CH_3CH_2CONH_2 \xrightarrow[(ii)\ H_2O]{(i)\ LiAlH_4} CH_3CH_2CH_2NH_2$$

21. Faraday's laws of electrolysis:-

First law: The mass of the substance (m) liberated at an electrode during electrolysis is directly proportional to the quantity of charge (Q) passed through the cell.

(i.e.,) $m \propto Q$, $m \propto It$, $(Q = It)$, $m = ZIt$

Second law: When the same quantity of charge is passed through the solutions of different electrolytes, the amount of substances liberated at the respective electrodes are directly proportional to their electro chemical equivalents.

22. Kohlrausch law:-

At infinite dilution, the limiting molar conductivity ($\Lambda_m^0$) of an electrolyte is equal to the sum of the limiting molar conductivities of its constituent ions. eg: $(\Lambda_m^0)_{NaCl} = (\lambda_m^0)_{Na^+} + (\lambda_m^0)_{Cl^-}$

23. Condensation methods:- (any 3)

* oxidation:-

$$2H_2Se + O_2 \longrightarrow 2H_2O + Se\ (sol)$$

$$HIO_3 + 5HI \longrightarrow 3H_2O + I_2\ (sol)$$

* Reduction:

$$2AuCl_3 + 3HCHO + 3H_2O \longrightarrow 6HCl + 3HCOOH + 2Au\ (sol)$$

* Hydrolysis:-

$$FeCl_3 + 3H_2O \longrightarrow Fe(OH)_3 + 3HCl$$

* Decomposition:

$$S_2O_3^{2-} + 2H^+ \longrightarrow S_{(sol)} + H_2O + SO_2$$

* Double Decomposition:-

$$As_2O_3 + 3H_2S \longrightarrow As_2S_3 + 3H_2O$$

24. Adsorption theory of Catalysis:-

1. This theory explains the mechanism of Heterogeneous Catalysis
2. 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.

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

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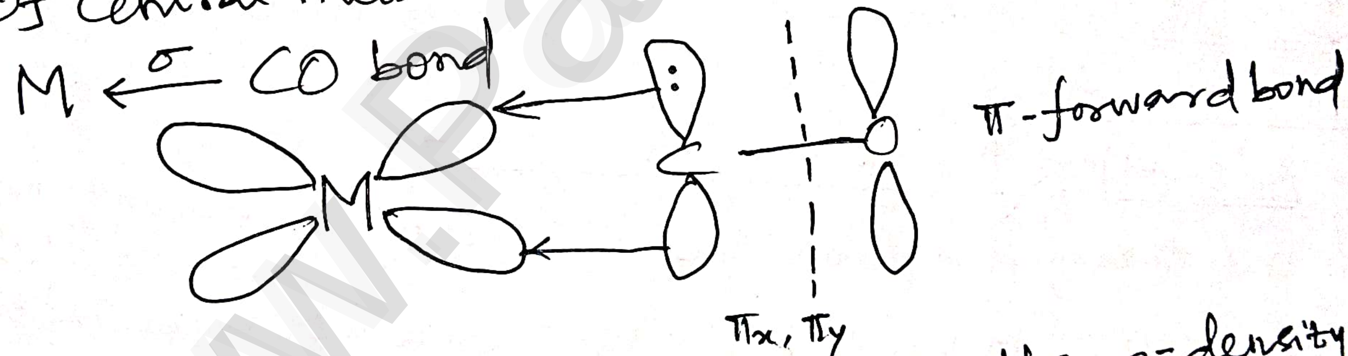
25. <u>Bonding in Metal Carbonyls:</u>

In metal carbonyls, the bond between metal atom and the Carbonyl ligand consists of 2 components:

1. The first Component is an e- pair donation from the Carbon atom of Carbonyl ligand into a vacant d-orbit Of Central metal atom. This e- pair donation forms




This σ bond formation increases the e- density in metal 'd' orbitals.

2. In order to compensate for this increased e- density a filled metal d-orbital interacts with the empty π* orbital on the Carbonyl ligand and transfers the added e- density back to the ligand. This is called π-back bonding.

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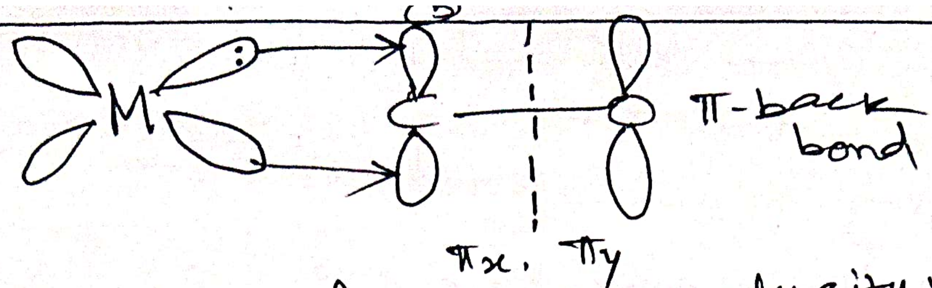



Thus, in metal carbonyls, e-density moves from ligand to metal through σ-bonding and from metal to ligand through π-bonding, this synergic effect accounts for strong M ← CO bond in metal carbonyls.

26. [Compulsory] :- $[Co^{3+}(C_2O_4^{6-})_3]^{3-}$



$Co \rightarrow 3d^7 4s^2$, $Co^{3+} \rightarrow 3d^6 4s^0$

$Co^{3+}$ ion ⇒ 3d: [↿⇂ | ↿ | ↿ | ↿ | ↿]  4s: [ ]  4p: [ | | ]

$(C_2O_4^{6-})_3$ act as strong field ligand so all the unpaired $e^-$s are paired up in 3d orbitals.

3d: [↿⇂ | ↿⇂ | ↿⇂ | ×× | ××]  4s: [××]  4p: [×× | ×× | ××]

Hybridisation ⇒ $d^2sp^3$ (Inner orbital complex)

Shape → Octahedral geometry

Magnetic Property → Diamagnetic, $\mu_s = 0$

5 Marks: Part-D $3 \times 5 = 15$

27. a) Postulates of Werner's 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.

2. Primary Valency of a metal ions are always satisfied by negative ions.

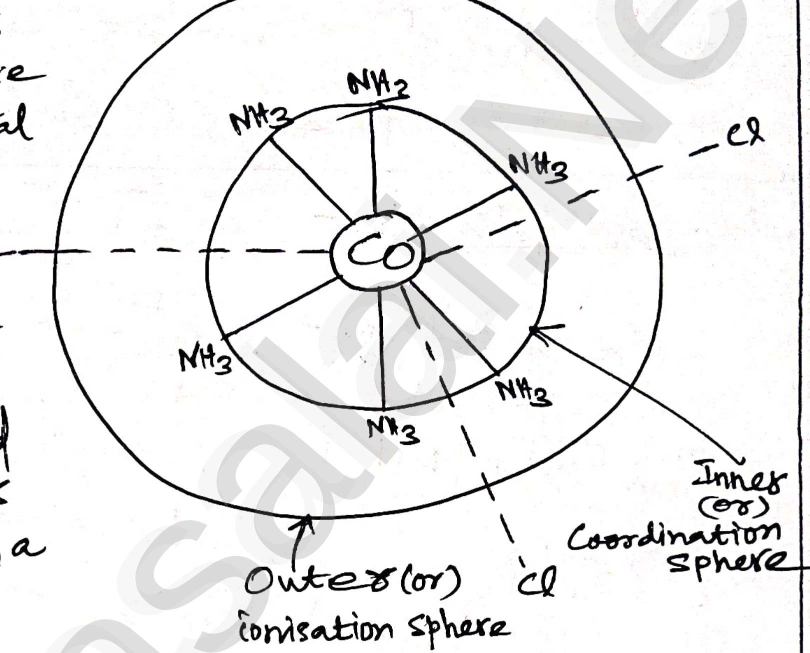
3. Secondary Valency of a metal ions in are always satisfied by negative ions, neutral molecules, positive ions (or) the combination of these

* Primary Valence referred as the Oxidation state Of the metal atom.
* Secondary Valence referred as the Coordination number.

4. According to werner, there are two spheres of attraction around a metal atom/ion in a Complex

* The inner (or) Coordination sphere:
The groups present in this sphere are firmly attached to the metal

* The outer (or) ionisation Sphere: Cl
The groups present in the sphere are loosely bound to the central metal ion and hence be separated into ions upon dissolving the complex in a suitable solvent.




5. The primary Valences are non-directional while the Secondary Valences are directional.

6. The geometry of the complex is determined by the spatial arrangement of the groups which satisfy the Secondary Valence.

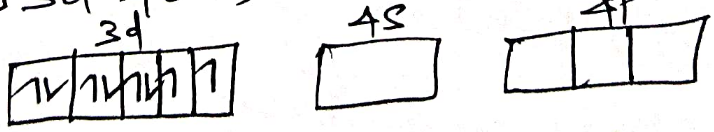


(OR)

27. b) $[Ni(H_2O)_6]^{2+}$ is Green:-

$Ni \rightarrow [Ar]\,3d^8 4s^2$, $Ni^{2+} \rightarrow [Ar]\,3d^8 4s^0$

$[Ni(H_2O)_6]^{2+} \rightarrow$




1. In above Complex, $H_2O$ molecules are weak field ligands, as a result, the Complex has 2 unpaired $e^-$s. Thus, d-d transition takes place due to

absorption of radiation corresponding to red light and the emission of complementary green colour occurs.

**$[Ni(CN)_4]^{2-}$ → Colourless:**

$Ni \rightarrow [Ar]\,3d^8 4s^2$, $Ni^{2+} \rightarrow [Ar]\,3d^8 4s^0$

$Ni^{2+} \rightarrow$ 3d: [↑↓][↑↓][↑↓][↑][↑] 4s: [ ] 4p: [ ][ ][ ]

$[Ni(CN)_4]^{2-} \rightarrow$ 3d: [↑↓][↑↓][↑↓][↑↓][ ] 4s: [ ] 4p: [ ][ ][ ]

In $[Ni(CN)_4]^{2-}$, $CN^-$ are strong field ligands, so the 2 unpaired e⁻s in the 3d orbital paired up. Hence there is no unpaired e⁻ and no d-d transition. Hence it is colourless.



28. a) **Construction of 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 externally 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 agar-agar gel mixed with an inert electrolyte such as KCl, $Na_2SO_4$.
3. When the switch (k) closes the circuit, the electrons flows from Zn strip to Cu strip.

**Anodic oxidation:** In Daniel cell, the oxidation takes place at Zn electrode. The $Zn^{2+}$ ions enters the solution and the e⁻s enter the Zn metal.



$$Zn_{(s)} \longrightarrow Zn^{2+}_{(aq)} + 2e^-$$

**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

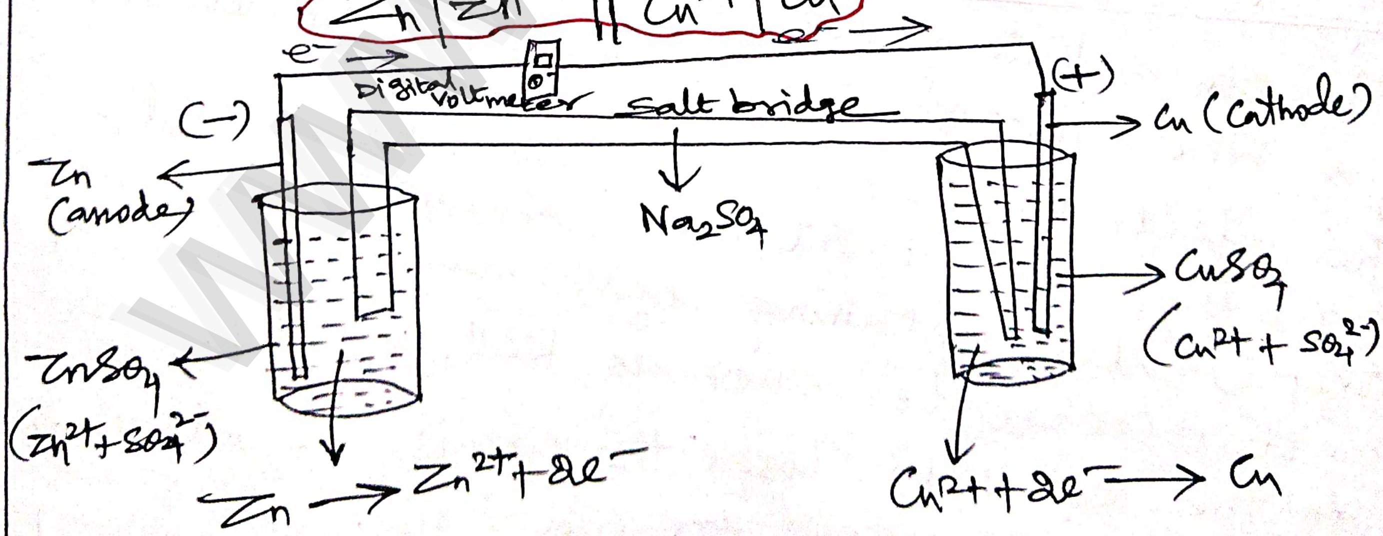
$$Cu^{2+}_{(aq)} + 2e^- \longrightarrow Cu_{(s)}$$

**Salt bridge:** The electrolyte present in 2 halfcells 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 the anodic compartment, at the same time some of cations $K^+$ ions move from the salt bridge into cathodic compartment.

**Completion of Circuit:**

Electrons flow from Zn into the Cu through the external wire, at the same time, anions move towards the anode and cations move towards cathode. This completes the circuit.

$$Zn \mid Zn^{2+} \parallel Cu^{2+} \mid Cu \qquad E^0 = 1.1\,V$$



(OR)

| 28.b) Chemisorption | Physisorption |
|---|---|
| 1. It is very low | It is instantaneous |
| 2. It is Very Specific | It is nonspecific |
| 3. When temperature is raised Chemisorption first increases and then decreases. | It decreases with increase in temperature. |
| 4. It involves transfer of $e^-$s between the adsorbent and adsorbate | No transfer of $e^-$s. |
| 5. Heat of adsorption is High | Heat of adsorption is low |
| 6. Monolayer of the adsorbate is formed. | Multilayer of the adsorbate is formed. |
| 7. Adsorption occurs at fixed sites | It occurs on all sides |
| 8. It involves the formation of activated complex with appreciable activation energy | Activation energy is insignificant |

29. a) Nernst equation:-

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

The reaction quotient Q for the above reaction is

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

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

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 eqn(2) we get

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

Divide the whole equation (3) by $-nF$ we get

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

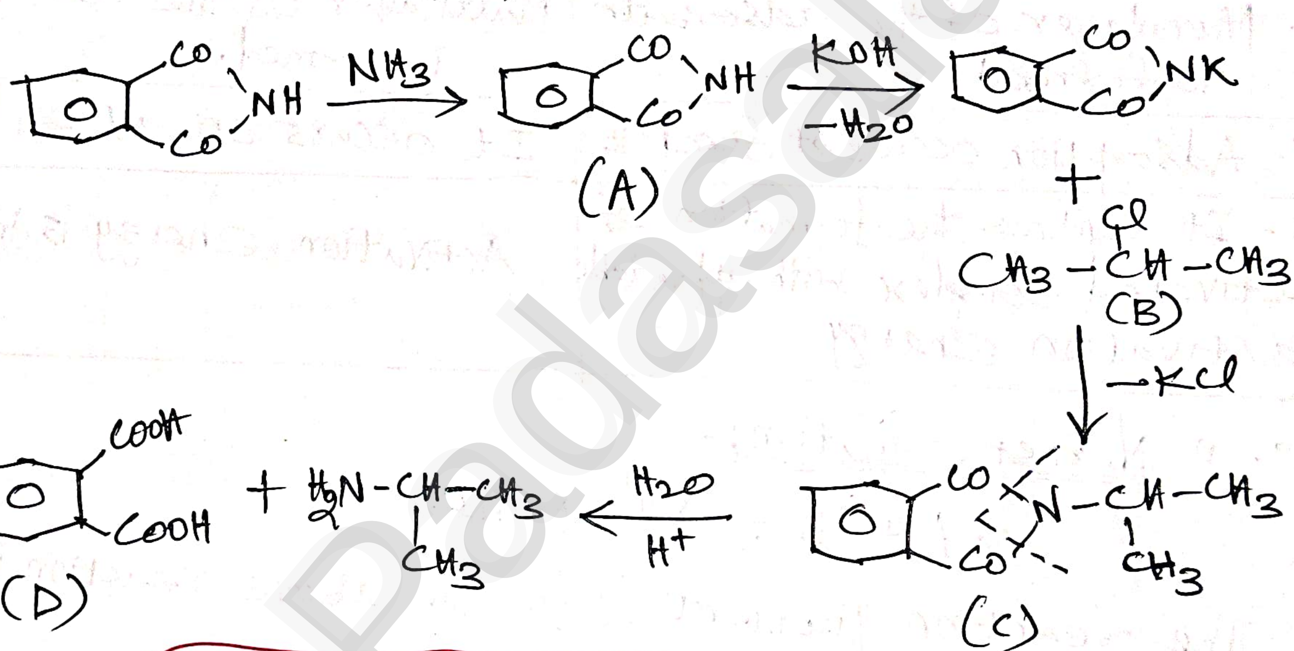
$\ln = 2.303 \log$ substitute in eqn (4)

$$E_{cell} = E^{\circ}_{cell} - \frac{2.303\,RT}{nF} \log \frac{[C]^l [D]^m}{[A]^x [B]^y} \quad \text{--- (5)}$$

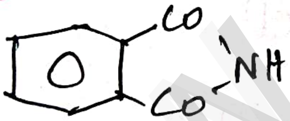
This equation is called the Nernst equation.

(OR)

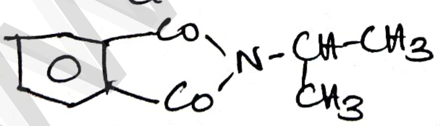
29. b)

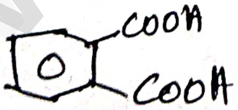



**Ans:**

A →  → Phthalimide

B → $CH_3-\underset{Cl}{CH}-CH_3$ → Isopropyl chloride

C →  → N-isopropyl Phthalimide

D →  → Phthalic acid

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