பா.கவியரசு M.Sc.,B.Ed.,
முதுகலை வேதியியல் ஆசிரியர்

Answer key

12

Reg. No.

Quarterly Examination - 2024

Time : 3.00 hrs. Max. Marks : 70

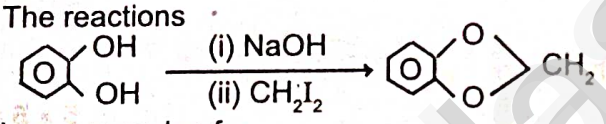
27.9.24

CHEMISTRY

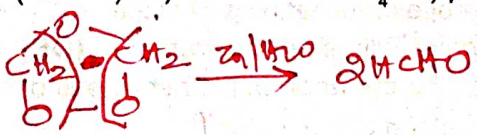
PART - I

I. **Note : (i) Answer all the questions. ii) Choose the best answer and write the option code and the corresponding answer.** 15 x 1 = 15

1. In the electrolytic refining of copper which one of the following is used as anode?
a) pure copper b) impure copper c) carbon rod d) platinum electrode
2. The compound that is used in nuclear reactors as protective shields and control rod is
a) metal borides b) metal oxides c) metal carbonates d) metal carbide
3. Sodium salt of tetraboric acid is known as Borax I volume Page No: 33
a) B_2H_6 b) Na_2BO_3 c) H_3BO_3 d) $Na_2B_4O_7 . 10H_2O$
4. The molarity of given orthophosphoric acid solution is 2M, its normality is
a) 6N b) 4N c) 2N d) none of the above
5. Which of the following is Caro's acid I Volume Page No: 81
a) $H_2S_2O_8$ b) $H_2S_2O_7$ c) H_2SO_5 d) H_2SO_3
6. Among the transition metals of 3d series the one that has highest negative (M^{2+}/M) standard electrode potential a) Zn b) Cu c) Mn d) Ti
7. The actinoid elements which show the highest oxidation state of +7 are
a) Np, Pu, Am b) U, Fm, Th c) U, Th, Md d) Es, No, Lr
8. The crystal with a metal deficiency defect is
a) NaCl b) FeO c) ZnO d) KCl
9. In Napthalene, constituent molecules are held together by I Volume Page No: 179
a) Electrostatic attraction b) London forces c) Hydrogen bond d) strong dipole - dipole interaction
10. The reactions



is an example of
a) Wurtz reaction b) Cyclic reaction c) Williamson reaction d) Kolbe reaction
11. The oxidising agent used in Swern oxidation is II volume Page No: 117
a) Fenton's reagent b) Dimethyl sulfoxide (DMSO) c) alkaline $KMnO_4$ d) periodic acid
12. $CH_2 = CH_2 \xrightarrow[(ii)\ Zn/H_2O]{(i)\ O_3} x$ 'x' is



a) Formaldehyde b) diacetone ammonia c) hexamethylene tetramine d) oxine
13. The aqueous solutions of sodium formate, anilinium chloride and potassium cyanide are respectively.
a) acidic, acidic, basic b) basic, acidic, basic c) basic, neutral, basic d) none of these
14. The relationship between the solubility product (ksp) and molar solubility (s) for Ag_2CrO_4 is
a) $Ksp = s^3$ b) $ksp = s^2$ c) $ksp = 4s^3$ d) $ksp = 3s^2$ II volume Page No: 26
15. If the initial concentration of the rectant is doubled, the time for half reaction is also doubled. Then the order of the reaction is
a) zero b) one c) fraction d) none of the above

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

BB-9
Int-6
15

PART - II

Answer any six questions. Q.No.24 is compulsory. 6 x 2 = 12

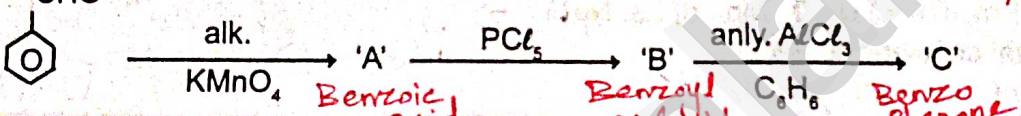
16. What is Activation energy (Ea)? F-12.1-11
17. What is the role of quick lime in the extraction of iron from its oxide Fe_2O_3? F-3-3

F → Focus guide

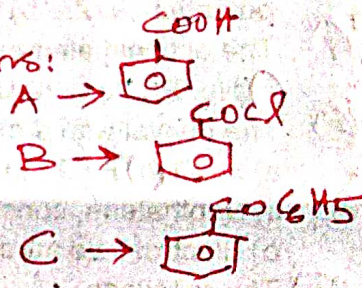
18. Distinguish between Isotropy and Anisotrophy in solids. F - 102-3
19. What is urotrophine? How is it prepared? F-242-20
20. Write a note on coupling reaction in phenol. F-215-40
21. Explain why Cr^{+2} is strongly reducing while Mn^{+3} is strongly oxidising. F-56-12
22. Write a note on hydroboration reaction. F-210-6
23. Explain the bleaching action of chlorine with suitable example. F-47-63
24. Calculate the pH of 0.04M HNO_3 F-135 Ans: pH = 1.40

PART - III

Answer any six questions. Q.No.33 is compulsory **6 x 3 = 18**

25. Explain Schotky defect. F-100-6
26. Differentiate molecularity from order. F-118-4
27. Explain common ion effect with an example. F-135-9
28. Explain Froth flotation method. F-8-7
29. (i) Write about McAfee process of manufacturing $AlCl_3$. F-27-34
    (ii) CO is a reducing agent. Justify with an example. F-20-4
30. (i) What is inertpair effect? F-37-1
    (ii) What is the hybridisation of Iodine in IF_7? Give its structure. F-38-8
31. Explain the method of preparation of potassium dichromate. F-64-1
32. Convert the following. F-210-11
    (i) Ethylene to Ethyleneglycol. (ii) Glycerol to Acrolein. F-221-12
33. 

Benzoic acid
Benzoyl Chloride
Benzo Phenone
Identify A, B & C. Explain the reaction.

Ans:


PART - IV

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

34. a) (i) Distinguish tetrahedral and octahedral voids. (3) F-101-9
    (ii) What is coordination number? What is the coordination of CsCl? (2) F-101-12 **(OR)**
    b) Explain the factors affecting reaction rate. (5) F-121-12 I Volume Page No: 222
35. a) (i) Explain Mond process for refining of nickel. (3) F-5-5
    (ii) Give the limitations of Ellingham diagram. (2) **(OR)** F-7-12
    b) (i) Write the reason for the anomalous behavious of nitrogen. F-39-13
    (ii) Give the uses of helium (2) F-38-7
36. a) Describe the structure of diborane. **(OR)** F-33-2
    b) Compare Lanthanoids and Actinoids. F-56-10
37. a) Derive an expression for Ostwald's dilution law. **(OR)** F-142-2
    b) (i) Mention the uses of glycerol. (2) F-213-25
    (ii) Write a note on Williamson synthesis. (3) F-222-4
38. a) Derive Henderson - Hasselbach equation. **(OR)** F-144-2
    b) (i) Explain the mechanism of Aldol - condensation. (3) F-249-5
    (ii) Write a note on Etard reaction. (2) F-241-12

+2 Em Quarterly Exam Answer Key

Date: 27.9.24 — Chemistry [Tiruppur district]

பா.கவியரசு M.Sc.,B.Ed., முதுகலை வேதியியல் ஆசிரியர்

1 marks :- Part-I — 15×1=15

1. b) impure copper
2. a) metal borides
3. d) $Na_2B_4O_7 \cdot 10H_2O$
4. a) 6N
5. c) H_2SO_5
6. d) Ti
7. a) Np, Pu, Am
8. b) FeO
9. b) London forces
10. c) Williamson reaction
11. b) Dimethyl sulfoxide (DMSO)
12. a) formaldehyde
13. b) basic, acidic, basic
14. c) $ksp = 4S^3$
15. a) zero

2 Marks: Part-II — 6×2=12

16. **Activation Energy: (Ea):**

The minimum energy that a molecule must have to posses to react is known as Activation Energy

17. In Iron extraction, limestone act as a basic flux. The Silica (gangue) present in the ore is acidic in nature. On heating limestone gives CaO. It combines with silica to form Calcium silicate ($CaSiO_3$) (slag).

$$\underset{\text{(flux)}}{CaO} + \underset{\text{(gangue)}}{SiO_2} \longrightarrow \underset{\text{(slag)}}{CaSiO_3}$$

பா.கவியரசு M.Sc.,B.Ed., முதுகலை வேதியியல் ஆசிரியர்

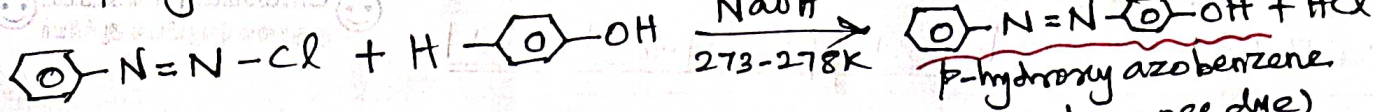
18.

Isotropy	Anisotropy
Isotropy means having identical values of physical properties in all directions. Such as refractive index, electrical conductance eg: Amorphous solids.	Anisotropy means having different values of physical properties when measured along different directions. eg: Crystalline solids.

19. **Urotropine:** Urotropine known as hexa methylene tetraamine formaldehyde forms hexamethylene tetramine with NH_3.

$$6CH_2O + 4NH_3 \longrightarrow \underset{\text{Urotropine}}{(CH_2)_6N_4} + 6H_2O$$

20. Coupling reaction in phenol :



p-hydroxy azobenzene (Red orange dye)

21.

$$Cr^{2+} \longrightarrow Cr^{3+} + e^-$$
$$(d^4) \qquad (d^3)$$

Cr^{3+} has half filled t_{2g}^3 configuration, it is a more stable configuration. Hence Cr^{2+} is easily oxidised to Cr^{3+}. So it acts as strong reducing agent.

$$Mn^{3+} + e^- \longrightarrow Mn^{2+}$$
$$(d^4) \qquad (d^5)$$

Thus Mn^{3+} is easily reduced to Mn^{2+}. The extra stability associated with half filled 'd' subshell makes the reduction of Mn^{3+} is very easy. Hence Mn^{3+} is act as strong oxidising agent.

22. Hydroboration reaction :-

Diborane reacts with propylene to form tripropyl borane which on treatment with H_2O_2 in presence of NaOH gives an alcohol. This reaction yields an anti-Markownikoff's product.

$$6\,CH_3-CH=CH_2 + B_2H_6 \longrightarrow 2\,(CH_3CH_2CH_2)_3B$$

$$(CH_3CH_2CH_2)_3B + 3H_2O_2 \xrightarrow{OH^-} 3\,CH_3CH_2CH_2OH + B(OH)_3$$

23. Bleaching action of Chlorine :

Aqueous chlorine forms HOCl and it gives nascent oxygen.

$$H_2O + Cl_2 \longrightarrow HCl + HOCl$$
$$HOCl \longrightarrow HCl + (O)$$

Colouring matter + (O) $\longrightarrow$ Colourless

The bleaching of chlorine is permanent.

24. [Compulsory] :- Concentration of $HNO_3 = 0.04\,M$

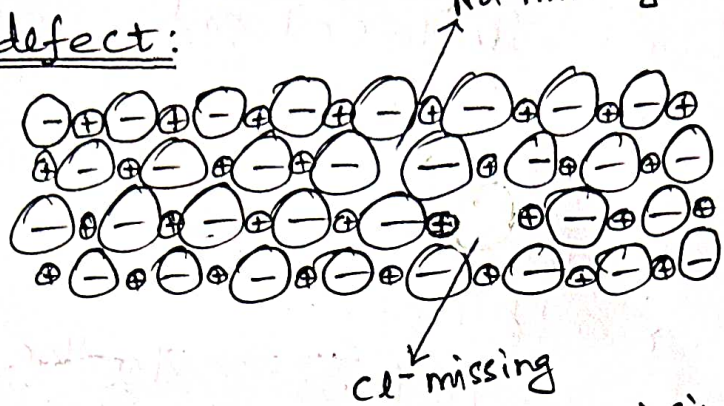
$[H_3O^+] = 0.04\ mol\,dm^{-3}$

$$pH = -\log[H_3O^+] = -\log(0.04) = -\log(4\times10^{-2}) = 2 - \log 4 = 2 - 0.6021 = 1.3979$$

$pH = 1.40$

3 Marks: Part-III 6×3=18

25. **Schotky 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 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.

26. Order of a reaction	Molecularity of a reaction
1. It is the sum of the power of concentration terms involved in the experimentally determined rate law.	It is the total number of reactant species that are involved in an elementary step.
2. It can be zero (or) fractional (or) integer.	It is always a whole number cannot be zero (or) a fractional numbe
3. It is assigned for a overall reaction.	It is assigned for each elementar step of mechanism.

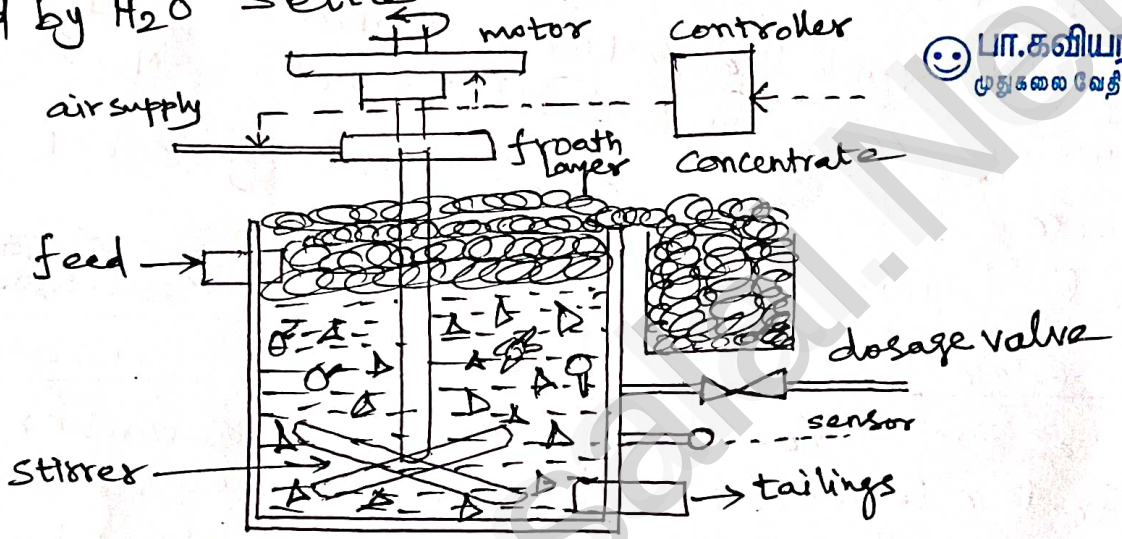
27. **Common ion effect:-**

The dissociation of weak acid is suppressed in the presence of salt containing an ion common to the electrolyte. eg: The dissociation of CH_3COOH is suppressed in the presence of CH_3COONa containing CH_3COO^- act as common ion.

28. **Froath flotation method:-**

* This method is commonly used to concentrate Sulphide ores.
  eg: Galena (PbS), Zinc blende (ZnS).

* Crushed ore is suspended in H_2O and mixed with frothing agent such as pine oil, eucalyptus oil and a small quantity of sodium ethyl xanthate which acts as a collector.
* A froath is generated by blowing air through this mixture. The collector molecules attach to the ore particle and make them water repellent.
* As a result, ore particles rise to the surface along with the froath and it is collected and dried to recover the concentrated ore. The gangue particles that are wetted by H_2O settle at the bottom.



29.(i) **McAfee Process**:-

Aluminium Chloride is obtained by heating a mixture of alumina and coke in a current of chlorine.

$$2Al_2O_3 + 3C + 6Cl_2 \longrightarrow 4AlCl_3 + 3CO_2$$

29.(ii) **CO is a reducing agent**:-

CO reduces Fe_2O_3 into Fe.

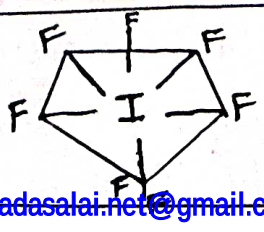
$$3CO + Fe_2O_3 \longrightarrow 2Fe + 3CO_2$$

30.(i) **Inert pair effect**:

In heavier post transition metal, the outer 's' electrons (ns) have tendency to remain inert and show unwillingness to take part in the bonding.

30.(ii) IF_7 $\Rightarrow$ sp^3d^3 hybridisation

This compound has a pentagonal bipyramidal structure.



31. Preparation of $K_2Cr_2O_7$:-

Ore: Chromate ($FeCr_2O_4$), Concentration: By gravity separation

1. Formation of Sodium Chromate:

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

Sodium chromate (yellow)

2. Formation of Sodium dichromate:

$$2Na_2CrO_4 + H_2SO_4 \longrightarrow Na_2Cr_2O_7 + Na_2SO_4 + H_2O$$

Sodium Chromate (yellow). Sodium dichromate (orange red)

3. Formation of Potassium dichromate:-

$$Na_2Cr_2O_7 + 2KCl \longrightarrow K_2Cr_2O_7 + 2NaCl$$

Sodium dichromate (orange red). Potassium dichromate (orange red)

32. (i) Ethylene ⟶ Ethylene glycol:-

$$CH_2=CH_2 + H_2O \xrightarrow{\text{Bayer's reagent (O)}} \underset{\text{Glycol}}{CH_2OH\text{-}CH_2OH}$$

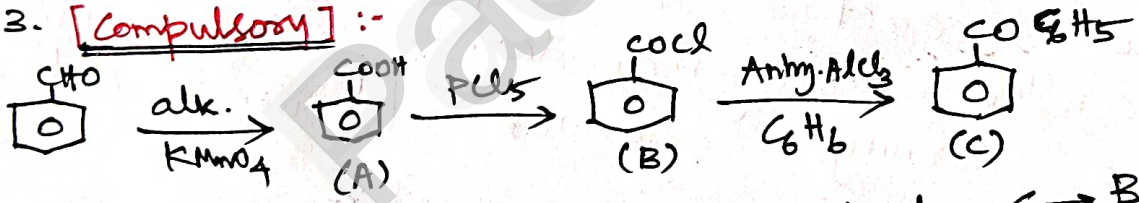
Ethylene

Bayer's reagent → Cold alkaline $KMnO_4$

(ii) Glycerol ⟶ Acrolein:-

$$\underset{\text{Glycerol}}{CH_2OH\text{-}CHOH\text{-}CH_2OH} \xrightarrow[-H_2O]{KHSO_4,\ \Delta} \underset{\text{Acrolein}}{CH_2=CH\text{-}CHO}$$

33. [Compulsory] :-



Ans: A → Benzoic acid, B → Benzoyl chloride, C → Benzophenone

5 Marks: Part - IV 5 × 5 = 25

34. a) (i) Tetrahedral Voids	Octahedral Voids
1. A Void surrounded by 4 spheres occupying the corners of a tetrahedron	A void surrounded by 6 spheres along the corners of an Octahedron.
2. It is formed when a sphere of second layer placed above the Void of first layer.	All the voids of first row which remain unoccupied form Octahedral Void.

Tetrahedral Voids	Octahedral Voids
3. Coordination number is 4	Coordination number is 6
4. The number of tetrahedral voids are equal to 2N	Total number of octahedral Voids are equal to N.

34. a) (ii) Coordination Number :- The number of nearest neighbours that surrounding a particle in a crystal.

* coordination number of CsCl is 8.

(OR)

34. b) Factors effecting reaction rate :-

(i) Nature and state of the reactant :-

* The net energy involved in the chemical reactions is dependent on the nature of the reactant and hence the rates are different for different reactants.

* The physical state of the reactant also plays an important role to influence the rate of reactions. Gas phase reactions are faster as compared to the reactions involving solid (or) liquid reactants.

(ii) Concentration of the reactant :-

The rate of reaction increase in the concentration of the reactants. The effect of concentration is explained on the basis of collision theory of reaction rates. According to this theory the rate of reaction depends upon the number of collisions between the reacting molecules. Higher the concentration greater is the possibility for collision and hence the rate.

(iii) Effect of surface area of the reactant :-

In heterogeneous reactions, the surface areas of the solid reactants play an important role in deciding the rate. For a given mass of a reactant, when the particle size decreases surface area increases. Increase in surface area of reactant leads to more collisions per litre per second and hence the rate of reaction in increased.

(iv) Temperature : When temperature increases rate of the reaction also increased.

(iv) **Effect of Presence of Catalyst**:-

However significant changes in the reaction can be brought out by the addition of substance called Catalyst. In the presence of catalyst, the energy of activation is lowered and hence greater number of molecules can cross the energy barrier and change over the products, thereby increasing the rate of reaction.

35. a) (i) **Mond Process for refining Nickel**:- The impure nickel is heated with stream of CO at around 350K to form a highly volatile nickel tetra carbonyl. The solid impurities left behind. On heating nickel tetra carbonyl around 460K, the complex decomposes to give pure metal.

$$\underset{\text{(impure)}}{Ni} + 4CO \xrightarrow{350K} [Ni(CO)_4] \xrightarrow{460K} \underset{\text{(Pure)}}{Ni} + 4CO$$

35. a) (ii) **Limitations Of Ellingham diagram**:-

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

(OR)

35. b)(i) **The Reason for the Anamalous behaviour of nitrogen**:-

Nitrogen differ from the members of this group due to its small size, High electronegativity. high Ionisation energy and non-availability of d-orbitals.

35. b)(ii) **Uses Of He**:-

1. He-O_2 mixture is used by divers inplace of air oxygen mixture. This prevents the painful dangerous condition called bends.

2. TO Provide inert atmosphere in electric arc welding of metals
3. It has lowest boiling point hence used in cryogenics (low temperature science)
4. Used for filling air baloons.

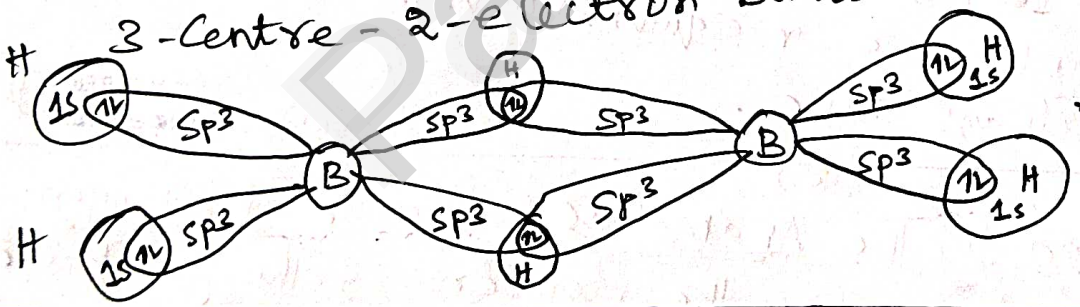
36. a) **Structure of diborane** :-

Structure:

* In diborane 2-BH_2 units are linked by 2 bridged hydrogens. Therefore, it has 8 B-H bonds.
* Diborane has only 12 Valence electrons
* 8 electrons react with 4 'H' atom to form 4 terminal B-H Covalent bonds. (2 Centre - 2 electron bond)
* The remaining 4 electrons have to be used for the bridged bonds. (two 3 centred B-H-B bonds)

Hybridisation in B_2H_6 :-

1. In diborane, the boron has 4-sp^3 hybridised orbitals out Of 4-sp^3 orbitals, 3-sp^3 hybridised orbitals contain One electron and the 4th orbital is empty.
2. 2-sp^3 orbitals of each boron overlap with the 2-Hydrogen to form 4-terminal 2 Centre - 2-electron bonds.
3. Remaining sp^3 orbital and one empty orbital of each boron atom reacts with 1s orbital of Hydrogen to form 3-Centre - 2-electron bonds B-H-B bond (3c-2e bond)



⟹ Structure of Diborane (B_2H_6)

(OR)

36. b) Lanthanoids	Actinoids
1. electron enters in '4f' orbital	electron enters in '5f' orbital
2. Binding energy of '4f' orbitals are higher.	Binding energy of '5f' orbitals are lower.
3. They show less tendency to form Complexes.	They show greater tendency to form Complexes.

Lanthanoids	Actinoids
4. Most of the lanthanoids are colourless.	Most of the Actinoids are coloured. eg: $U^{3+} \rightarrow$ Red
5. They donot form oxocations	They do form oxocations eg: UO_2^{2+}
6. Besides +3 oxidation states lanthanoids show +2 and +4 oxidation states.	Besides +3 oxidation states actinoids show +4, +5, +6 and +7

37. a) **Ostwald's dilution law:-**

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

	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	$(1-\alpha)c$	αc	αc

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

$$K_a = \frac{\alpha c \cdot \alpha c}{(1-\alpha)c} = \frac{\alpha^2 c}{1-\alpha}$$

If α is too small, $1-\alpha = 1$

$$K_a = \alpha^2 c, \quad \alpha^2 = \frac{K_a}{c}$$

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

$$[H^+] = \alpha \cdot c = \sqrt{\frac{K_a}{c}} \cdot c = \sqrt{\frac{K_a \cdot c^2}{c}} = \sqrt{K_a \cdot c}$$

For weak base,

$$[OH^-] = \sqrt{K_b \cdot c}, \quad \alpha = \sqrt{\frac{K_b}{c}}$$

(OR)

37. b) (i) **Uses of Glycerol:-**

* It is used as a sweetening agent in confectionery and beverages.
* It is used in the manufacture of cosmetics and transparent soaps.
* It is used to making printing inks and stamp pad ink and lubricant for watches and clocks.
* It is used in the manufacture of explosive like dynamite and Cordite by mixing it with China clay.

37. b) (ii) **Williamson Synthesis:-** (SN^2)

$$CH_3ONa + BrC_2H_5 \xrightarrow{\Delta} CH_3OC_2H_5 + NaBr$$

Sodium methoxide — ethyl Bromide — Methoxy ethane

38. a) **Henderson – Hasselbach equation:-**

For acidic buffer $\Rightarrow [H_3O^+] = K_a \frac{[acid]}{[base]}$ ——— (1)

Due to common ion effect [base] = [salt]

$[H_3O^+] = K_a \frac{[acid]}{[salt]}$ ——— (2)

Taking negative log on both sides,

$-\log [H_3O^+] = -\log K_a - \log \frac{[Acid]}{[Salt]}$ ——— (3)

We know that,

$pH = -\log [H_3O^+]$, $pK_a = -\log K_a$

eqn(3) becomes $pH = pK_a - \log \frac{[Acid]}{[salt]}$

$$pH = pK_a + \log \frac{[salt]}{[Acid]} \quad \text{——— (4)}$$

Similarly for a basic buffer, $$pOH = pK_b + \log \frac{[salt]}{[base]} \quad \text{——— (5)}$$

(OR)

38. b) (i) **Mechanism of Aldol condensation:**

$CH_3CHO + HCH_2CHO \xrightarrow{dil.NaOH} CH_3CH(OH)CH_2CHO$ (Aldol)

Step 1: α-Hydrogen Removal

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

Step 2: $CH_3\overset{\curvearrowleft}{CH}=O + {}^-CH_2CHO \longrightarrow CH_3CH(O^-)CH_2CHO$

Step 3: $CH_3CH(O^-)CH_2CHO \xrightarrow{H-OH} CH_3CH(OH)CH_2CHO + OH^-$ (Aldol)

38. b) (ii) **Etard reaction:-**

Toluene $\xrightarrow[CS_2]{2CrO_2Cl_2}$ $C_6H_5CH(OCrOHCl_2)_2$ $\xrightarrow{H_3O^+}$ Benzaldehyde.

Prepared By

Mr. கவியரசு,
முதுகலை வேதியியல் ஆசிரியர்.

பா.கவியரசு M.Sc.,B.Ed., முதுகலை வேதியியல் ஆசிரியர்

B.KAVIYARASU M.Sc.,B.Ed.,
P.G.Asst In Chemistry,
Govt.Model Hr.Sec.School,
Mulanur, Tiruppur-638 106.