Class XII Session 2023-24
Subject - Chemistry
Sample Question Paper - 8

Time Allowed: 3 hours **Maximum Marks: 70**

General Instructions:

Read the following instructions carefully.

1. There are **33** questions in this question paper with internal choice.
2. SECTION A consists of 16 multiple-choice questions carrying 1 mark each.
3. SECTION B consists of 5 very short answer questions carrying 2 marks each.
4. SECTION C consists of 7 short answer questions carrying 3 marks each.
5. SECTION D consists of 2 case-based questions carrying 4 marks each.
6. SECTION E consists of 3 long answer questions carrying 5 marks each.
7. **All questions are compulsory.**
8. **Use of log tables and calculators is not allowed.**

Section A

1. The synthesis of 3 – octyne is achieved by adding a bromoalkane into a mixture of sodium amide and an alkyne. The bromoalkane and alkyne respectively are **[1]**

a) $BrCH_2CH_2CH_3$ and $CH_3CH_2CH_2C \equiv CH$

b) $BrCH_2CH_2CH_2CH_3$ and $CH_3C \equiv CH$

c) $BrCH_2CH_2CH_2CH_2CH_3$ and $CH_3CH_2C \equiv CH$

d) $BrCH_2CH_2CH_2CH_3$ and $CH_3CH_2C \equiv CH$

2. Nucleic acids are the polymers of **[1]**

a) sugars

b) bases

c) nucleosides

d) nucleotides

3. Grignard reagent (CH_3MgBr) on reaction CH_3OH will give: **[1]**

a) Aldehyde

b) Ethane

c) Ester

d) Methane

4. The product formed in Aldol condensation is: **[1]**

a) a beta – hydroxy aldehyde or a beta – hydroxy ketone.

b) an alpha – hydroxy aldehyde or ketone.

c) a beta – hydroxy acid

d) an alpha, beta unsaturated ester

5. E_a for the reaction is 1.18×10^5J/mol. The slope of the graph of log k vs. 1/T is **[1]**

a) – 672.1

b) – 6162

c) – 6721

d) – 1036

6. Match the items of column I with appropriate entries of column II. **[1]**

Column I	Column II
(a) Non ideal solution with positive deviation	(i) H_2O (57%) + HI (43%)
(b) Maximum boiling azeotrope	(ii) $CHCl_3 + (CH_3)_2CO$
(c) Non ideal solution with negative deviation	(iii) C_2H_5OH (95.4%) + H_2O (4.6%)
(d) Minimum boiling azeotrope	(iv) $CCl_4 + C_6H_5CH_3$

a) (a) - (iv), (b) - (i), (c) - (ii), (d) - (iii)

b) (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)

c) (a) - (i), (b) - (ii), (c) - (iii), (d) - (iv)

d) (a) - (ii), (b) - (iii), (c) - (i), (d) - (iv)

7. IUPAC name of $(CH_3)_3CCl$ is: **[1]**

a) n – butyl chloride

b) 3 – chloro butane

c) t – butyl chloride

d) 2-chloro, 2-methyl propane

8. Which forms protective and non-corrosive oxide layer? **[1]**

a) Cu

b) Zn

c) Cr

d) Ni

9. The rate of the first-order reaction is $0.69 \times 10^{-2} mol\, L^{-1} \min^{-1}$ and the initial concentration is $0.2 mol\, L^{-1}$ the half-life period is: **[1]**

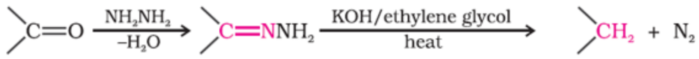
a) 1200 s

b) 600 s

c) 0.33 s

d) 1 s

10. The following reaction is: **[1]**



a) catalytic hydrogenation

b) Clemens reduction

c) None of these

d) Wolff – Kishner reduction

11. The preparation of ethers by acid dehydration of secondary or tertiary alcohols is not a suitable method. This is so because: **[1]**

a) Alkyl group is hindered.

b) None of these

c) Alkyl group should be unhindered.

d) Elimination competes over substitution and alkenes are easily formed.

12. Aniline upon heating with conc. HNO_3 and conc. H_2SO_4 mixture gives: **[1]**

a) The mixture of o, p, and m nitroaniline:

b) No reaction

c) o-and p-nitroaniline

d) o-nitroaniline

13. **Assertion (A):** Alpha (α)-amino acids exist as internal salt in solution as they have amino and carboxylic acid groups in near vicinity. **[1]**

Reason (R): H^+ ion given by carboxylic group (-COOH) is captured by amino group ($-NH_2$) having lone pair of electrons.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

14. **Assertion (A):** Formaldehyde is a planar molecule. **[1]**

Reason (R): It contains sp^2 hybridised carbon atom.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

15. Alkyl halides are insoluble in water **[1]**

a) the force of attraction between the alkyl halide and water is weaker and cannot overcome the force of attraction between alkyl halide and alkyl halide as also that of water and water molecules

b) alkyl halides are non polar compounds

c) high energy is released when new attractions are set up between the haloalkane and the water molecules

d) weak hydrogen bonds exist between water molecules

16. **Assertion (A):** Solubility of alcohols decreases with an increase in size of alkyl/aryl groups. **[1]**

Reason (R): Alcohols form H-bonding with water to show soluble nature.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

Section B

17. What type of hybrid orbital is associated with Ni atom in $[Ni(CN)_4]^{2-}$. **[2]**

18. When MnO_2 is fused with KOH in the presence of KNO_3 as an oxidizing agent, it gives a dark green compound (A). Compound (A) disproportionates in acidic solution to give purple compound (B). An alkaline solution of compound (B) oxidises KI to compound (C) whereas an acidified solution of compound (B) oxidises KI to (D). Identify (A), (B), (C), and (D). **[2]**

19. **Answer the following:** **[2]**

(i) What is molecularity? **[1]**

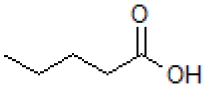
(ii) There is no bar on the no. of collisions among the reaching species. Why most of the reactions do not take place under normal conditions? **[1]**

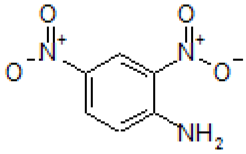
20. Calculate the osmotic pressure in pascals exerted by a solution prepared by dissolving 1.0 g of polymer of molar mass 185,000 in 450 mL of water at 37°C. **[2]**

OR

A person suffering from high blood pressure should take less common salt, why?

21. Write IUPAC names of the following compounds: **[2]**

i. 

ii. 

Section C

22. Calculate the emf of the following cell at 25°C. **[3]**

$\mathrm{Fe}\ |\mathrm{Fe}^{2+}(0.001\mathrm{M})||\mathrm{H}^{+}(0.01\mathrm{M})|\mathrm{H}_2(\mathrm{g})(1\ \mathrm{bar}\ )|\mathrm{Pt(s)}$

Given that, $E^o_{Fe^{2+}/Fe}$ = -0.44 V; $E^o_{H^+/H_2}$ = 0.00 V

23. Some $PH_3(g)$ is introduced into a flask at 600°C containing an inert gas. $PH_3(g)$ decomposes to $P_4(g)$ and $H_2(g)$ and the reaction goes to completion. The total pressure is given below as function of time. **[3]**

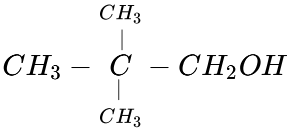
Find the order of reaction and calculate the rate constant.

Time (sec)	0	60	120	∞
P (mm)	262.40	272.90	275.51	276.40

24. How can phenol be converted to aspirin? **[3]**

OR

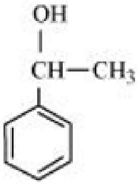
Classify the following as primary, secondary and tertiary alcohols:

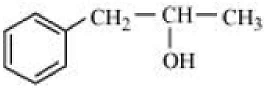
i. 

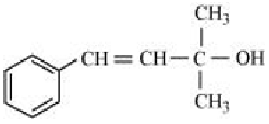
$$CH_3 - \underset{CH_3}{\overset{CH_3}{\underset{|}{\overset{|}{C}}}} - CH_2OH$$

ii. $H_2C = CH - CH_2OH$

iii. $CH_3 - CH_2 - CH_2 - OH$

iv. 

v. 

vi. 

25. A compound **A** (C_2H_4O) on oxidation gives **B** ($C_2H_4O_2$). **A** undergoes Iodoform reaction to give yellow precipitate and reacts with HCN to form the compound **C**. **C** on hydrolysis gives 2-hydroxypropanoic acid. Identify the compounds **A**, **B** and **C**. Write down equations for the reactions involved. **[3]**

26. Write the Nernst equation and calculate the emf of the following cell at 298 K: **[3]**

$\mathrm{Zn}\ |\ \mathrm{Zn}^{2+}\ (0{\cdot}1\ \mathrm{M})\ ||\ \mathrm{Cd}^{2+}\ (0{\cdot}01)\ |\ \mathrm{Cd}$

Given : $\mathrm{E}^{\ominus}_{\mathrm{Zn}^{2+}/\mathrm{Zn}}$ = -0·76 V

$\mathrm{E}^{\ominus}_{\mathrm{Cd}^{2+}/\mathrm{Cd}}$ = -0·40 V

(log 10 = 1)

27. Tert-Butylbromide reacts with aq. NaOH by S_N1 mechanism while n-butylbromide reacts by S_N2 mechanism. **[3]**

Why?

28. How much electricity is required in coulomb for the oxidation of **[3]**

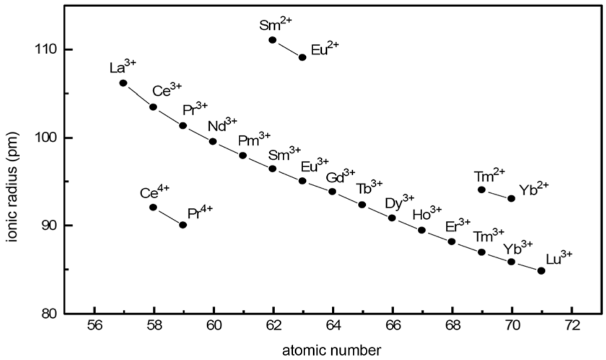
i. 1 mol of H_2O to O_2?

ii. 1 mol of FeO to Fe_2O_3?

Section D

29. **Read the text carefully and answer the questions:** **[4]**

The f-block consists of the two series, lanthanoids (the fourteen elements following lanthanum) and actinoids (the fourteen elements following actinium). Because lanthanum closely resembles the lanthanoids. The chemistry of the actinoids is much more complicated. The complication arises partly owing to the occurrence of a wide range of oxidation states in these elements and partly because their radioactivity creates special problems in their study. The overall decrease in atomic and ionic radii from lanthanum to lutetium (the lanthanoid contraction) is a unique feature in the chemistry of the lanthanoids. In the lanthanoids, La(II) and Ln(III) compounds are predominant species.



(i) Which metal in the first transition series (3d series) exhibits +1 oxidation state most frequently and why?

OR

The transition metals (with the exception of Zn, Cd and Hg) are hard and have high melting and boiling points. Give reason.

(ii) Both O_2 and F_2 stabilize high oxidation states of transition metals but the ability of oxygen to do so exceeds that of fluorine. Give reason.

(iii) The atomic radii of the metals of the third (5d) series of transition elements are virtually the same as those of the corresponding members of the second (4d) series. Give reason.

30. **Read the text carefully and answer the questions:** **[4]**

Vapour pressure of a liquid or a solution is the pressure exerted by the vapour in equilibrium with the liquid or solution at a particular temperature. It depends upon the nature of the liquid and temperature. The non-volatile solute in solution reduces the escaping tendency of the solvent molecules in the vapour phase because some of the solute particles occupy the positions of the solvent molecules on the liquid surface. The relative lowering of the vapour pressure of a solution containing a non-volatile solute is equal to the mole fraction of the solute in the solution. This is also known as Raoult's law. However, for solutions of volatile solutes, the vapour pressure of a component in a solution at a given temperature is equal to the mole fraction of that component in the solution multiplied by the vapour pressure of that pure component. The solutions in which each component obeys Raoult's law is called an ideal solution. For ideal solutions ΔH_{mixing} and ΔV_{mixing} are also zero. Practically no solution is ideal. A non-ideal solution is that solution in which solute and solvent molecules interact with one another with a different force than the forces of interaction between the molecules of the pure components. There are two types of non-ideal solutions, showing positive deviations and negative deviations from ideal behaviour. If for the two components A and B, the forces of interaction between A and B molecules are less than the A-A and B-B interactions, the non-ideal solutions have positive deviations. On the other hand, if the forces of interaction between A and B molecules are more than the A-A and B-B interactions, the non-ideal solutions have negative deviations.

(i) What is the mole fraction of A in solution obeying result's low if the vapour pressure of a pure liquid A is 40 mm of Hg at 300 K. The vapour pressure of this liquid in solution with liquid B is 32 mm of Hg?

(ii) Vapour pressure of a solution of heptane & octane is given by the equation:
P(sol.)(mm Hg) = 35 + 65x, where x is the mole fraction of heptane. Calculate the vapour pressure of pure octane.

(iii) What is the value of ΔV_{mixing} and ΔH_{mixing} for non-ideal solution showing negative deviation?

OR

Acetic acid + pyridine, the mixture is an example of which type of solution?

Section E

31. **Attempt any five of the following:** **[5]**

(i) What products would be formed when a nucleotide from DNA containing thymine is hydrolysed? **[1]**

(ii) Write function of carbohydrates in plants. **[1]**

(iii) What is meant by invert sugars? **[1]**

(iv) Amino acids show amphoteric behaviour. Why? **[1]**

(v) Why are polysaccharides considered non-sugars? **[1]**

(vi) The two strands in DNA are not identical but are complementary. Explain. **[1]**

(vii) Name the purines present in DNA. **[1]**

32. a. Amongst the following, the most stable complex is: **[5]**

i. $[Fe(H_2O)_6]^{3+}$

ii. $[Fe(NH_3)_6]^{3+}$

iii. $[Fe(C_2O_4)_3]^{3-}$

iv. $[FeCl_6]^{3+}$

b. What will be the correct order for the wavelength of absorption in the visible region for the following:

$[Ni(NO_2)_6]^{4-}$, $[Ni(NH_3)_6]^{2+}$, $[Ni(H_2O)_6]^{2+}$

OR

Using crystal field theory, draw energy level diagram, write the electronic configuration of the central metal atom/ion and determine the magnetic moment value in the following:

i. $[CoF_6]^{3-}$, $[Co(H_2O)_6]^{2+}$, $[Co(CN)_6]^{3-}$

ii. $[FeF_6]^{3-}$, $[Fe(H_2O)_6]^{2+}$, $[Fe(CN)_6]^{4-}$

33. Give plausible explanation for each of the following: **[5]**

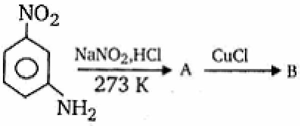
i. Why are amines less acidic than alcohols of comparable molecular masses?

ii. Why do primary amines have higher boiling point than tertiary amines?

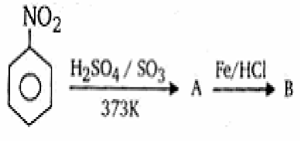
iii. Why are aliphatic amines stronger bases than aromatic amines?

OR

Identify A and B in the following reactions:

i. 

ii. $CH_3CH_2CH_2Br \xrightarrow{NaGN} A \xrightarrow{LiAJH_i} B$

iii. 

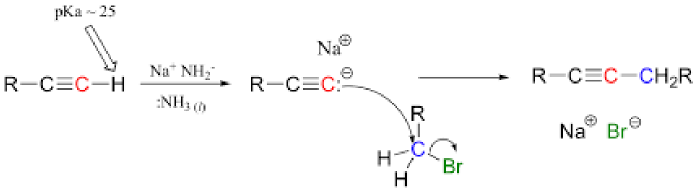
Solution

Section A

1.

(d) $BrCH_2CH_2CH_2CH_3$ and $CH_3CH_2C \equiv CH$

Explanation:



$CH_3CH_2C{\equiv}BrCH_2CH_2CH_2CH3+NaNH2 \rightarrow CH3CH_2CH_2CH_2CH_2CH_2C{\equiv}CH+NH_3+NaBr$

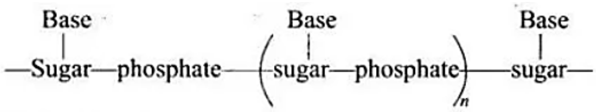
$NaNH_2$ is a very strong base it will abstract H from alkyne (But-1-yne in this case) and then nucleophilic substitution reaction will occur as shown where the resulting compound will be Oct-1-yne as here the reactants contain a total of 8 C.

2.

(d) nucleotides

Explanation:

Nucleic acids are polymers of nucleotides in which nucleic acids are linked together by a phosphodiester linkage also called a polynucleotide.



$$\text{—}\underset{\text{Sugar}}{\overset{\text{Base}}{|}}\text{—phosphate—}\left(\underset{\text{sugar}}{\overset{\text{Base}}{|}}\text{—phosphate}\right)_n\text{—}\underset{\text{sugar}}{\overset{\text{Base}}{|}}\text{—}$$

e.g., DNA, RNA, etc.

3.

(d) Methane

Explanation: CH_3MgBr reacts with CH_3OH and form CH_4.

Grignard Reagent act as both base as well as a nucleophile. In the presence of alcohol, H_2O or other groups having acidic hydrogen Grignard reagent act as base and abstract acidic H.

4. **(a)** a beta – hydroxy aldehyde or a beta – hydroxy ketone.

Explanation: In aldol, we get beta hydroxyl aldehyde/ketone which undergoes further dehydration to give alpha- and beta-unsaturated aldehyde/ketone.

5.

(b) – 6162

Explanation: $lnK = lnA - \frac{Ea}{RT}$

on comparing with y = mx + c

graph between logK and 1/T is a straight line with negative slope.

$slope = -\frac{E_a}{2.303R}$

$slope = -\frac{1.18 \times 10^5}{2.303 \times 8.314}$

slope = -6162.8

6. **(a)** (a) - (iv), (b) - (i), (c) - (ii), (d) - (iii)

Explanation: (a) - (iv), (b) - (i), (c) - (ii), (d) - (iii)

7.

(d) 2-chloro, 2-methyl propane

Explanation: Longest chain will be of three carbon to which Cl and CH_3 will be attached at 2 positions.

8.

(c) Cr

Explanation: Oxygen combines with chromium to create a protective film of chromium oxide (Cr_2O_3) on the surface.

9. **(a)** 1200 s

Explanation: rate of first-order = k[R]

$k = \frac{rate}{[R]} = \frac{0.69 \times 10^{-2} mol L^{-1} min^{-1}}{0.2 mol L^{-1}}$

$k = 3.45 \times 10^{-2} min^{-1} = \frac{3.45 \times 10^{-2}\ s^{-1}}{60}$

now,

$t_{1/2} = \frac{0.69}{k} = \frac{0.69 \times 60}{3.45 \times 10^{-2}} = 1200s$

the half-life period is = 1200s

10.

(d) Wolff – Kishner reduction

Explanation: This is Wolff Kishner reduction of Carbonyls to alkanes. Wolff kishner reaction uses hydrazine (NH_2-NH_2) and conc base like NaOH or KOH for reduction of carbonyl to alkanes.

11.

(d) Elimination competes over substitution and alkenes are easily formed.

Explanation: The formation of ethers by dehydration of the alcohol is a bimolecular reaction ($S_N{}^2$) involving the attack of an alcohol molecule on a protonated alcohol molecule. In the method, the alkyl group should be unhindered. In the case of secondary or tertiary alcohols, the alkyl group is hindered. As a result, elimination dominates substitution as 3° carbocation is more stable.

Hence, in place of ethers, alkenes are formed.

12. **(a)** The mixture of o, p, and m nitroaniline:

Explanation: Mixture of ortho, meta, and para nitroaniline is formed because of the formation of anilinium ion which is formed by direct nitration of aniline.

13. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation: NH_3-CH_3-COOH is a typical α-amino acid. In solution it exists as, internal sait or zwitter ion,

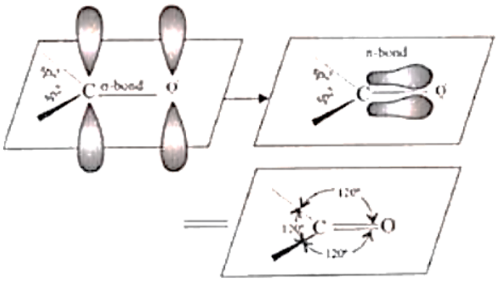
(NH_3-CH_2-COO^-)

because the proton (H^+) of -COOH group is captured by -NH_2 group as NH_2 has a lone pair of electrons on N atom.

14. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation: Formaldehyde is a planar molecule because it contains sp^2 hybridised carbon atom.

Explanation:



Orbital diagram for the formation of the carbonyl group.

15. **(a)** the force of attraction between the alkyl halide and water is weaker and cannot overcome the force of attraction between alkyl halide and alkyl halide as also that of water and water molecules

Explanation: In alkyl halides, there exist dipole-dipole attractions whereas in water van der Waal's forces or the hydrogen bonding exists. It is difficult for alkyl halides to break these hydrogen bonds, hence making them almost insoluble in water.

16.

(b) Both A and R are true but R is not the correct explanation of A.

Explanation: The tendency to show H-bonding decreases with increasing hydrophobic character of carbon chain.

Section B

17. dsp^2

18. MnO_2 is fused with KOH in the presence of KNO_3 as an oxidizing agent, it gives a dark green compound (A).

$$2\,MnO_2 + 4KOH + O_2 \longrightarrow 2K_2MnO_4 + 2H_2O$$

Compound (A) disproportionates in acidic solution to give purple compound (B).

$$3MnO_4^{2-} + 4H^+ \longrightarrow 2MnO_4^- + MnO_2 + 2H_2O$$

An alkaline solution of compound (B) oxidises KI to compound (C) whereas an acidified solution of compound (B) oxidises KI to (D).

$$2MnO_4^- + H_2O + KI \longrightarrow 2MnO_2 + 2OH^- + KIO_3$$

An acidified solution of compound (B) oxidises KI to compound (D).

$$MnO_4^- + 8H^+ + 10KI \longrightarrow Mn^{+2} + 5I_2 + 4H_2O + 10K^+$$

Therefore,

A = K_2MnO_4 / MnO_4^{2-} = Potassium manganate,

B= $KMnO_4$ / MnO_4^- = Potassium permanganate,

C= IO_3^- / KIO_3 = Potassium iodate,

D= I_2 = Iodine.

19. Answer the following:
    (i) The number of reacting species (atoms, ions or molecules) taking part in an elementary reaction, which must collide simultaneously in order to bring about a chemical reaction is called molecularity of a reaction.
    (ii) The product formation in a reaction occurs only when reactants have required energy and are properly oriented. In absence of either one of these parameters, the collisions between reactants doesn't result in product formation.

20. It is given that:

Volume of water, V= 450 mL = 0.45 L

Temperature, T = (37 + 273) K = 310 K

Number of moles of the polymer, $n = \frac{1}{185000} mol$

We know that:

Osmotic pressure, $\pi = \frac{n}{V} RT$

$= \frac{1}{185000} mol \times \frac{1}{0.45} \times 8.314 \times 10^3 PaLK^{-1} mol^{-1} \times 310K$

= 30.98 Pa

= 31 Pa (approximately)

OR

Common salt contains Na^+ and Cl^- which increase osmotic pressure of blood, therefore increase blood pressure. So an increase in salt intake retains the fluids which raises the blood pressure by increasing the blood volume and can increase the work load on the heart.

21. i. Pentanoic acid
    ii. 2,4-Dinitro-1-aminobenzene

Section C

22. **At anode,** Fe(s) $\rightarrow$ Fe^{2+}(aq) + $2e^-$

At cathode, [H^+ (aq) + e^- $\rightarrow$ $\frac{1}{2}H_2$(g)] $\times$ 2

Overall reaction:

Fe(s) + $2H^+$(aq) $\rightarrow$ Fe^{2+}(aq) + H_2(g)

Given, $E^o_{Fe^{2+}/Fe}$ = -0.44 V and $E^o_{H^+/H_2}$ = 0.00 V

E^o(cell) = E^o(cathode) - E^o(anode) = [0.00- (-0.44)] = 0.44V

Now, Applying Nernst equation:

$E_{cell} = E^o_{cell} - \frac{0.00591}{2} \log \frac{[Fe^{2+}]}{[H^+]^2} = 0.44 - \frac{0.00591}{2} \log \frac{10^{-3}}{(10^{-2})^2}$

$= 0.44 - \frac{0.00591}{2} = 0.4104$ V

23. We know that

$R_0 \propto P_\infty - P_0$

where R_o = Initial concentration of the reactant, P_o = Initial pressure of reactant, P_∞ = Pressure after a long time

$R_0 \propto\ (\underline{276.40 - 262.40})$

$R_0 \propto 14.0\ mm$

$P_t - P_0 \propto\ \ x$ (where x = amount decomposed, P_t = Pressure at time t)

$R \propto [\,P_\infty - P_0] - [P_t - P_0]$ (where R = Concentration at time t)

$R \propto P_\infty - P_t$

We know that

$k = \frac{2.303}{t} \log \frac{[R_0]}{[R]}$

where k = rate constant, t = time

$= \frac{2.303}{t} \log \frac{P_\infty - P_0}{P_\infty - P_t}$

$k = \frac{2.303}{60} \log \frac{276.4-262.4}{276.4-272.9}$

$= 2.31 \times 10^{-2} s^{-1}$

$k = \frac{2.303}{120} \times \log \frac{14}{0.89}$

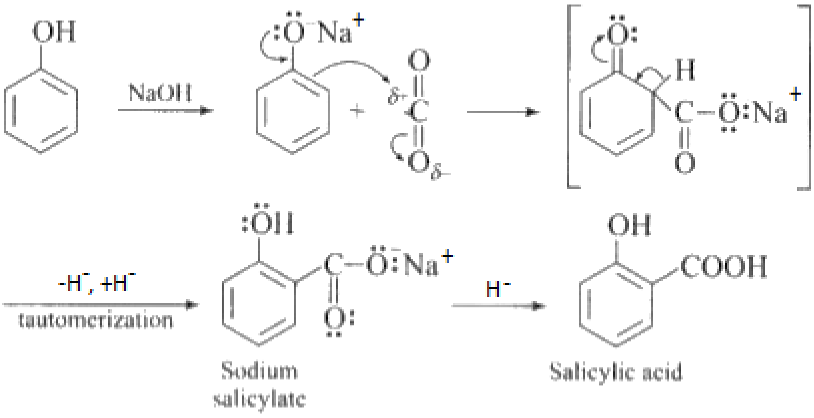
$= 2.296 \times 10^{-2} s^{-1}$

This implies that the reaction is of first order

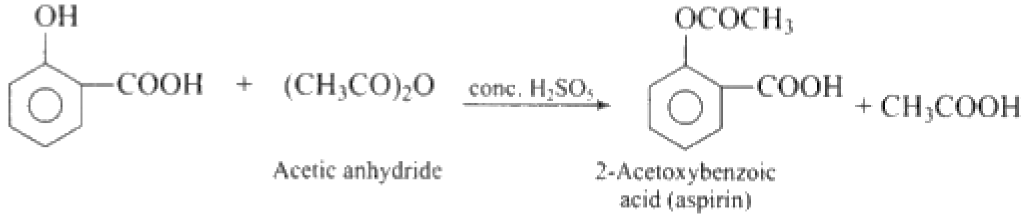
$k = \frac{2.310+2.296}{2} \times 10^{-2} s^{-1}$

$k = 2.303 \times 10^{-2} s^{-1}$

24. Phenol is converted into salicylic acid. The reaction is usually carried out by allowing sodium phenoxide to absorb carbon dioxide and then heating the product to 400 K and 4-7 atm pressure. The first unstable intermediate is formed which undergoes a proton shift to form sodium salicylate. The subsequent acidification of sodium salicylate gives.



Then aspirin is obtained by acetylating salicylic acid with acetic anhydride and conc. H_2SO_4



The preparation of Aspirin from salicylic acid is an example of an electrophilic substitution reaction in which carbon dioxide is an electrophile.

OR

Primary alcohols: (i), (ii), (iii)

Secondary alcohols: (iv), (v)

Tertiary alcohols: (vi)

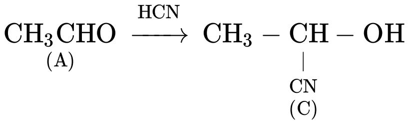
25. A = Acetaldehyde (CH_3CHO)

B = Ethanoic acid (CH_3COOH)

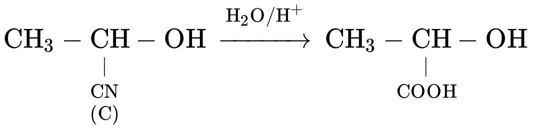
C = Acetaldehyde cyanohydrin ($CH_3CH(OH)CN$)

$\underset{(A)}{CH_3CHO} \overset{[O]}{\rightarrow} \underset{(B)}{CH_3COOH}$

$$\underset{(A)}{CH_3CHO} \xrightarrow{I_2\ NAOH} \underset{\text{Yellow ppt}}{CHI_3}$$



$$\underset{(A)}{CH_3CHO} \xrightarrow{HCN} CH_3-\underset{\underset{(C)}{CN}}{CH}-OH$$



$$CH_3-\underset{\underset{(C)}{CN}}{CH}-OH \xrightarrow{H_2O/H^+} CH_3-\underset{COOH}{CH}-OH$$

26. $E_{\text{cell}} = E^0_{\text{cell}} - \frac{0.059}{2}\log\frac{[Zn^{2+}]}{[Cd^{2+}]}$

E^0_{cell} = -0.40 - (-0.76) = 0.36 V

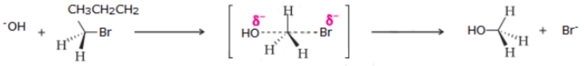
$E_{cell} = 0.36 - \frac{0.059}{2}\log\frac{[Zn^{2+}]}{[Cd^{2+}]}$

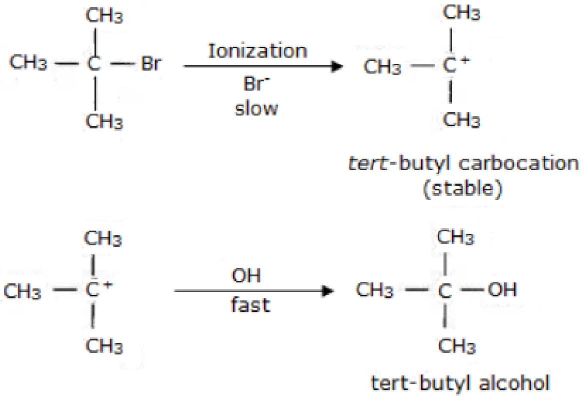
= 0.36 - $\frac{0.059}{2}\log\frac{(0.1)}{(-01)}$

= 0.36 - 0.0295 log10

E_{cell} = 0.3305 V

27. Tert-butylbromide undergoes substitution by S_N1 unimolecular substitution mechanism because it is able to form a stable carbocation in the first step after cleavage of the halide group. The carbocation then reacts with the nucleophile OH^-. On the other hand, primary halide n-butylbromide cannot form a stable carbocation so it undergoes S_N2 bimolecular substitution mechanism, which is a one-step substitution that involves the attack of OH^- and simultaneous leaving of X^- to form n-butyl alcohol.





28. i. According to the question,

$H_2O \rightarrow H_2 + \frac{1}{2}O_2$

Now, we can write:

$O^2 \rightarrow \frac{1}{2}O_2 + 2e^-$

Electricity required for the oxidation of 1 mol of H_2O to O_2 = 2 F

$= 2 \times 96487C$

= 192974 C

ii. According to the question,

$Fe^{2+} \rightarrow Fe^{3+} + e^{-1}$

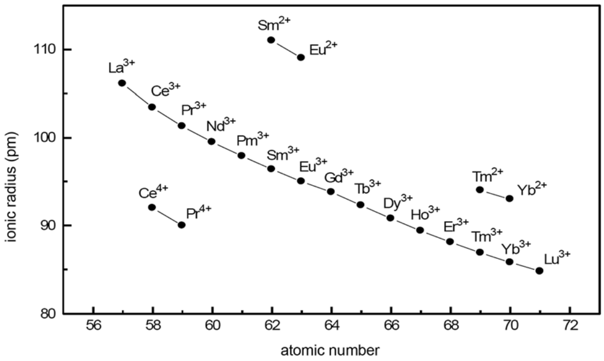
Electricity required for the oxidation of 1 mol of FeO to Fe_2O_3 = 1 F

= 96487 C

Section D

29. **Read the text carefully and answer the questions:**

The f-block consists of the two series, lanthanoids (the fourteen elements following lanthanum) and actinoids (the fourteen elements following actinium). Because lanthanum closely resembles the lanthanoids. The chemistry of the actinoids is much more complicated. The complication arises partly owing to the occurrence of a wide range of oxidation states in these elements and partly because their radioactivity creates special problems in their study. The overall decrease in atomic and ionic radii from lanthanum to lutetium (the lanthanoid contraction) is a unique feature in the chemistry of the lanthanoids. In the lanthanoids, La(II) and Ln(III) compounds are predominant species.



(i) Copper exhibits +1 oxidation state more frequently i.e., Cu^{1+} because of its electronic configuration $3d^{10}4s^{1}$. It can easily lose $4s^{1}$ electron to give stable $3d^{10}$ configuration.

OR

Because of stronger metallic bonding and high enthalpies of atomization.

(ii) The ability of O_2 to stabilize higher oxidation states exceeds that of fluorine because oxygen can form multiple bonds with metals.

(iii) Due to lanthanoid contraction in second series after lanthanum, the atomic radii of elements of second and third series become almost same and hence show similarities in properties.

30. **Read the text carefully and answer the questions:**

Vapour pressure of a liquid or a solution is the pressure exerted by the vapour in equilibrium with the liquid or solution at a particular temperature. It depends upon the nature of the liquid and temperature. The non-volatile solute in solution reduces the escaping tendency of the solvent molecules in the vapour phase because some of the solute particles occupy the positions of the solvent molecules on the liquid surface. The relative lowering of the vapour pressure of a solution containing a non-volatile solute is equal to the mole fraction of the solute in the solution. This is also known as Raoult's law. However, for solutions of volatile solutes, the vapour pressure of a component in a solution at a given temperature is equal to the mole fraction of that component in the solution multiplied by the vapour pressure of that pure component. The solutions in which each component obeys Raoult's law is called an ideal solution. For ideal solutions ΔH_{mixing} and ΔV_{mixing} are also zero. Practically no solution is ideal. A non-ideal solution is that solution in which solute and solvent molecules interact with one another with a different force than the forces of interaction between the molecules of the pure components. There are two types of non-ideal solutions, showing positive deviations and negative deviations from ideal behaviour. If for the two components A and B, the forces of interaction between A and B molecules are less than the A-A and B-B interactions, the non-ideal solutions have positive deviations. On the other hand, if the forces of interaction between A and B molecules are more than the A-A and B-B interactions, the non-ideal solutions have negative deviations.

(i) $P_A = x_A \times P_A^\circ$

$32 = x_A \times 40$

$x_A = \frac{32}{40}$

$x_A = 0.8$

(ii) For pure octane, x = 0

$\therefore$ p(sol.)(mm Hg) = P (octane) = $35 + 65 \times 0 = 35$ mm of Hg

(iii) The value of ΔV_{mixing} and ΔH_{mixing} is negative.

OR

It is an example of Non-ideal solution.

Section E

31. Attempt any five of the following:

(i) When a nucleotide from the DNA containing thymine is hydrolyzed, thymine β -D-2-deoxyribose and phosphoric acid are obtained as products.

(ii) They store energy in the form of starch in plants.

(iii) Hydrolysis of sucrose brings about a change in sign of rotation from dextro (+) to laevo (-) and hence, it is known as invert sugar.

(iv) Amino acids contain both amino ($-NH_2$) and carboxyl (-COOH) groups, thus they react with both acids and bases. Hence, amino acids are amphoteric in nature.

(v) Polysaccharides are not sweet in taste & hence are called non-sugars.

(vi) In the helical structure of DNA, the two strands are held together by hydrogen bonds between specific pairs of bases. Cytosine forms hydrogen bond with guanine, while adenine forms hydrogen bond with thymine. As a result, the two strands are complementary to each other.

(vii) Adenine and Guanine.

32. a. Complexes containing didentate or polydentate ligands are more stable than those containing monodentate ligands. In each of the given complex, Fe is in +3 state.

As $C_2O_4^{2-}$ is didentate chelating ligand, hence is the most stable complex.

b. As metal ion is fixed, the wavelength of absorption will decided by the field strengths (CFSE values) of the ligands.
From the spectrochemical series, the order of CFSE is: $H_2O < NH_3 < NO_2$

Thus, the energies absorbed for excitation will be in the order:

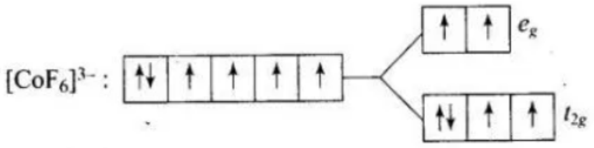
$[Ni(NH_3)_6]^{2+} < [Ni(H_2O)_6]^{2+} < [Ni(NO_2)_6]^{4-}$

As wavelength and energy are inversely related.The wavelengths absorbed will be in the opposite order:

$[Ni(NH_3)_6]^{2+} > [Ni(H_2O)_6]^{2+} > [Ni(NO_2)_6]^{4-}$

OR

i.

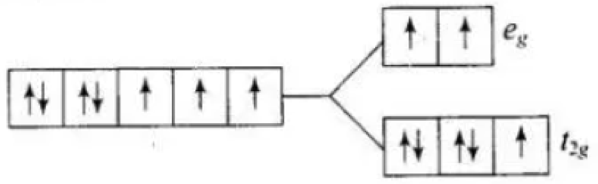


$Co^{2+} = 3d^7$

Number of unpaired electrons = 4

Magnetic moment = $\sqrt{n(n+2)} = \sqrt{4(4+2)}$ = 4.9 B.M

$[Co(H_2O)_6]^{2+}$:

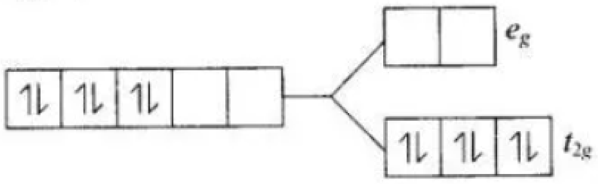


$Co^{2+} = 3d^7$

Number of unpaired electrons = 3

Magnetic moment = $\sqrt{3(3+2)}$ = 3.87 B.M

$[Co(CN)_6]^{3-}$:

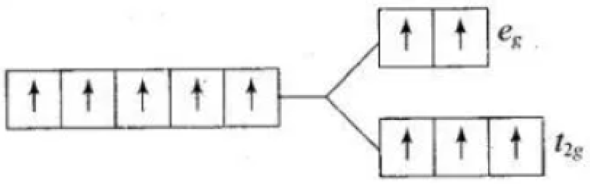


$Co^{3+} = 3d^6$

Number of unpaired electrons = 0

Diamagnetic in nature.

ii. FeF_6^{3-} :



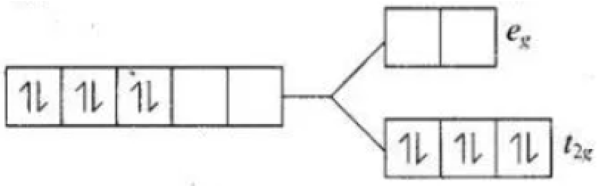
$Fe^{2+} = 3d^6$

$[Fe(H_2O)_6]^{2+}$: $t^4_{2g}\ e_g^2$

Number of unpaired electrons = 4

Magnetic moment = $\sqrt{4(4+2)}$ = 4.9 B.M

$[Fe(CN)_6]^{4-}$:



$Fe^{2+} = 3d^6$

Diamagnetic in nature.

33. i. Loss of a proton from an amine gives RNH^- ion while the loss of a proton from alcohol gives RO- ion as shown below :

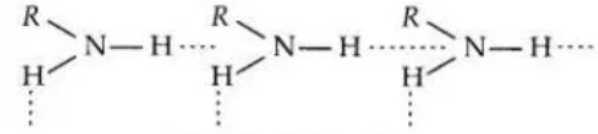
$R - NH_2 \rightarrow R - NH^- + H^+$

$R - O - H \rightarrow R - O^- + H^+$

As O is more electronegative than N, RO^- can accommodate the negative charge more easily than the RNH^- can.

As, RO^- is more stable than RNH^- the former is formed more. As a result, amines are less acidic than alcohols.

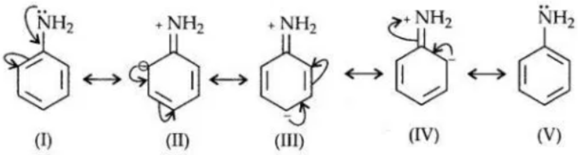
ii. A primary amine is engaged in intermolecular association due to hydrogen bonding between the nitrogen of one nad hydrogen of other while tertiary amine does not have intermolecular association due to the absence of hydrogen atom therefore the boiling point of primary amine is more than tertiary amine.



H-bonding in 1° amines

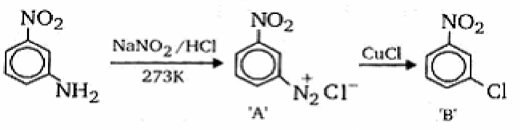
iii. a. The basic nature of amines is a result of the presence of l.p. of electron on the N atom. Also, the electron density is increased on N due to the +I effect of the alkyl group.

b. In aryl amines, the l.p. on N is involved in resonance with the benzene ring and hence less available for protonation.



c. In aliphatic amines, there is no such delocalisation and hence it is more basic.

OR

i. 

3-Chloronitrobenzene

ii. $CH_3CH_2CH_2Br \xrightarrow{NaGN} \underset{'A'}{CH_3CH_2\,CH_2\,C \equiv N} = \xrightarrow{LiAJH_4} \underset{'B'}{\underset{Bu\tan a\min e}{CH_3CH_2CH_2CH_2NH_2}}$

iii.