MM: 70   **Time: 3 hours**

General Instructions:

Read the following instructions carefully.

a) There are **35** questions in this question paper with internal choice.

b) SECTION A consists of 18 multiple-choice questions carrying 1 mark each.

c) SECTION B consists of 7 very short answer questions carrying 2 marks each.

d) SECTION C consists of 5 short answer questions carrying 3 marks each.

e) SECTION D consists of 2 case- based questions carrying 4 marks each.

f) SECTION E consists of 3 long answer questions carrying 5 marks each.

g) **All questions are compulsory.**

h) **Use of log tables and calculators is not allowed**

Section A

[1]

1.

The major product obtained in this reaction is:

a)

b)

c)

d)

2. Glucose is hydrolysed by an enzyme zymase into: [1]

a) dicarboxylic acid   b) alcohol

c) aromatic acid   d) amino acid

3. Which one of the following does not correctly represent the correct order of the property indicated against it? [1]

a) Ti < V < Mn < Cr : increasing 2nd ionization enthalpy

b) Ti < V < Cr < Mn; increasing number of oxidation states

c) Ti < V < Cr < Mn : increasing melting points

d) $Ti^{3+} < V^{3+} < Cr^{3+} < Mn^{3+}$: increasing magnetic moment

4. The data for the reaction $A + B \rightarrow C$, is [1]

Experiment	$[A]_0$	$[B]_0$	Initial rate
1	0.012	0.035	0.10
2	0.024	0.070	0.80
3	0.024	0.035	0.10
4	0.012	0.070	0.80

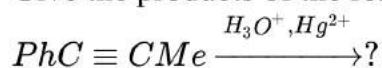The rate law corresponds to the above data is:

a) Rate = k $[B]^4$

b) Rate = k $[A]$ $[B]^3$

c) Rate = k $[B]^3$

d) Rate = k $[A]^2$ $[B]^2$

5. Give the products of the reaction [1]

$$PhC \equiv CMe \xrightarrow{H_3O^+, Hg^{2+}} ?$$
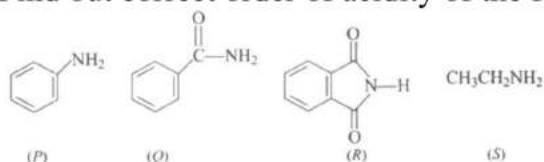
    a) $PhCH_2CH_2CHO$ b) $PhCOCH_2CH_3$

    c) $PhCOCOMe$ d) $PhCH_2COCH_3$

6. Faraday's laws of electrolysis are related to the: [1]

    a) speed of the cation   b) equivalent mass of the electrolyte

    c) atomic number of the reactants   d) atomic number of the anion

7. Find out correct order of acidity of the following compounds. [1]

    a) P > Q > R > S   b) R > Q > S > P

    c) P > S > Q > R   d) R > Q > P > S

8. For a certain reaction of order **n** the time for half change $t_{1/2}$ is given by; [1]

$t_{\frac{1}{2}} = \frac{2 - \sqrt{2}}{K} \times c_0^{\frac{1}{2}}$, where K is rate constant and c_0 is initial concentration. The value of n is:
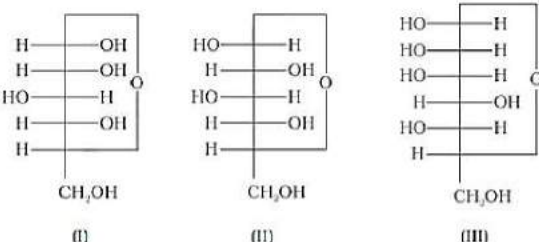
    a) 2   b) 1

    c) 0   d) 0.5

9. When ethanal is treated with Fehling's solution, it gives a precipitate of [1]

    a) CuO b) Cu

    c) Cu_2O d) Cu_3O

10. In the observed electronic configuration of lutetium (Lu), the number of 4f, 5d and 6s electrons are _____ respectively. [1]
(Atomic number of Lu = 71)

a) 10, 1, 2　　　　　　　　　　　　b) 14, 0, 2

c) 14, 0, 1　　　　　　　　　　　　d) 14, 1, 2

11. Absolute ether is diethyl ether, which　　　　　　　　　　　　　　　　[1]

   a) Is totally free from moisture and peroxides

   b) Is obtained from Williamson's synthesis

   c) Contains trace of peroxide

   d) Is mixed with absolute alcohol

12. Three cyclic structures of monosaccharides are given below which of these are anomers.　　[1]

   a) III is anomer of I and II

   b) I and II

   c) II and III

   d) I and III

13. An ion is reduced to the element when it absorbs 6×10^{20} electrons. The number of equivalents of the ion is:　　[1]

   a) 0.01

   b) 0.0001

   c) 0.10

   d) 0.001

14. Many naturally occurring aldehydes and ketones are used in the blending of perfumes and flavouring agents. But the preferred ones are_____.　　[1]

   a) lower ketones

   b) higher ketones

   c) lower aldehydes

   d) higher aldehydes

15. **Assertion (A):** The boiling point of diethyl ether is much less than that of ethanol.　[1]
Reason (R): In ethanol, the molecules are associated by the formation of intermolecular hydrogen bonding whereas in diethyl ether, it is not possible.

   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.

16. **Assertion (A):** Nitration of aniline can be conveniently done by protecting the amino group by acetylation.　[1]
Reason (R): Acetylation increases the electron density in the benzene ring.

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.

17. **Assertion:** The $[Ni(en)_3]Cl_2$ (en = ethylene diamine) has lower stability than $[Ni(NH_3)_6]Cl_2$. [1]

Reason: In $[Ni(en)_3]Cl_2$ the geometry of Ni is trigonal bipyramidal.

a) If both Assertion & Reason are true and the reason is the correct explanation of the assertion.

b) If both Assertion & Reason are true but the reason Is not the correct explanation of the assertion

c) If Assertion is true statement but Reason is false.

d) If both Assertion and Reason are false statements.

18. **Assertion:** Zn^{2+} and Cu^{2+} are colourless. [1]

Reason: Both Zn^{2+} and Cu^{2+} contain 3d-filled subshell.

a) Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

b) Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

c) Assertion is CORRECT but, reason is INCORRECT.

d) Both assertion and reason are INORRECT.

Section B

19. State the 'rate law' for chemical reactions. [2]

20. In the button cells widely used in watches and other devices the following reaction takes place: $zn(s) + Ag_2O(s) + H_2O(l) \rightarrow zn^{2+}(aq) + 2Ag(s) + 2OH^-$ (aq). Determine $\Delta_r G^\Theta$ and E^Θ for the reaction. [2]

OR

The molar conductivity of 0.1M CH_3COOH solution is $4.6cm^2mol^{-1}$. What is the conductivity and resistivity of the solution?

21. What is meant by hexadentate ligand? Give one example. How is such ligand useful for measuring hardness of water. [2]

OR

Write the formula of the following complexes:

i. Hexaammine platinum (IV) chloride.

ii. Dichloro tetrammine cobalt (III) ion.

22. State Henry's law. Calculate the solubility of CO_2 in water at 298 K under 760 **[2]** mm Hg. (K_H for CO_2 in water at 298 K is 1.25×10^6 mm Hg)

23. Derive an expression for the pH of electrolyte in the following half cell. **[2]** $PtH_2(1atm)|H^+(aq)$. The reduction potential is - 0.30 V.

24. What happens when phenol is treated with H_2 in presence of nickel? **[2]**

25. Write the structure of the major organic product of the reaction: **[2]** $CH_3CH_2CH_2OH + SOCl_2 \rightarrow$

Section C

26. How will you convert:: **[3]**
    i. Benzene diazonium chloride to nitrobenzene.
    ii. Aniline to benzene diazonium chloride.
    iii. Ethyl amide to methylamine.

27. In the button cell widely used in watches and other devices the following reaction **[3]** takes place:
    $Zn(s) + Ag_2O(s) + H_2O(l) \rightarrow Zn^{2+}(aq) + 2Ag(s) + 2OH^-(aq)$
    Determine $\Delta_r G^{(-)}$ and $E^{(-)}$ for the reaction
    Given $Zn \rightarrow Zn^{2+} + 2e^-$, $E^0 = 0.76V$
    Given $Ag \rightarrow Ag^+ + 2e^-$, $E^0 = 0.344V$

28. Give reasons for the following: **[3]**
    a. Transition metals form complex compounds.

    b. E_0 values for (Zn^{2+}/Zn) and (Mn^{2+}/Mn) are more negative than expected.

    c. Actinoids show wide range of oxidation states.

29. For the reaction $A + B \rightarrow C + D$, the rate of reaction doubles when the **[3]** concentration of A doubles, provided the concentration of B is constant. To what order does A enter into the rate expression?

30. What happens when **[3]**
    i. n-butyl chloride is treated with alcoholic KOH.
    ii. bromobenzene is treated with Mg in the presence of dry ether.
    iii. chlorobenzene is subjected to hydrolysis.

    OR

    Predict the order of reactivity of the following compounds in S_N1 and S_N2 reactions:
    i. The four isomeric bromobutanes
    ii. $C_6H_5CH_2Br$, $C_6H_5CH(C_6H_5)Br$, $C_6H_5CH(CH_3)Br$, $C_6H_5C(CH_3)(C_6H_5)Br$

Section D

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

Biomolecules are complex molecules which build up living organisms and required for their growth, maintenance and ability to reproduce. Carbohydrates are polyhydroxy aldehydes and ketones which are major sources of energy. Monosachharides are simple sugars which cannot be hydrolysed. Oligosachharide, on hydrolysis give 2 to 10 molecules of monosachharides. Polysachharides like starch and cellulose on hydrolysis give large number of molecules of glucose a-glucose and b-glucose (Anomers). Proteins are complex nitrogeneous polymers of amino acids connected through peptide bonds. The sequence in which amino acids are linked is called Primary structure. Secondary structures are of 2 types a-helix in globular proteins and b-pleated structure in fibrous proteins involving H-bonds. Tertiary structure has H-bonds, disulphide linkage, ionic bonding and van der Waals' forces. Insulin is hormone for metabolism of glucose, has quarternary structure. Denaturation of protein destroys secondary and tertiary structure, loss of biological activity but primary structure remaining the same.Enzymes are highly specific, work at specific pH, moderate temperature and catalyse biochemical reactions. Hormones perform specific functions and secreated by endocrine glands. Vitamins are essential for healthy body. A, D, E, K are fat soluble vitamins. Vitamin C and B1, B2, B6 are water soluble. B12 is neither water, nor fat soluble. Nucleic acids are polymer of nucleotides. RNA consist of m-RNA, t-RNA, r-RNA. RNA has Adenine, Cytosine, Uracil and Guanine. It helps in protein synthesis. It cannot replicate. DNA contains deoxyribose, A, C, G and Thymine. It transfers genetic characteristics. DNA has double helix structure and undergoes replication.

(i) Name a disachharide which on hydrolysis give glucose and galactose.

(ii) What type of protein is albumin?

(iii) Name one non-reducing sugar.

OR

Which one is complementary base of cytosine in one strand of DNA to that in other strand of DNA?

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

The coordination compounds are of great importance. These compounds are widely present in the mineral, plant and animal worlds and are known to play many important functions in the area of analytical chemistry, metallurgy, biological systems, industry and medicine. The selective estimation of these ions can be done due to the difference in the stability constants of calcium and magnesium complexes. Coordination compounds are of great importance in biological systems. The pigment responsible for photosynthesis, chlorophyll, is a coordination compound of magnesium. Among the other compounds of biological importance with coordinated metal ions are enzymes like carboxypeptidase and carbonic anhydrase (catalysts of biological systems). Coordination compounds are used as catalysts for many industrial processes. Articles can be electroplated with

silver and gold much more smoothly and evenly from solutions of the complexes, $[Ag(CN)_2]^-$ and $[Au(CN)_2]^-$ than from a solution of simple metal ions.

(i) How can excess of copper and iron are removed?

(ii) Purification of metals can be achieved through the formation and subsequent decomposition of their coordination compounds. Give one example.

(iii) Coordination compounds find use in many qualitative and quantitative chemical analysis. Justify.

OR

Gold is a co-ordinate compound. Justify.

Section E

33. An unknown aldehyde **A** on reacting with alkali gives a β- hydroxy-aldehyde,   **[5]** which losses water to form an unsaturated aldehyde, 2-butenal. Another aldehyde **B** undergoes disproportionation reaction in the presence of conc. alkali to form products C and D. C is an aryl alcohol with formula C_7H_8O.

  i. Identify A and B

 ii. Write the sequence of reactions involved.

iii. Name the product, when 'B' reacts with Zn amalgam and hydrochloric acid.
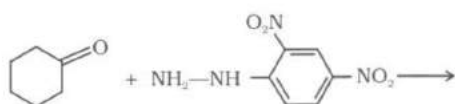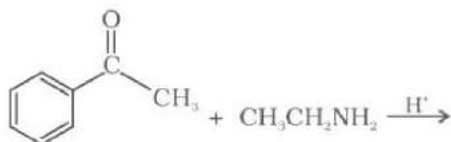
OR

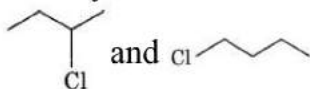Predict the products of the following reactions:

  i.
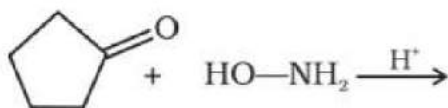
 ii.

iii.

 iv.

34. Answer the following questions: **[5]**

(i) Why does vanadium pentaoxide act as a catalyst?

(ii) Identify the chiral molecule in the following pair.

 and

(iii) Out of o-nitrophenol and p-nitrophenol, which is more volatile? Explain.

(iv) Arrange the following in decreasing order of their basic strength: $C_6H_5NH_2$, $C_2H_5NH_2$, $(C_2H_5)_2$ NH, NH_3

(v) What is meant by invert sugars?

35. Two elements A and B form compounds having formula AB_2 and AB_4. When **[5]** dissolved in 20 g of benzene (C_6H_6), 1 g of AB_2 lowers the freezing point by 2.3 K whereas 1.0 g of AB_4 lowers it by 1.3 K. The molar depression constant for benzene is $5.1\ K\ kg\ mol^{-1}$. Calculate atomic masses of A and B.
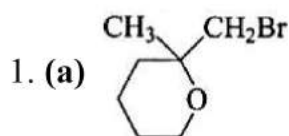
OR

0.6 mL of acetic acid (CH_3COOH), having density 1.06 g mL^{-1}, is dissolved in 1 litre of water. The depression in freezing point observed for this strength of acid was 0.0205°C. Calculate the van't Hoff factor and the dissociation constant of acid.

SOLUTION

Section A

1. **(a)**
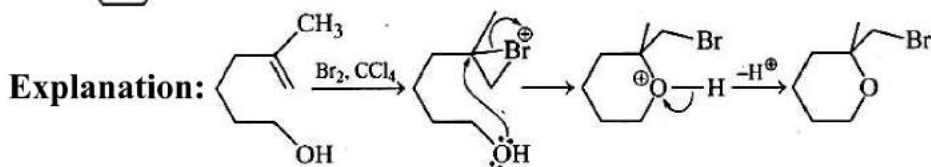
Explanation:

2. **(b)** alcohol
   Explanation: alcohol

3. **(c)** Ti < V < Cr < Mn : increasing melting points
   Explanation:

Element	Ti	<	V	<	Cr	<	Mn
No. of oxidation states	3		4		5		6

Given order is correct.

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

For Ti^{3+} n = 1, $\mu = \sqrt{1(1+2)} = \sqrt{3}$ B.M.

For V^{3+} n = 2, $\mu = \sqrt{2(2+2)} = \sqrt{8}$ B.M.

For Cr^{3+} n = 3, $\mu = \sqrt{3(3+2)} = \sqrt{15}$ B.M.

For Mn^{3+} n = 4, $\mu = \sqrt{4(4+2)} = \sqrt{24}$ B.M.

Thus magnetic moment:	Ti^{3+}	<	V^{3+}	<	Cr^{3+}	<	Mn^{3+}
Melting point order:	1245°C		1668°C		1875°C		1900°C
2nd ionisation enthalpy order	Ti	<	V	<	Mn	<	Cr
kJ/Mol	1320		1376		1513		1635

4. **(c)** Rate = k $[B]^3$

   Explanation: $r = K[A]^m [B]^n$

   $0.1 = K[0.012]^m [0.035]^n$ ...(i)

   $0.80 = K[0.024]^m [0.070]^n$ ...(ii)

   $0.10 = K[0.024]^m [0.035]^n$ ...(iii)

   $0.80 = K[0.012]^m [0.070]^n$ ...(iv)

   By (i) and (iii) 0

By (i) and (iii) m = 0

By (i) and (ii) $\frac{1}{8} = \left[\frac{1}{2}\right]^m \left[\frac{1}{2}\right]^n = \left(\frac{1}{2}\right)^0 \left[\frac{1}{2}\right]^n$
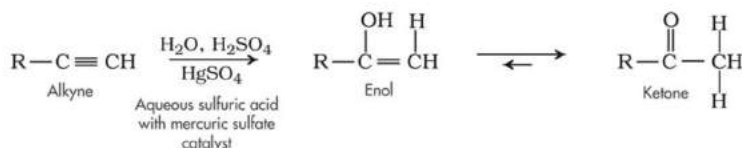
$\therefore$ n = 3

r = K [B]^3

5. **(b)** PhCOCH$_2$CH$_3$

   Explanation: Hydration of given alkyne will occur according to Markovnikoff's rule leading to the formation of enol which will tautomerise to give keto form.
   The general reaction of alkyne hydrations shown below:
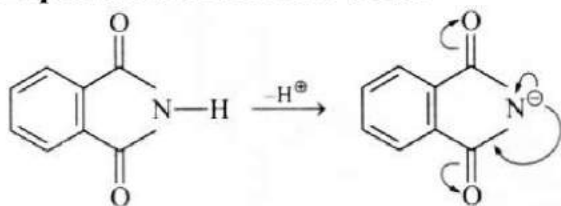

   Same reaction will occur with

   $PhC \equiv CMe \xrightarrow{H_3O^+, Hg^{2+}} ? PhC(OH) = CHCH_3 \Leftrightarrow PhCOCH_2CH_3$.

6. **(b)** equivalent mass of the electrolyte

   Explanation: $\frac{w}{E} = \frac{i \cdot t}{96500}$ (I law)

7. **(d)** R > Q > P > S

   Explanation: R is most acidic

8. **(d)** 0.5

   Explanation: 0.5

9. **(c)**
   Cu$_2$O

   Explanation: $CH_3CHO + 2CuO \rightarrow CH_3COOH + Cu_2O$
   (Blue)   (Red ppt)

   Thus in this reaction, the precipitate of copper oxide (Cu$_2$O) is formed.
   Fehling' solution is an alkaline solution of cupric ion complexed with sodium potassium tartrate.

10. **(d)** 14, 1, 2

    Explanation: The observed electronic configuration of lutetium (Lu) is [Xe] 4f^{14} 5d^1 6s^2.

11. **(a)** Is totally free from moisture and peroxides

    Explanation: Absolute ether is 100 % pure diethyl ether, totally free from any impurities.

12. **(b)** I and II

    Explanation: Cyclic structures of monosaccharides which differ in the structure at carbon- 1 position are known as anomers.
    Here, I and II are anomer because they differ from each other at carbon- 1 only.

13. **(d)** 0.001

   Explanation: 6×10^{23} electron = 1 eq

14. **(d)** higher aldehydes

   Explanation: Higher aldehydes like aldehyde C-10 etc. are used in floral blends like rose, jasmine, etc.

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

   Explanation: Both A and R are true and R is the correct explanation of A.

16. **(c)** A is true but R is false.

   Explanation: Acetylation decreases the electron-density in the benzene ring thereby preventing oxidation.

17. **(d)** If both Assertion and Reason are false statements.

   Explanation: $[Ni(en)_3]$ Cl_2 is a chelating compound and chelated complexes are more stable than similar complexes with unidentate ligands as dissociation of the complex involves breaking of two bonds rather than one.

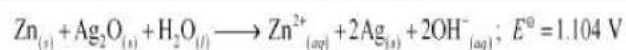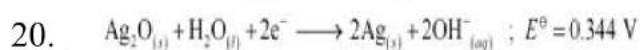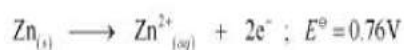   In $[Ni(en)_3]$ Cl_2,, Ni with d^8 configuration shows octahedral geometry.

18. **(d)** Both assertion and reason are INORRECT.

   Explanation: Both assertion and reason are INORRECT.

Section B

19. Rate law is the expression in which reaction rate is given in terms of molar concentration of reactants with each term raised to some power, which may or may not be same as the stoichiometric coefficient of the reacting species in a balanced chemical equation. For the reaction: aA + bB → cC + dD, the rate law is: Rate = k $[A]^x$ $[B]^y$; where a may or may be equal to x; and b may or may be equal to y. Rate law is experimentally determined.

$$Zn_{(s)} \longrightarrow Zn^{2+}_{(aq)} + 2e^- \; ; \; E^\ominus = 0.76V$$

20. $$\underline{Ag_2O_{(s)} + H_2O_{(l)} + 2e^- \longrightarrow 2Ag_{(s)} + 2OH^-_{(aq)} \; ; \; E^\ominus = 0.344 \text{ V}}$$

$$Zn_{(s)} + Ag_2O_{(s)} + H_2O_{(l)} \longrightarrow Zn^{2+}_{(aq)} + 2Ag_{(s)} + 2OH^-_{(aq)} \; ; \; E^\ominus = 1.104 \text{ V}$$

Therefore, $E^\ominus = 1.104$ V

We know that,

$\Delta_r G^\ominus = -nFE^\ominus$

$= \text{-}2 \times 96487 \times 1.04$

$= \text{-}213043.296$ J

$= \text{-}213.04$ kJ

<div align="center">OR</div>

$\lambda m = \frac{\kappa}{C} \times 1000$ S cm^2 mol^{-1}

$= \frac{1000\,\kappa}{M}$

$\kappa = \frac{\lambda m \times M}{1000}$

$= \frac{4.6 Scm^2/mol \times 0.1m}{100}$

$= 0.00046$ s/cm

Resistivity $= \frac{1}{\kappa}$

$= \frac{1}{0.00046 \text{ S cm}^{-1}} = 2174 \; \Omega$ cm

21. Hexadentate ligand is a ligand which has 6 donor atoms, e.g. EDTA.

EDTA forms complex with Ca^{2+} and Mg^{2+} therefore it is used for estimating hardness of water.

<div align="center">OR</div>

1. $[Pt(NH_3)_6]Cl_4$

2. $[CoCl_2(NH_3)_4]^+$

22. Henry's Law states that "the partial pressure of the gas in vapour phase (p) is proportional to the mole fraction of the gas (x) in the solution" and is expressed as:

$p = K_H x$

Here K_H is the Henry's law constant.

Given, T = 298 K, $K_H = 1.25 \times 10^6$, p = 760 mm Hg

We know by Henry's Law, $p = K_H \times x$, where x is mole fraction of the gas in the solution.

$760 = 1.25 \times 10^6 \times x$

$x = \dfrac{760}{1.25 \times 10^6}$

$x = 6.08 \times 10^{-4}$

23. Applying Nernst equation

$E = E^0_{H^+/H_2} - 0.0591/2 \log 1/[H^+]^2$

$-0.30V = 0 - \dfrac{0.0591}{2} \log \dfrac{1}{[H^+]^2}$

$\log \dfrac{1}{[H^+]^2} = \dfrac{0.60}{0.0591} = 10$

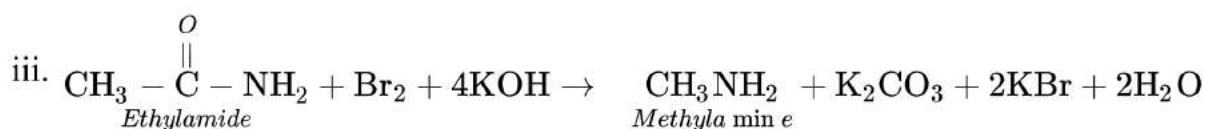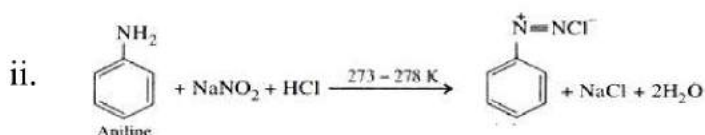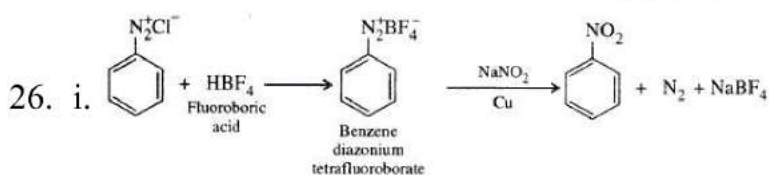$\log \dfrac{1}{[H^+]^2} = \log 10^{10} \Rightarrow \dfrac{1}{[H^+]^2}$

$= 10^{10} = [H^+] = 10^{-5} mol^{-1}$

$pH = -\log[H^+] = -\log 10^{-5}$

$5 \log 10 = 5$

24.

25. $CH_3CH_2CH_2 OH + SOCl_2 \rightarrow CH_3CH_2CH_2Cl + SO_2 + HCl$
    1−Propanol   1−Chloropropane

Section C

26. i.

ii.

iii.

$CH_3 - \overset{\overset{O}{\|}}{C} - NH_2 + Br_2 + 4KOH \rightarrow CH_3NH_2 + K_2CO_3 + 2KBr + 2H_2O$
    Ethylamide   Methyla min e
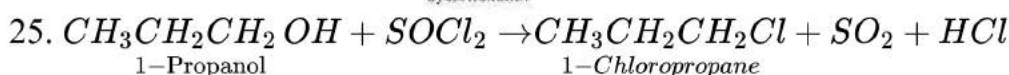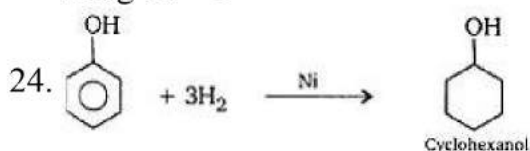
27. Zn is oxidized and Ag_2O is reduced (as Ag^+ ions change to Ag)

$E^0_{cell} = E^0[Ag_2O/Ag](red) + E^0[Zn/Zn^{2+}](ox)$

$$= 0.344 + 0.76$$
$$= 1.104 \text{ V}$$
$$\Delta_r G^0 = -nFE^0 cell = -2 \times 96500 \times 1.104 J$$
$$= -2.13 \times 10^5 J$$

28. a. Transition metals form complex compounds due to small size, high ionic charge and availabilty of d-orbital.

    b. E_0 values for (Zn^{2+}/Zn) and (Mn^{2+}/Mn) are more negative than expected due to stable $3d^{10}$ configuration in Zn^{2+} and $3d^5$ configuration in Mn^{2+}.

    c. Actinoids show wide range of oxidation states due to comparable energies of 5f ,6d and 7s orbitals.
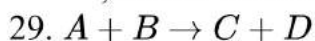
29. $A + B \rightarrow C + D$
    $Rate = k [A]^x$

    Rate = 1 when [A] = 1 .....1)
    Rate = 2 when [A] = 2 ..... 2)
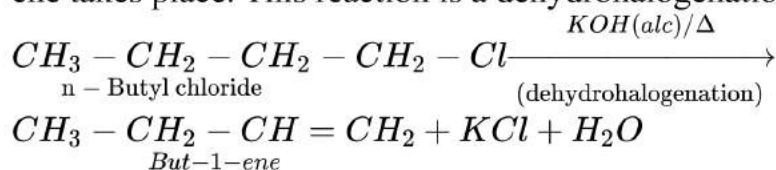   Dividing equation 2) by 1)
 $$\frac{2}{1} \alpha \frac{(2)^x}{1^x}$$
    $$2^1 \alpha (2)^x$$
 $$\therefore x = 1$$
    The reaction is first order reaction.

30. i. When n - butyl chloride is treated with alcoholic KOH, the formation of but - 1 - ene takes place. This reaction is a dehydrohalogenation reaction.

    $$CH_3 - CH_2 - CH_2 - CH_2 - Cl \xrightarrow[\text{(dehydrohalogenation)}]{KOH(alc)/\Delta}$$
    $$\underset{n-\text{Butyl chloride}}{}$$
    $$CH_3 - CH_2 - \underset{But-1-ene}{CH = CH_2} + KCl + H_2O$$

    ii. When bromobenzene is treated with Mg in the presence of dry ether, (Grignard reagent) phenylmagnesium bromide is formed.
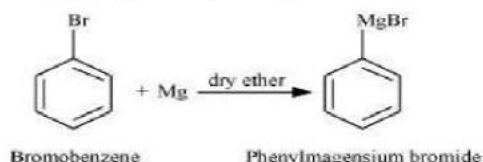
    iii. The chlorobenzene does not undergo hydrolysis under normal conditions. However, it undergoes hydrolysis when heated in an aqueous sodium hydroxide solution at a temperature of 623 K and a pressure of 300 atm form phenol(replacement by hydroxyl group).
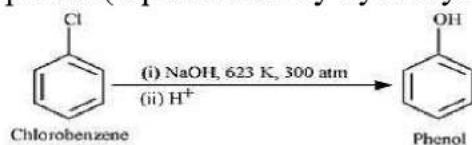
    OR

    i. $CH_3CH_2CH_2CH_2Br < (CH_3)_2CHCH_2Br < CH_3CH_2CH(Br)CH_3 < (CH_3)_3CBr$ (S_N1) $CH_3CH_2CH_2CH_2Br > (CH_3)_2CHCH_2Br > CH_3CH_2CH(Br)CH_3 > (CH_3)_3CBr$ (S_N2)

    Of the two primary bromides, the carbocation intermediate derived from $(CH_3)_2CHCH_2Br$ is more stable than derived from $CH_3CH_2CH_2CH_2Br$ because

of greater electron-donating inductive effect of $(CH_3)_2CH-$ group. Therefore, $(CH_3)_2CHCH_2Br$ is more reactive than $CH_3CH_2CH_2CH_2Br$ in S_N1 (unimolecular substitution) reactions. $CH_3CH_2CH(Br)CH_3$ is a secondary bromide and $(CH_3)_3CBr$ is a tertiary bromide. Hence the above order is followed in S_N1 unimolecular substitution reaction. The reactivity in S_N2 (bimolecular substitution) reactions follows the reverse order as the steric hindrance around the electrophilic carbon increases in that order.

ii. $C_6H_5C(CH_3)(C_6H_5)Br > C_6H_5CH(C_6H_5)Br > C_6H_5CH(CH_3)Br > C_6H_5CH_2Br$ (S_N1) $C_6H_5C(CH_3)(C_6H_5)Br < C_6H_5CH(C_6H_5)Br < C_6H_5CH(CH_3)Br < C_6H_5CH_2Br$ (SN_2)

Of the two secondary bromides, the carbocation intermediate obtained from $C_6H_5CH(C_6H_5)Br$ is more stable than obtained from $C_6H_5CH(CH_3)Br$ because it is stabilized by two phenyl groups due to resonance. Therefore, the former bromide is more reactive than the latter in S_N1 unimolecular substitution reactions. A phenyl group is bulkier than a methyl group. Therefore, $C_6H_5CH(C_6H_5)Br$ is less reactive than $C_6H_5CH(CH_3)Br$ in S_N2 bimolecular substitution reactions.

Section D

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

Biomolecules are complex molecules which build up living organisms and required for their growth, maintenance and ability to reproduce. Carbohydrates are polyhydroxy aldehydes and ketones which are major sources of energy. Monosachharides are simple sugars which cannot be hydrolysed. Oligosachharide, on hydrolysis give 2 to 10 molecules of monosachharides. Polysachharides like starch and cellulose on hydrolysis give large number of molecules of glucose a-glucose and b-glucose (Anomers). Proteins are complex nitrogeneous polymers of amino acids connected through peptide bonds. The sequence in which amino acids are linked is called Primary structure. Secondary structures are of 2 types a-helix in globular proteins and b-pleated structure in fibrous proteins involving H-bonds. Tertiary structure has H-bonds, disulphide linkage, ionic bonding and van der Waals' forces. Insulin is hormone for metabolism of glucose, has quarternary structure. Denaturation of protein destroys secondary and tertiary structure, loss of biological activity but primary structure remaining the same. Enzymes are highly specific, work at specific pH, moderate temperature and catalyse biochemical reactions. Hormones perform specific functions and secreated by endocrine glands. Vitamins are essential for healthy body. A, D, E, K are fat soluble vitamins. Vitamin C and B1, B2, B6 are water soluble. B12 is neither water, nor fat soluble. Nucleic acids are polymer of nucleotides. RNA consist of m-RNA, t-RNA, r-RNA. RNA has Adenine, Cytosine, Uracil and Guanine. It helps in protein synthesis. It cannot replicate. DNA contains deoxyribose, A, C, G and Thymine. It transfers genetic characteristics. DNA has double helix structure and undergoes replication.

(i) Lactose
(ii) Globular protein
(iii) Sucrose

OR

Guanine

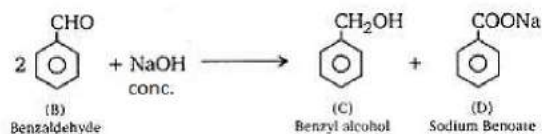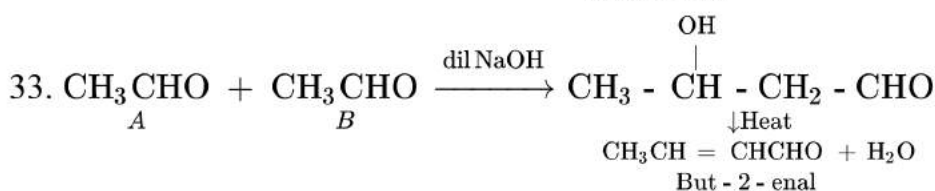**32. Read the text carefully and answer the questions:**

The coordination compounds are of great importance. These compounds are widely present in the mineral, plant and animal worlds and are known to play many important functions in the area of analytical chemistry, metallurgy, biological systems, industry and medicine. The selective estimation of these ions can be done due to the difference in the stability constants of calcium and magnesium complexes. Coordination compounds are of great importance in biological systems. The pigment responsible for photosynthesis, chlorophyll, is a coordination compound of magnesium. Among the other compounds of biological importance with coordinated metal ions are enzymes like carboxypeptidase and carbonic anhydrase (catalysts of biological systems). Coordination compounds are used as catalysts for many industrial processes. Articles can be electroplated with silver and gold much more smoothly and evenly from solutions of the complexes, $[Ag(CN)_2]^-$ and $[Au(CN)_2]^-$ than from a solution of simple metal ions.

(i) Excess of copper and iron are removed by the chelating ligands D-penicillamine and desferrioxime B via the formation of coordination compounds.

(ii) Impure nickel is converted to $[Ni(CO)_4]$, which is decomposed to yield pure nickel.

(iii) The familiar colour reactions given by metal ions with a number of ligands (especially chelating ligands), as a result of formation of coordination entities, form the basis for their detection and estimation by classical and instrumental methods of analysis.

OR

Gold, for example, combines with cyanide in the presence of oxygen and water to form the coordination entity $[Au(CN)_2]^-$ in aqueous solution.
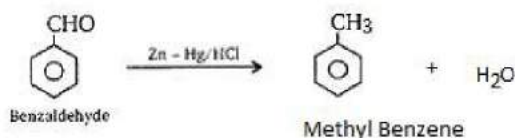
Section E

33.
$$CH_3CHO + CH_3CHO \xrightarrow{dil\ NaOH} CH_3 - \underset{\underset{OH}{|}}{CH} - CH_2 - CHO$$

$$\downarrow Heat$$
$$CH_3CH = CHCHO + H_2O$$
$$But - 2 - enal$$

i. 'A' is acetaldehyde, 'B' is Benzaldehyde.

ii. Reactions are shown above. First one is Aldol condensation(aldehydes and ketones containing one alpha hydrogen atom) and second one is Cannizzaro reaction(aldehydes and ketones containing no alpha hydrogen atom)
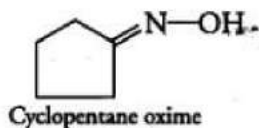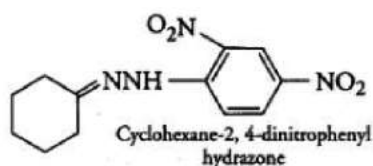
iii. This is Clemmensen Reduction.
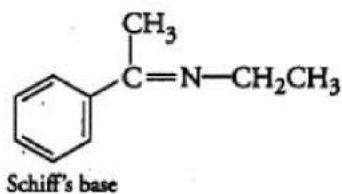

OR

Product of the reaction is

i.

Cyclopentane oxime

ii.

Cyclohexane-2, 4-dinitrophenyl hydrazone

iii.

$$R\text{-}CH\text{=}CH\text{-}CHO \quad + \quad NH_2\text{-}\overset{\overset{O}{\|}}{C}\text{-}NH\text{-}NH_2 \xrightarrow{H^+}$$

NH_2 attached to NH is more electrophilic than NH_2 attached to $>C=O$ group. Thus, reaction occurs through the NH_2 attached to NH.

iv.

Schiff's base

34. Answer the following questions:

(i) V_2O_5 act as a catalyst because vanadium can exists in multiple oxidation states.

(ii) is chiral molecule as it contains an asymmetric carbon atom (which is denoted by *).

(iii) Ortho nitrophenol is much more volatile in steam due to chelation. Intramolecular hydrogen bonding is present in o-nitrophenol and intermolecular hydrogen bonding in p-nitrophenol.

(iv) The decreasing order of basic strength of the above amines and ammonia (NH_3) follows in the following order:

$(C_2H_5)_2 NH > C_2H_5NH_2 > NH_3 > C_6H_5NH_2$

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

35. We know that

$$M_2 = \frac{1000 \times w_2 \times k_f}{\Delta T_f \times w_1}$$

Then, $M_{AB_2} = \frac{1000 \times 1 \times 5.1}{2.3 \times 20}$

$= 110.87 \, gmol^{-1}$

$M_{AB_4} = \frac{1000 \times 1 \times 5.1}{1.3 \times 20}$

$= 196.15 \, gmol^{-1}$

Now, we have the molar masses of AB_2 and AB_4 as $110.87 gmol^{-1}$ and $196.15 gmol^{-1}$ respectively.

Let the atomic masses of A and B be x and y respectively.

Now, we can write:

$x + 2y = 110.87$ ....(i)

$x + 4y = 196.15$ ....(ii)

Subtracting equation (i) from (ii), we have

2y = 85.28

$\Rightarrow y = 42.64$

Putting the value of y=42.64 in equation (1), we have

$x + 2 \times 42.64 = 110.87$

$\Rightarrow x = 25.59$

Hence, the atomic masses of A and B are 25.59 u and 42.64 u respectively.

<div align="center">OR</div>

Given that, 0.6mL of acetic acid (CH_3COOH) density = $1.06 gmL^{-1}$

Number of moles of acetic acid = $\frac{0.6mL \times 1.06 gmL^{-1}}{60 gmol^{-1}}$ = 0.0106 mol = n

Molality = $\frac{0.0106 mol}{1000 mL \times 1 gmL^{-1}}$ = 0.0106 mol kg^{-1}

Using equation of depression of freezing point ΔT_f = 1.86 K kg mol^{-1} $\times$ 0.0106 mol kg^{-1} = 0.0197K

van't Hoff Factor (i) = $\frac{\text{Observed freezing point}}{\text{Calculated freezing point}}$ = $\frac{0.0205K}{0.0197K}$ = 1.041

Acetic acid is a weak electrolyte and will dissociate into two ions: acetate and hydrogen ions per molecule of acetic acid. If x is the degree of dissociation of acetic acid, then we would have n(1 - x) moles of undissociated acetic acid, nx moles of CH_3COO^- and nx moles of H^+ ions,

$$CH_3COOH \underset{n(1-x)}{\overset{n \, mol}{\rightleftharpoons}} \underset{nx \, mol}{\overset{0}{H^+}} + \underset{nx \, mol}{\overset{0}{CH_3COO^-}}$$
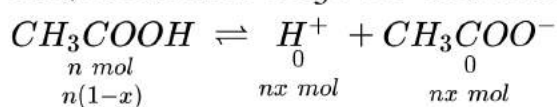
Thus total moles of particles are: n(1 - x + x + x) = n(1 + x)

i = $\frac{n(1+x)}{n}$ = 1 + x = 1.041

Thus degree of dissociation of acetic acid = x = 1.041 - 1.000 = 0.041

Then $[CH_3COOH]$ = n(1 - x) = 0.0106(1 - 0.041)

$[CH_3COO^-]$ = nx = 0.0106 $\times$ 0.041, $[H^+]$ = nx = 0.0106 $\times$ 0.041}

$K_a = \frac{[CH_3COO^-][H^+]}{[CH_3COOH]} = \frac{0.0106 \times 0.041 \times 0.0106 \times 0.041}{0.0106(1.00 - 0.041)}$

=1.86 $\times$ 10^{-5}