Class XII Session 2025-26
Subject - Chemistry
Sample Question Paper - 8

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

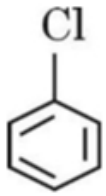
General Instructions:

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. Which of the following is most reactive towards nucleophilic substitution reaction? **[1]**

   a) 

   b) CH_3-CH_2-CH_2-Cl

   c) CH_2=CH-CH_2-Cl

   d) CH_2 = CH-C

2. The deficiency of which of the following vitamins causes Scurvy? **[1]**

   a) Vitamin B_{12}

   b) Vitamin C

   c) Vitamin A

   d) Vitamin B_6

3. Which of the following reagents can be used to oxidise primary alcohols to aldehydes? **[1]**

   a) CrO_3 in an anhydrous medium.

   b) Pyridinium chlorochromate.

   c) All of these

   d) Heat in the presence of Cu at 573K.

4. Which of the following compounds will give a ketone on oxidation with chromic anhydride (CrO_3)? **[1]**

   a) $CH_3CH_2CH_2OH$

   b) $(CH_3)_3C$-OH

   c) $CH_3 - CH_2 - \underset{\underset{OH}{|}}{C}H - CH_3$

   d) $(CH_3)_2CH$-CH_2OH

5. The half life of a substance in a first order reaction is 15 min. The rate constant is **[1]**

a) $4.62 \times 10^{-2}\ min^{-1}$

b) $2.46 \times 10^{2}\ min^{-1}$

c) $7.18 \times 10^{2}\ min^{-1}$

d) $6.74 \times 10^{-2}\ min^{-1}$

6. Match the items given in column I with that in column II. **[1]**

Column I	Column II
(a) Molarity	(i) $\frac{\text{Mass of solute}}{\text{Mass of solution}} \times 10^{6}$
(b) Molality	(ii) Number of gram moles of a solute per litre of solution
(c) Normality	(iii) Number of gram moles of a solute per kg of solvent
(d) ppm	(iv) Number of gram equivalent of a solute per litre of solution

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

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

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

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

7. C - Cl bond in chlorobenzene in comparison to C - Cl bond in methyl chloride is: **[1]**

a) longer and weaker

b) longer and stronger

c) shorter and stronger

d) shorter and weaker

8. Which of the following elements of 3d series of transition elements has the lowest $\Delta_a H^0$? **[1]**

a) Zn

b) Cu

c) Sc

d) Cr

9. As temperature increases, the reaction rate: **[1]**

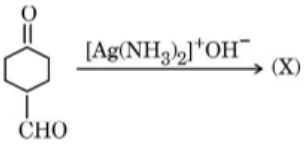
a) Stays the same

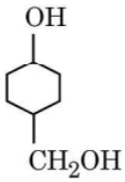
b) Increases

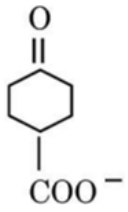
c) First decreases then increases

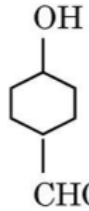
d) Decreases

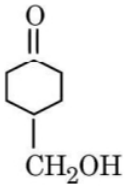
10. The product (X) obtained in the following reaction is: **[1]**



a) 

b) 

c) 

d) 

11. Dehydration of tertiary alcohols with Cu at 573 K gives: **[1]**

a) Ketone

b) Alkyne

c) Aldehyde

d) Alkene

12. The best reagent for converting, 2-phenylpropanamide into 1- phenylethanamine is _____. **[1]**

a) Br_2/NaOH

b) $LiAlH_4$

c) excess H_2/Pt

d) $NaBH_4$/methanol

13. **Assertion (A):** The backbone of DNA and RNA molecules is a chain consisting of heterocyclic base, pentose sugar and phosphate group. **[1]**

Reason (R): Nucleotides and nucleosides mainly differ from each other in presence of phosphate group.

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

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

c) Assertion (A) is true, but Reason (R) is false.

d) Assertion (A) is false, but Reason (R) is true.

14. **Assertion (A):** Benzoic acid does not undergo Friedel - Crafts reaction. **[1]**

Reason (R): Carboxyl group is deactivating and the catalyst aluminium chloride gets bonded to the carboxyl group.

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. **Assertion (A):** KCN reacts with methyl chloride to give methyl isocyanide. **[1]**

Reason (R): CN^- is an ambident nucleophile.

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):** Last traces of moisture in ethanol can be removed by keeping it over sodium wire **[1]**

Reason (R): Sodium reacts with water but not with ethanol to produce H_2 gas.

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) Both A and R are false.

Section B

17. A 5% solution (by mass) of cane sugar in water has a freezing point of 271K. Calculate the freezing point of 5% glucose in water if the freezing point of pure water is 273.15 K. **[2]**

OR

Under what condition do non-ideal solutions show negative deviations?

18. i. What type of isomerism is shown by the complex $[Cr(H_2O)_6]Cl_3$? **[2]**

ii. On the basis of crystal field theory, write the electronic configuration for d^4 ion if $\Delta_o > P$.

iii. Write the hybridization and shape of $[CoF_6]^{3-}$. (Atomic number of Co = 27)

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

a. What is the general electronic configuration of lanthanoids?

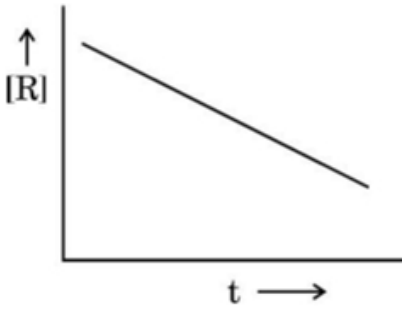
b. What are the common oxidation states of Cerium (At. no. 58)?

c. Why do actinoids show a wide range of oxidation states?

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

(a) Consider the equation $2NO(g) + 2H_2(g) \rightarrow N_2(g) + 2H_2O(g)$. The rate law for this equation is first order with respect to H_2 and second order with respect to NO. write the rate law for this reaction. **[1]**

(b) For a chemical reaction R → P, the variation in the concentration [R] vs time t plot is given as: **[1]**



a. Predict the order of the reaction and write the unit of rate constant (k) for this order of reaction.

b. What is the slope of the curve?

21. Write the equation involved in the Etard reaction. **[2]**

Section C

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

Zn | Zn^{2+} (0·1 M) || Cd^{2+} (0·01) | Cd

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

$E^{\ominus}_{Cd^{2+}/Cd}$ = -0·40 V

(log 10 = 1)

23. Hydrogen peroxide, $H_2O_2(aq)$ decomposes to H_2O and O_2 in a reaction which is first order in H_2O_2 and has a rate constant, $k = 1.06 \times 10^{-3} min^{-1}$. Then: **[3]**

i. How long will it take 15% of a sample of H_2O_2 to decompose?

ii. How long will it take 85% of a sample of H_2O_2 to decompose?

24. Draw the structure and name the product formed if the following alcohols are oxidized. Assume that an excess of oxidizing agent is used. **[3]**

i. $CH_3CH_2CH_2CH_2OH$

ii. 2-Butanol

iii. 2-methylpropanol

OR

What is fermentation? How is ethanol obtained by fermentation of molecules giving chemical equations?

25. i. Which will undergo faster nucleophilic addition reaction? **[3]**

Acetaldehyde or Propanone

ii. What is the composition of Fehling's reagent?

iii. Draw structure of the semicarbazone of Ethanal.

26. Explain why electrolysis of aqueous solution of NaCl gives H_2 at cathode and Cl_2 at anode. Write overall reaction. **[3]**

$$\begin{pmatrix} E^0_{Na^+/Na} = -2.71V;\ E^0_{H_2O/H_2} = -0.83V \\ E^0_{Cl_2/2Cl^-} = +1.36V;\ E^0_{H^+ + O_2/H_2O} = 1.23V \end{pmatrix}$$

27. Arrange the compounds of each set in order of reactivity towards S_N2 displacement: **[3]**

i. 2-bromo-2-methyl butane,1-bromopentane, 2-bromopentane.

ii. 1-bromo-3-methylbutane, 2-bromo-2-methylbutane, 3-bromo-2-methylbutane.

iii. 1-bromobutane, 1-bromo-2, 2-dimethylpropane, 1-bromo-2-methylbutane, 1-bromo-3-methylbutane.

28. a. Write the formulation for the galvanic cell in which the reaction **[3]**
$Cu(s) + 2Ag^+(aq) \rightarrow Cu^{2+}(aq) + 2Ag(s)$ takes place.
Identify the cathode and the anode reactions in it.

b. Write Nernst equation and calculate the emf of the following cell: Sn(s) | Sn^{2+}(0.04M) || H^+(0.02M) | H_2(g)|Pt(s)
$\left(Given\ \ E^{\ominus}_{Sn^{2+}/Sn} = -0.14V\right)$

Section D

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

The f-block consists of elements in which 4f and 5f orbitals are progressively filled. They are placed in a separate panel at the bottom of the periodic table. The names transition metals and inner transition metals are often used to refer to the elements of d-and f-blocks respectively. The d–block occupies the large middle section of the periodic table flanked between s and p blocks in the periodic table. In general, the electronic configuration of the outer orbitals of these elements is (n - 1)$d^{1-10}ns^{1-2}$. The electronic configurations of outer orbitals of Zn, Cd, Hg and Cn are represented by the general formula (n - 1)$d^{10}ns^2$. The transition metals and their compounds also exhibit catalytic property and paramagnetic behaviour. Transition metal also forms an alloy. An alloy is a blend of metals prepared by mixing the components. Alloys may be homogeneous solid solutions in which the atoms of one metal are distributed randomly among the atoms of the other.

i. Transition metals form alloys. Justify? (1)

ii. Why do transition elements exhibit higher enthalpies of atomization? (1)

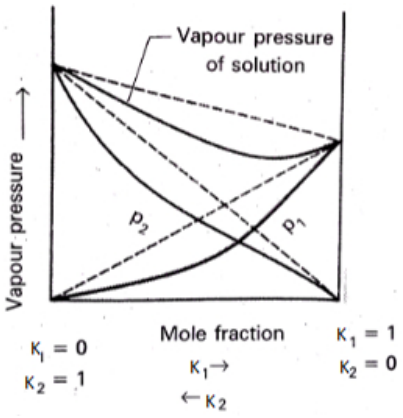
iii. Transition metals and many of their compounds show paramagnetic behaviour. Give reason. (2)

OR

Transition metals and their many compounds act as good catalyst. Give reason. (2)

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

Raoult's law states that for a solution of volatile liquids, the partial vapour pressure of each component of the solution is directly proportional to its mole fraction present in solution. Dalton's law of partial pressure states that the total pressure (P_{total}) over the solution phase in the container will be the sum of the partial pressures of the components of the solution and is given as: $P_{total} = P_1 + P_2$



i. Is the above-mentioned Raoult's law applicable for non-volatile liquids? (1)

ii. What type of deviation from Raoult's law does the above graph represent? (1)

iii. Give an example of such system. (2)

OR

A solution of two liquids boils at a temperature more than the boiling point of either of them. What type of deviation will be shown by the solution formed in terms of Raoult's law? (2)

Section E

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

(a) Define the following terms: **[1]**

a. Essential amino acids

b. Nucleotide

(b) Name the bases present in RNA. Which one of these is not present in DNA? **[1]**

(c) What are nucleic acids? Why two strands in DNA are not identical but are complementary? **[1]**

(d) Write the products obtained after hydrolysis of DNA. **[1]**

(e) What is the structural feature characterising reducing sugars? **[1]**

(f) What is the basic structural difference between starch and cellulose ? **[1]**

(g) a. How can you explain the absence of an aldehyde group in the pentaacetate of D-glucose? **[1]**

b. Name the bases present in RNA. Which one of these is not present in DNA?

32. **[5]**

a. i. For the complex $[Fe(H_2O)_6]^{3+}$, write the hybridization magnetic character and spin of the complex. (At. number : Fe = 26).

ii. Draw one of the geometrical isomers of the complex $[Pt(en)_2CI_2]^{2+}$ which is optically inactive.

b. i. Using crystal field theory, write the electronic configuration of iron ion in the following complex ion. Also predict its magnetic behaviour: $[Fe(H_2O)_6]^{2+}$

ii. Write the IUPAC name of the coordination complex: $[CoCl_2(en)_2]NO_3$

OR

i. Define crystal field splitting energy. On the basis of crystal field theory, write the electronic configuration for d^4 ion if $\Delta_0 < P$.

ii. $[Ni(CN)_4]^{2-}$ is colourless whereas $[Ni(H_2O)_6]^{2+}$ is green. Why? (At. no. of Ni = 28)

33. Account for the following: **[5]**

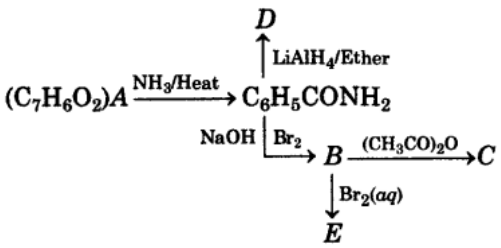
i. Aniline is a weaker base compared to ethanamine.

ii. Aniline does not undergo Friedel-Crafts reaction.

iii. Only aliphatic primary amines can be prepared by Gabriel Phthalimide synthesis.

OR

An aromatic compound 'A' of molecular formula $C_7H_6O_2$ undergoes a series of reactions as shown below. Write the structures of A, B, C, D and E in the following reactions.



Solution

Section A

1.

(c) CH_2=CH-CH_2-Cl

Explanation:

The most reactive towards nucleophilic substitution reaction is CH_2=CH-CH_2-Cl

2.

(b) Vitamin C

Explanation:

Scurvy is caused by not having enough vitamin C in your diet over a long period of time. Vitamin C is mainly found in fruit and vegetables.

3.

(c) All of these

Explanation:

Oxidation of alcohols to aldehydes is partial oxidation; aldehydes are further oxidized to carboxylic acids. Conditions required for making aldehydes are heat and distillation.

In aldehyde formation, the temperature of the reaction should be kept above the boiling point of the aldehyde and below the boiling point of the alcohol.

These include:

- Chromium-based reagents, such as Collins reagent ($CrO_3 \cdot Py_2$)
- PDC or PCC.
- Heat in the presence of Cu at 573K.

4.

(c) $CH_3 - CH_2 - \underset{\underset{OH}{|}}{C}H - CH_3$

Explanation:

$CH_3 - CH_2 - \underset{\underset{OH}{|}}{C}H - CH_3$

5. **(a)** $4.62 \times 10^{-2}\ min^{-1}$

Explanation:

for first order reaction

$t_{1/2} = \frac{0.693}{k}$

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

Explanation:

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

7.

(c) shorter and stronger

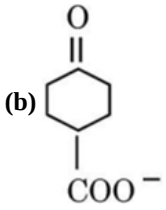
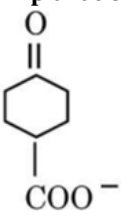
Explanation:

In chlorobenzene, the hybridization of carbon attached to Cl is $sp^{2,}$ and in methyl chloride hybridization of C attached to Cl is sp^3. In sp^2 hybridization, s-character is 33% and in sp^3 s-character is 25%. The sp^2 hybridized carbon with a greater s-character is more electronegative and can hold the electron pair of C—X bond more tightly than sp^3-hybridized carbon in haloalkane with less s-character resulting in a short bond length of C-Cl bond. Since it is difficult to break a shorter bond than a longer

bond, means it is stronger. Also in chlorobenzene, the electron pairs on Cl atom are in conjugation with π-electrons of the ring, so C—Cl bond acquires a partial double bond character due to resonance which makes the bond stronger.

8. **(a)** Zn
Explanation:
Zn

9. **(b)** Increases
Explanation:
With an increase in temperature the effective molecular collisions increases, hence the rate of reaction also increases.

10. **(b)**

Explanation:


11. **(d)** Alkene
Explanation:
Alkene

12. **(a)** Br_2/NaOH
Explanation:
$$\underset{\text{2 - Phenylpropanamide}}{CH_3-\underset{\underset{C_6H_5}{|}}{C}H-CONH_2} \xrightarrow[\text{(Hofmann'sbromamide reaction)}]{Br_2/NaOH} \underset{\text{1 - Phenyletanamine}}{CH_3-\underset{\underset{C_6H_5}{|}}{C}H-NH_2} + Na_2CO_3 + 2H_2O$$

13. **(c)** Assertion (A) is true, but Reason (R) is false.
Explanation:
In a tetrapeptide, there are four amino acids connected by three peptide bonds

14. **(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.

15. **(d)** A is false but R is true.
Explanation:
Haloalkanes react with AgCN to form alkyl isocyanides as the main product while KCN forms alkyl cyanides as the chief product.

16. **(d)** Both A and R are false.

Explanation:

Last traces of moisture in ethanol cannot be removed by keeping it over sodium wire. Sodium reacts both with H_2O and ethanol.

Section B

17. Given,5% sugar solution means, w_B = 5g

w_A = 95g,M_B = 342g mol^{-1}

Similarly, for 5% glucose solution, w_B(glucose) = 5g

w_A = 95 g and M_B(glucose) = 180 g mol^{-1}

ΔT_f(canesugar) = 273.15K - 271K = 2.15K

$\Delta T_f = \frac{K_f \times w_B \times 1000}{M_B w_A}$

$2.15 = \frac{K_f \times 5 \times 1000}{342 \times 95}$

$k_f = \frac{2.15 \times 342 \times 95}{5 \times 1000} = 13.9707$

similarly, for glucose

$\Delta T_f(glucose) = \frac{13.9707 \times 5 \times 1000}{180 \times 95}$

$\Delta T_f = 4.085K$

Freezing point of the solution

= 273.15K - 4.085K = 269.065 K

OR

When the new forces of attraction between components are greater than those in the pure components. That is when two components A and B are mixed, the interactions between A....B is greater than A...A and B...B interaction then the binary non-ideal solution would show negative deviation from Raoult's law.

18. i. Hydration isomerism

ii. Electronic configuration is t_{2g}^4

iii. Hybridization is sp^3d^2 and shape is octahedral.

19. a. The general electronic configuration of lanthanoids is $4f^{1\text{-}14}\ 5d^{0\text{-}1}\ 6s^2$

b. +3 and +4

c. 5f 6d 7s orbitals are of comparable energies

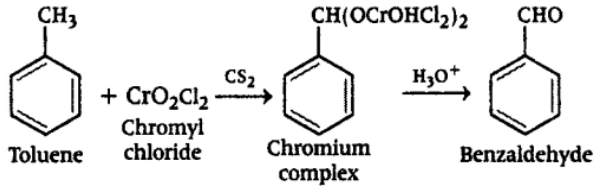
20. Answer the following:

(i) The rate law is R = k $[NO]^2$ $[H_2]$

(ii) a. Zero order, mol L^{-1} s^{-1} or mol L^{-1} t^{-1}

b. -K

21. **Etard Reaction:** Toluene reacts with chromyl chloride in presence of CS_2 followed by hydrolysis produces benzaldehyde.



Section C

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

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

23. i. For 15% decomposition of H_20_2

[R]$_0$ = 100 M, [R] = 100 - 15 = 85 M

k = 1.06 $\times$ 10^{-3} min^{-1}

For first order reaction

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

$t = \frac{2.303}{1.06\times10^{-3}} \times \log\left[\frac{100}{85}\right]$

$t = \frac{2.303}{1.06\times10^{-3}} \times [\log 100 - \log 85]$

$t = \frac{2.303}{1.06\times10^{-3}} \times \log(2 - 1.9292)$

$t = \frac{2.303}{1.06\times10^{-3}} \times (0.0706)$

t = 153.38 min.

ii. Similarly, for 85% decomposition of reaction

$t = \left(\frac{2.303}{1.06\times10^{-3}}\right)\log\left(\frac{100}{15}\right)$

t = 1790.325 min.

24. i. $\underset{\text{Butanol}}{CH_3CH_2CH_2CH_2OH} \xrightarrow[Oxidation]{[O]} \underset{\text{Butanoic acid}}{CH_3CH_2CH_2COOH}$

ii. $CH_3 - \underset{OH}{\underset{|}{CH}} - CH_2CH_3 \xrightarrow[Oxidation]{[O]} CH_3 - \underset{O}{\underset{||}{C}} - CH_2CH_3$

$\text{Butan}-2-one$

iii. $CH_3 - \underset{CH_3}{\underset{|}{\overset{H}{\overset{|}{C}}}} - CH_2 - OH \xrightarrow[Oxidation]{[O]} CH_3 - \underset{CH_3}{\underset{|}{\overset{H}{\overset{|}{C}}}} - COOH$

$2-Methylpropanoic\ acid$

OR

The process of fermentation involves breaking down of large molecules into simpler ones in presence of enzymes.

In India, ethanol is mainly prepared by fermentation of molecules a dark brown coloured group left after crystallization of sugar.

$\underset{Maltose}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow[(from\ yeast)]{Maltase} \underset{Glucose}{2C_6H_{12}O_6}$

$\underset{Glucose}{C_6H_{12}O_6} \xrightarrow{Zymase} \underset{Ethyl\ alcohol}{2C_2H_5OH} + 2CO_2$

25. i. Acetaldehyde

ii. Aqueous copper sulphate solution and alkaline solution of sodium-potassium tartarate (Rochelle's salt).

iii. $CH_3CH = NNHCONH_2$

26. At cathode, the following reduction reactions can take place:

$Na^+_{(aq)} + e^- \rightarrow Na_{(s)}; E^0_{Na^+/Na} = -2.71V$

$H^+_{(aq)} + e^- \rightarrow \frac{1}{2}H_2(g);\ E^0_{H^+/H_2} = OV$

A reduction reaction with higher reduction potential is preferred. Therefore, the reaction at the cathode during electrolysis is

$H^+_{(aq)} + e^- \rightarrow \frac{1}{2}H_{2(g)}$

This is why electrolysis of aqueous solution of NaCl gives H_2 at the cathode.

At anode, the following oxidation reactions can take place:

$Cl^-_{(aq)} \rightarrow \frac{1}{2}Cl_{2(g)} + e^- E^0_{Cl_2/2Cl^-} = +1.36V$

$2H_2O_{(l)} \rightarrow O_{2(g)} + 4H^+_{(aq)} + 4e^- E^0_{H^+ + O_2/H_2O}$ = 1.23V

At anode, the reaction with lower value of E_0 is preferred. But, due to overvoltage, oxidation of chloride ion occurs and chlorine gas is obtained. Hence, the reaction at the anode during electrolysis is

$Cl^-_{(aq)} \rightarrow \frac{1}{2}Cl_{2(g)} + e^-\ E^0_{Cl_2/2Cl^-} = +1.36V$

This is why electrolysis of aqueous solution of NaCl gives Cl_2 at the anode.

The overall cell reaction is given below.

$H^+ + Cl^- \rightarrow \frac{1}{2}H_2 + \frac{1}{2}Cl_2$

27. In S_N2 reaction, steric factors determine the reactivity. more reactive alkyl halides have less steric hindrance. Hence, the decreasing order of the reactivity of alkyl halides is $1^o > 2^o > 3^o$. The order of reactivity as follows:

i. 1-bromopentane > 2-bromopentane > 2-bromo-2-methylbutane

ii. 1-bromo-3-methylbutane > 3-bromo-2-methylbutane > 2-bromo-2-methylbutane

iii. 1-bromobutane > 1-bromo-3-methylbutane > 1-bromo-2-methylbutane> 1-bromo-2, 2 dimethylpropane

28. a. We have

$E^{\Theta}_{(Cu^{2+}/Cu)} = 0.34V$ and $E^{\Theta}_{(Ag^{+}/Ag)} = 0.80V$

Standard emf of Cu is less than Ag, therefore it is strong reducing agent and is oxidised. Therefore Cu acts as Anode and Ag acts as Cathode.

Half cell reactions are:

At Cathode (Reduction):

$2Ag^{+}(aq) + 2e^{-} \rightarrow 2Ag(s)$

At Anode (Oxidation):

$Cu(s) \rightarrow Cu^{2+}(aq) + 2e^{-}$

b. The reactions are :

At Anode:

$Sn(s) \rightarrow Sn^{2+}(aq) + 2e^{-}$

At Cathode:

$2H^{+}(aq) + 2e^{-} \rightarrow H_2(g)$

Full cell reaction:

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

Standard emf of the cell is:

$E^0_{cell} = E^0_{H^+/H_2} - E^0_{Sn^{2+}/Sn}$

= 0 - (-0.14)V

= + 0.14V

For this reaction n=2 moles of electrons. Using Nernst equation,

$E_{cell} = 0.14 - \frac{0.0591}{2}\log\frac{[Sn^{2}+]}{[H^{+}]^{2}}$

$= 0.14 - \frac{0.0591}{2}\log\frac{0.04}{(0.02)^2}$

$= 0.14 - \frac{0.0591}{2}\log\frac{4}{100} \times \frac{100}{2} \times \frac{100}{2}$

= 0.14 V - 0.0591 V

= 0.0809 V

Section D

29. i. The transition metals are quite similar in size and, therefore, the atoms of one metal can substitute the atoms of other metal in its crystal lattice. Thus, on cooling a mixture solution of two or more transition metals, solid alloys are formed.

ii. The high enthalpies of atomization are due to a large number of unpaired electrons in their atoms. Therefore, they have stronger interatomic interactions and hence, stronger bonding between atoms.

iii. Transition elements and many of their compounds are paramagnetic, i.e., they are weakly attracted by a magnetic field. This is due to the presence of unpaired electrons in atoms, ions or molecules. The paramagnetic character increases as the number of unpaired electrons increases.

OR

a. The ability of transition metal ion to pass easily from one oxidation state to another and thus providing a new path to reaction with lower activation energy.

b. The surface of transition metal acts as very good adsorbent and thus provides increased concentration of reactants on their surface causing the reaction to occur.

30. i. KCl in a kg of water would be expected to increase the boiling point by 2 $\times$ 0.52 K = 1.04 K. This could led us to conclude that mass of 2 moles of particles is 74.5 g hence mass of 1 mole of KCl would be 37.25 g. Hence, in case of KCl where dissociation occurs experimentally determined molar mass is always lower than true value.

ii. Negative Deviation.

iii. A liquid mixture consisting of 20 % acetone and 80%. chloroform by mass.

OR

Negative Deviation.

Section E

31. Attempt any five of the following:

(i) a. Amino acids which cannot be synthesised in the body and must be obtained through diet.

b. When nucleoside is linked to phosphoric acid at 5'-position of sugar moiety. / Base + sugar + phosphoric acid.

(ii) Uracil, cytosine, guanine and adenine are present in RNA. Among these, uracil is not present in DNA.

(iii) Nucleic acids are polymers of Nucleotides.

Because the H-bonds are formed between specific pairs of bases/pairing between A & T and between C & G.

(iv) Hydrolysis of DNA gives 2-deoxyribose, nitrogen containing heterocyclic base(Adenine, Guanine, Cytosine and Thymine), phosphoric acid.

(v) The reducing sugars have free aldehydic or ketonic groups.

(vi) **Starch:** It is a branched chain polymer of α-glucose and consists of two components: Amylose(water soluble) and Amylopectin (water insoluble).

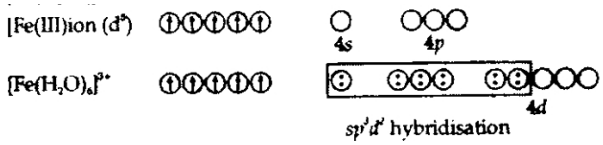
Cellulose: It is a straight chain polysaccharide composed only of β-D-glucose units which are joined by glycosidic linkage between C_1 of one glucose unit and C_4 of the next glucose unit.

(vii) a. The pentaacetate of glucose does not react with hydroxylamine / HCN / Schiff's reagent indicating the absence of free -CHO group.

b. Adenine, Guanine, Uracil and Cytosine Uracil

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

$[Fe(H_2O_6]^{3+}$



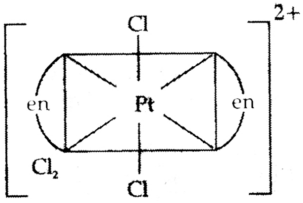
Since H_2O is a weak field ligand, it cannot cause pairing of electrons. Therefore, the number of unpaired electrons is 5.

$\mu = \sqrt{n(n+2)} = \sqrt{5(5+2)} = \sqrt{35}$ = 5.92 BM

Thus, it is strongly paramagnetic (due to presence of unpaired electrons).

In $[Fe(H_2O)_6]^{3+}$ outer d-orbitals are used in hybridization to from high spin complex.

ii. Geometrical isomers of $[Pt(en)_2Cl_2]^{2+}$



trans-$[PtCl_2(en)_2]^{2+}$ is optically inactive

b. i. $t_{2g}{}^4 e_g{}^2$ Paramagnetic

ii. Dichloridobis (ethane-1,2-diamine)cobalt (III) nitrate

OR

i. Crystal field splitting energy is the energy difference between two sets of d-orbital levels that split when ligands approach a transition metal ion.

If $\Delta_0 > P$, it becomes more energetically favourable for the d^4 election to occupy a t_{2g} orbital with configuration $t_{2g}^4 e_g^0$.

ii. $[Ni(CN)_4]^{2}$ is colounless whereas

$[Ni(H_2O)_6]^{2+}$ is green, because

In both complexes, Ni is in +2 oxidation state with electronic configuration of $3\ d^8$.

In the presence of weak field water ligands, two unpaired electrons do not pair up.

Hence, the complex $[Ni(H_2O)_6]^{2+}$ has two unpaired electrons which result in green colour compound.

Due to d-d transition, red light is absorbed and complimentary light emitted is green.

In presence of strong field cyanide ligand, the unpaired electrons in 3d orbital pair up.

Due to an absence of unpaired electrons and no d-d transitions are possible and the complex $[Ni(CN)_4]^{2-}$ ends up as colourless compound.

33. i. Aniline is typical of aromatic primary amines - where the -NH_2 group is attached directly to a benzene ring. These are very much weaker bases than ammonia.

Aniline is more basic than ethylamine because of resonance. When aniline loses a proton the resulting ion is more stable than that of ethylamine and hence, aniline is more basic than ethylamine. Hence, aniline looses proton more readily than ethylamine.

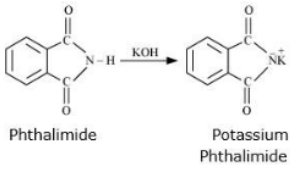
ii. Aniline being a Lewis base reacts with Lewis acid ($AlCl_3$) to form a salt.

$$C_6H_5NH_2 + AlCl_3 \longrightarrow C_6H_5\overset{+}{N}H_2AlCl_3^-$$

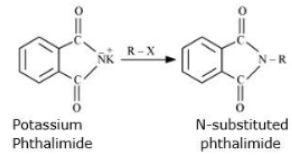
As a result, N acquires a positive charge so, it acts as a strong deactivating group for electrophilic substitution reaction. Thus, aniline does not undergo Friedel-Crafts reaction.

iii. Gabriel phthalimide synthesis is a very convenient method for the preparation of pure aliphatic amines

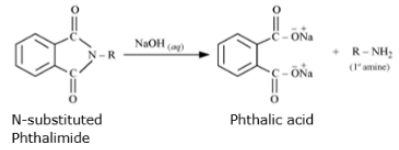
Step 1: Phthalimide is treated with KOH to form potassium phthalimide



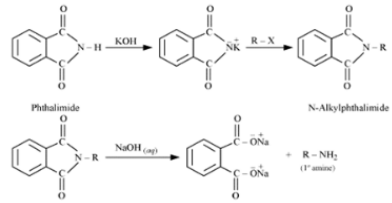
Step 2: Potassium phthalimide is treated with a suitable alkyl halide to form N-substituted phthalimides.



Step 3: N-substituted phthalimides undergoes hydrolysis in the presence of dil. HCl or with alkali(NaOH) to give primary amines.

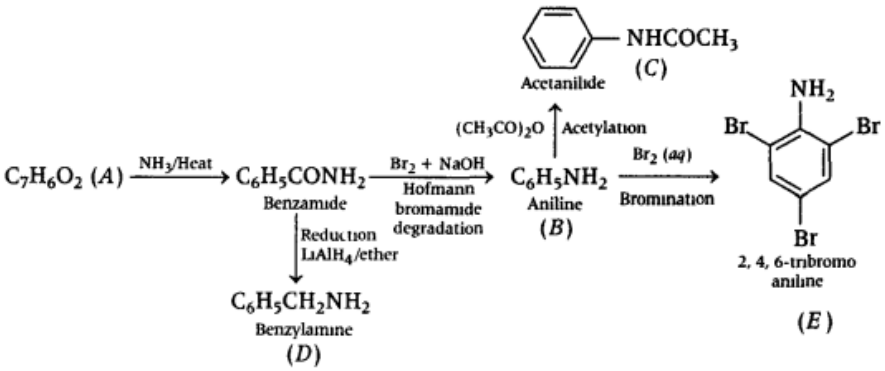


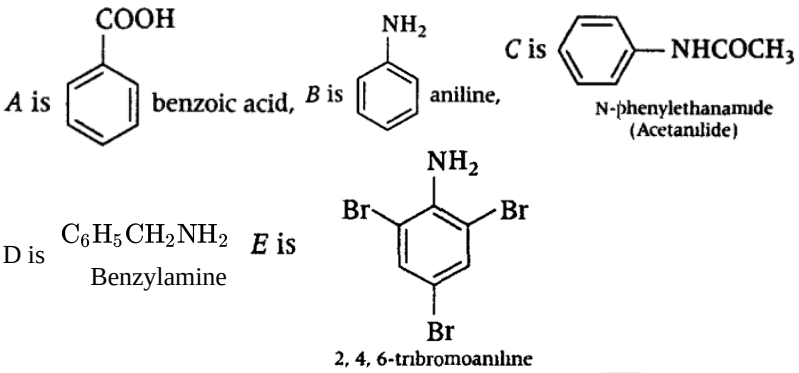
Overall reaction:



Gabriel phthalimide synthesis results in the formation of primary(1° amine) only. Secondary or tertiary amines are not formed through this synthesis. Hence, Gabriel phthalimide synthesis preferred for the formation of primary amines only.

OR





D is $C_6H_5CH_2NH_2$
Benzylamine

E is

2, 4, 6-tribromoaniline