

Sample Question Paper 1

CHEMISTRY (Solved)

(A Highly Simulated Practice Question Paper for CBSE Class XII Examination)

Instructions

- There are 33 questions in this question paper. All questions are compulsory.
- Section A :** Q. no. 1-2 are case-based questions having four MCQs or Assertion-Reason type based on given passage each carrying 1 mark and Question 3 to 16 are MCQs and Assertion-Reason type questions carrying 1 mark each.
- Section B :** Q. no. 17 to 25 are short answer type I questions and carry 2 marks each.
- Section C :** Q. no. 26 to 30 are short answer type II questions and carry 3 marks each.
- Section D :** Q. no. 31 to 33 are long answer questions carrying 5 marks each.
- There is no overall choice. However, an internal choices have been provided.
- Use of calculators and log tables is not permitted.

Time : 3 hours

Max. Marks : 70

SECTION A : Objective Questions

(1 Mark)

Passage Based Questions

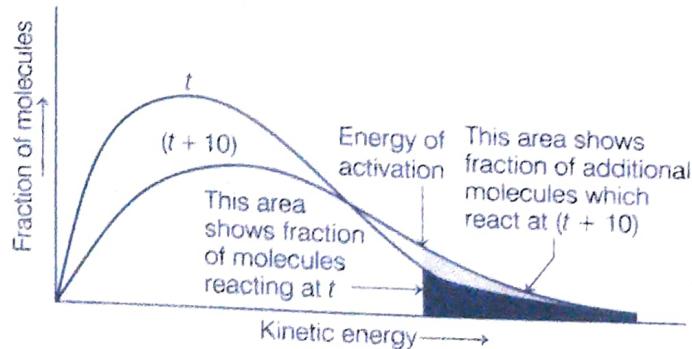
1. Read the passage given below and answer the following questions :

Most of the chemical reactions are accelerated by increase in temperature T . At a particular temperature T , all the molecules of reactants do not have the same kinetic energy but the fractions of molecules having particular kinetic energies at a particular temperature remain constant. The distribution of kinetic energy may be described by plotting the fraction of molecules (N_E/N_T) with a given kinetic energy (E). This is called Maxwell's Boltzmann distribution of energies. Here, N_E is the number of molecules with energy E and N_T is the total number of molecules.

The temperature dependence of rate of a chemical reaction is expressed by Arrhenius equation, $k = Ae^{-E_a/RT}$

The following questions are multiple choice questions. Choose the most appropriate answer :

- (i) Given the Maxwell's Boltzmann's distribution curve showing dependence of rate of reaction.



- (a) Time (b) Conc. of reactant
(c) Amount of reactant (d) Temperature
- (ii) What does the peak of the distribution curve represents?
(a) Kinetic energy
(b) Potential energy
(c) Number of molecules
(d) Time

- (iii) What does the graph show that on increasing the temperature rate of reaction gets doubled?
- Doubles the concentration of reactants
 - Half the amount of reactant
 - Double the rate of reaction
 - Half the rate of reaction

Or

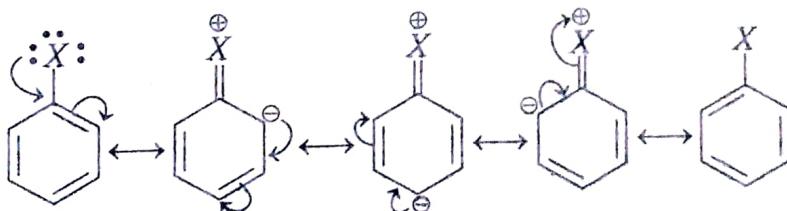
The rate constant of a reaction is $1.5 \times 10^{-7} \text{ s}^{-1}$ at 50°C and $4.5 \times 10^{-7} \text{ s}^{-1}$ at 100°C . Calculate the value of activation energy E_a for the reaction $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$, $\log 3 = 0.4771$.

- 22.01 J mol^{-1}
- $22.01 \text{ kJ mol}^{-1}$
- 19.15 J mol^{-1}
- 19.5 kJ mol^{-1}

- (iv) With the help of Arrhenius equation, what will be the effect on increasing the temperature result in in the rate of reaction?
- increase
 - decrease
 - constant
 - None of these

2. Read the passage given below and answer the following questions :

Nucleophilic substitution reactions in aryl halides occur only under drastic conditions, whereas electrophilic substitution reactions such as halogenation, nitration, sulphonation and Friedel-Craft's reaction occur easily. In these reactions, stronger electrophile replaces weaker electrophile. The electrophilic substitution reactions in haloarenes occur slowly and requires more drastic conditions. This is due to the *ortho*- and *para*-directing influence of halogen atom attached to a benzene ring which can be understood by following resonating structures.



In the question that follow Assertion and Reason are given. Reason is purported to the explanation for assertion. Study carefully and then mark your answers, according to the codes given below.

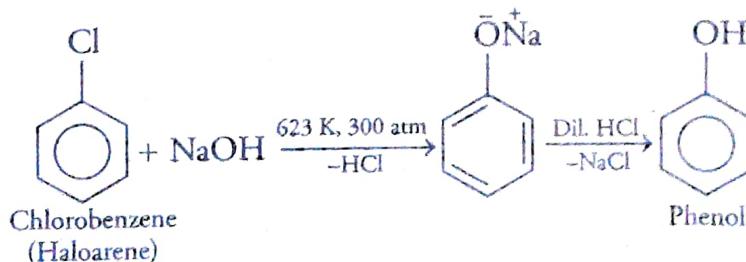
Mark your answer as :

- Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).
- Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A).
- Assertion (A) is correct, but Reason (R) is incorrect statement.
- Assertion (A) is incorrect, but Reason (R) is correct statement.

(i) **Assertion** Haloarenes are less reactive towards substitution reactions.

Reason The electron pairs on the halogen atom are in conjugation with π -electrons of the ring.

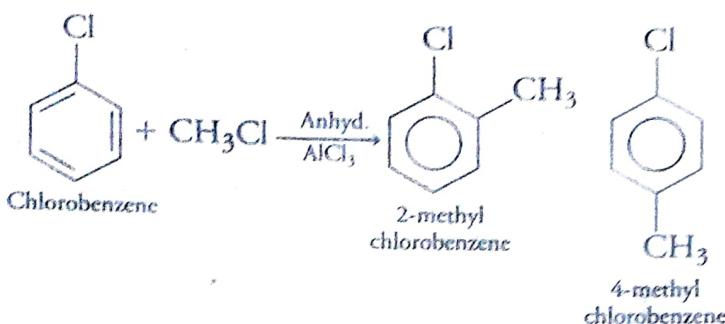
(ii) **Assertion**



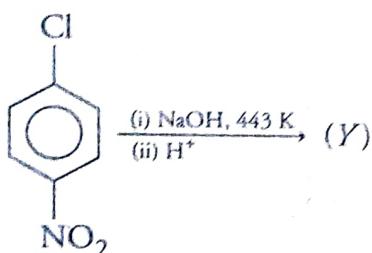
Reason It is equation for nucleophilic substitution reaction of haloarene.

Or Assertion Two products formed from Friedel-Craft's alkylation in chlorobenzene.

Reason

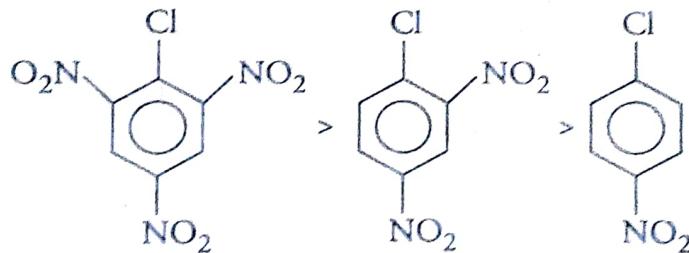


(iii) Assertion



Reason Y is 2-nitrophenol.

(iv) Assertion



Reason The order of reactivity towards electrophilic addition reaction.

Multiple Choice Questions

3. The degree of dissociation (α) of weak electrolyte $A_x B_y$ is related to van't Hoff factor (i) by the expression.

$$(a) \alpha = \frac{i-1}{(x+y-1)} \quad (b) \alpha = \frac{i-1}{(x+y+1)} \quad (c) \alpha = \frac{x+y-1}{i-1} \quad (d) \alpha = \frac{x+y+1}{i-1}$$

Or We know that the relationship between K_c and K_p is

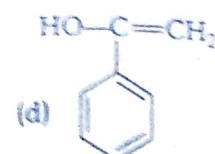
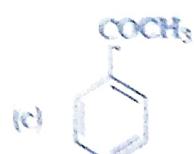
$$K_p = K_c (RT)^{\Delta n}$$

What would be the value of Δn for the reaction?



- | | | | |
|-------|---------|---------|-------|
| (a) 1 | (b) 0.5 | (c) 1.5 | (d) 2 |
|-------|---------|---------|-------|
4. For strong electrolytes, the plot of molar conductance v/s \sqrt{C} is
- | | | | |
|---------------|------------|----------------|--------------|
| (a) parabolic | (b) linear | (c) sinusoidal | (d) circular |
|---------------|------------|----------------|--------------|
5. Which of the following group(s) increases basic strength of substituted aniline?
- | | | | |
|---------------------|--------------------|----------------------------|----------------------|
| (a) $-\text{OCH}_3$ | (b) $-\text{CH}_3$ | (c) $-\text{SO}_3\text{H}$ | (d) Both (a) and (b) |
|---------------------|--------------------|----------------------------|----------------------|

Or Which of the following will reduce Tollen's reagent as Fehling's reagent?



6. Ratio of O_2 and N_2 in the air is 1:4. Find out the ratio of their solubilities in terms of mole fractions of O_2 and N_2 dissolved in water at atmospheric pressure and room temperature.

$$\left[K_S(O_2) = 3.30 \times 10^7 \text{ torr} \right]$$

$$\left[K_S(N_2) = 6.60 \times 10^7 \text{ torr} \right]$$

- (a) 1:2 (b) 2:1

- (c) 1:1

- (d) None of these

7. Among the ligands NH_3 , en, CN^- and CO, the correct order of their increasing field strength, is

(a) $CO < NH_3 < en < CN^-$

(b) $NH_3 < en < CN^- < CO$

(c) $CN^- < NH_3 < CO < en$

(d) $en < CN^- < NH_3 < CO$

8. What happens to the glucose on heating with Fehling solution?

- (a) Oxidation (b) Reduction (c) Decomposition (d) Condensation

Or At intermediate pH value of about 6.0, an amino acid behaves as a dipolar ion on decreasing and increasing the pH, the amino acid becomes

- (a) basic and acidic respectively

- (b) acidic and basic respectively

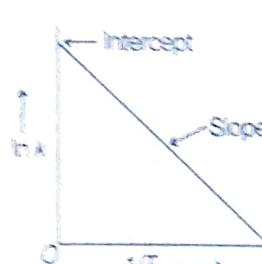
- (c) remains in state of a neutral molecule

- (d) loses its optical activity

9. Heterolytic complex is

- (a) $[Fe(CN)_6]^{4-}$ (b) $[Co(NH_3)_6]SO_4^{+}$ (c) $[HgI_4]^{2-}$ (d) $[Co(NH_3)_6]^{3-}$

10. Consider the following plot between $\ln k$ and $1/T$.



In this plot, the intercept and slope respectively are

- (a) $-\frac{E_a}{R}; \ln A$ (b) $\ln A; -\frac{E_a}{R}$ (c) $\frac{E_a}{R}; -\ln A$ (d) $\frac{E_a}{R}; A$

Or Which of the following options will be correct for the stage of half completion of the reaction $A \rightleftharpoons B$?

- (a) $\Delta G^\circ = 0$ (b) $\Delta G^\circ > 0$ (c) $\Delta G^\circ < 0$ (d) $\Delta G^\circ = -RT \ln K$

11. The electrophile used in Reimer-Tiemann reaction is

- (a) CCl_3^+ (b) $.CCl_2$ (c) Cl^+ (d) H_2O

Assertion-Reason

In the following questions (Q.No. 12-16) a statement of Assertion followed by a statement of Reason is given. Choose the correct answer out of the following choices.

- (a) Assertion and Reason both are correct statements and Reason is correct explanation for Assertion.

(b) Assertion and Reason both are correct statements but Reason is not correct explanation for Assertion.

(c) Assertion is correct statement but Reason is incorrect statement.

(d) Assertion is incorrect statement but Reason is correct statement.

12. Assertion The aldehyde group is absent in the pentacetate of D-glucose?

Reason It has ketonic group.

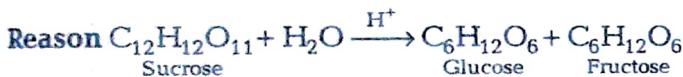
Q Assertion When glucose is treated with HI, it forms hexane.

Reason Due to presence of amino acids.

13. Assertion S_N1 reaction is accompanied by racemisation.

Reason Carbocation is formed in this reaction and attack of nucleophile can be from either side of the leaving group.

14. Assertion Glucose can be prepared from sucrose.



15. Assertion Pure water conducts electricity.

Reason Pure water exists in unionised form.

16. Assertion Ethanol and acetone show positive deviation from Raoult's law.

Reason Pure ethanol molecule show hydrogen bond and on adding acetone hydrogen bond between ethanol molecules breaks.

SECTION B : Short Answer Type I Questions (2 Marks)

17. Why is the reactivity of all the three classes of alcohols with conc. HCl and $ZnCl_2$ (Lucas reagent) different?

Or

NF_3 is an exothermic compound, while NCl_3 is not, why?

18. A solution containing 34.2 g of cane sugar ($C_{12}H_{22}O_{11}$) dissolved in 500 cm^3 of water brought 0.374 K . Calculate the freezing point depression constant of water.

19. Ethylamine is soluble in water whereas, aniline is not soluble in water. Explain.

20. Write the IUPAC name for each of the following :

- (a) $[\text{Ca}(\text{NH}_3)_6]\text{Cl}$ (b) $\text{K}_3[\text{Fe}(\text{CN})_6]$ (c) $[\text{Ag}(\text{NH}_3)_2]\text{Cl}$ (d) $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$

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Draw the structure of isomers of following complex and write its IUPAC name also.
 $[\text{Cr}(\text{NH}_3)_4 \text{Cl}_2]^+$

21. Calculate the 'spin only' magnetic moment of $M^{2+}(aq)$ ion. ($Z = 27$)
 Or Explain why $Cu^+(I)$ ion is not stable in aqueous solution?
22. Vapour pressure of pure water at 298 K is 23.8 mm of Hg. 50 g of urea (NH_2CONH_2) is dissolved in 850 g of water. Calculate the vapour pressure of water for this solution and its relative lowering.
23. Calculate the strength of the current required to deposit 1.2 g of magnesium from molten $MgCl_2$ in 1 h.
 [1 F = 96500 C mol⁻¹, atomic mass of Mg = 24.0]
24. The half-life period of a first order reaction is 60 min. What percentage will be left after 120 minutes?
25. Why are haloarenes more stable than haloalkanes and undergo electrophilic substitution reaction at *o*- and *p*-position?

SECTION C: Short Answer Type II Questions (3 Marks)

26. Explain the following terms:
 (i) Linkage isomerism
 (ii) Outer orbital complex
 (iii) A bidentate ligand
- Or For the complex $[NiCl_4]^{2-}$, write
 (i) the IUPAC name.
 (ii) the hybridisation type
 (iii) the shape of the complex. (Atomic number of Ni = 28)
27. Account for the following differences in the acidic character of the following.
 (i) $Me_3C—CH_2—COOH > Me_3SiCH_2COOH$
 (ii) $H_2C=CHCH_2COOH > CH_3CH_2COOH$
 (iii) $N \equiv C—CH_2COOH > CH_3COCH_2—COOH$
28. Give reasons for the following:
 (i) Acetylation of aniline reduces its activation effect.
 (ii) CH_3NH_2 is more basic than $C_6H_5NH_2$.
 (iii) Although $—NH_2$ is *o/p* directing group, yet aniline on nitration gives a significant amount of *m*-nitroaniline.
29. Write the four characteristic features of enzymes. Name a disease which is caused by the deficiency of a particular enzyme.
 Or What is glycogen? How is it different from starch?
30. Give the reaction of alcohols with phosphorus trihalides and hydrogen halides.

SECTION D: Long Answer Type Questions (5 Marks)

31. (i) Can you store copper sulphate solution in a zinc pot ?
(ii) The molar conductivity of 0.025 mol L^{-1} methanoic acid is $46.1 \text{ S cm}^2 \text{ mol}^{-1}$. Calculate its degree of dissociation and dissociation constant.
Given $\lambda^\circ(\text{H}^+) = 349.6 \text{ S cm}^2 \text{ mol}^{-1}$ and $\lambda^\circ(\text{HCOO}^-) = 54.6 \text{ S cm}^2 \text{ mol}^{-1}$

On

- (ii) Given the standard electrode potentials,
 $K^+ / K = -2.93 \text{ V}$, $\text{Ag}^+ / \text{Ag} = 0.80 \text{ V}$, $\text{Hg}^{2+} / \text{Hg} = 0.79 \text{ V}$, $\text{Mg}^{2+} / \text{Mg} = -2.37 \text{ V}$,
 $\text{Cr}^{3+} / \text{Cr} = -0.74 \text{ V}$

Arrange these metals in their increasing order of reducing power.

- (ii) Conductivity of 2.5×10^{-4} M methanoic acid is 5.25×10^{-5} S cm $^{-1}$. Calculate its molar conductivity and degree of dissociation.
 Given: $\lambda^{\circ}(H^+) = 349.5$ S cm 2 mol $^{-1}$ and $\lambda^{\circ}(HCOO^-) = 50.5$ S cm 2 mol $^{-1}$

- Q2. The elements of 3d-transition series given as:

Sc Ti V Cr Mn Fe Co Ni Cu Zn

Answer the following:

- (i) Write the element which shows maximum number of oxidation states. Give reason.
 - (ii) Which element has the highest melting point?
 - (iii) Which element show only +3 oxidation state?
 - (iv) Which element is strong oxidising agent in +3 oxidation state and why?

On

- Q. A ketone $A(C_4H_8O)$ which undergoes a haloform reaction and gives compound B on reduction. B on heating with sulphuric acid gives a compound C , which forms mono-ozonide D . D on hydrolysis with zinc dust gives only E . Identify A, B, C, D and E . Write the reactions involved. How does compound A give iodoform reaction?

On

Predict the products formed when cyclohexane carbaldehyde reacts with following reagents:

- (ii) PhMgBr and then H_3O^+
 (iii) Semicarbazide and weak acid
 (iv) Zinc amalgam and dilute hydrochloric acid

Solutions

1. (i) (d) This curve is showing temperature dependence of rate of reaction.
- (ii) (a) The peak of the curve represents the kinetic energy possessed by the maximum fraction of molecules that is known as most probable kinetic energy
- (iii) (c) The graph shows that in the curve at $t + 10$ the area showing the fraction of reacting molecules having energy equal to or greater than activation energy gets doubled and hence, doubles the rate of a reaction.

Or (d) From Arrhenius equation, we have

$$\log \frac{k_2}{k_1} = \frac{E_a}{2.303 R} \left[\frac{1}{T_1} - \frac{1}{T_2} \right]$$

$$\log \frac{4.5 \times 10^{-7} \text{ s}^{-1}}{1.5 \times 10^{-7} \text{ s}^{-1}}$$

$$= \frac{E_a}{2.303 \times 8314} \left[\frac{1}{323} - \frac{1}{373} \right]$$

$$E_a = \frac{0.4771 \times 19147 \times 323 \times 373}{50}$$

$$E_a = 22011.59 \text{ J mol}^{-1} \text{ or } 22.01 \text{ kJ mol}^{-1}$$

- (iv) (a) In Arrhenius equation, $k = A e^{-E_a/RT}$, the factor $e^{-E_a/RT}$ represents the fraction of molecules that have kinetic energy more than the activation energy (E_a).

Thus, it is clear from Arrhenius equation that increasing the temperature or decreasing the activation energy will result in an increase in the rate of reaction.

2. (i) (a) This is because, in haloarenes, the electron pairs on the halogen atom are in conjugation with π -electrons of the ring. As a result, the C—Cl bond acquires partial double bond character.

Therefore, the bond cleavage in halogens is difficult than haloalkanes in which carbon is attached to halogen by a pure single bond. Hence, haloarenes are less reactive than haloalkanes.

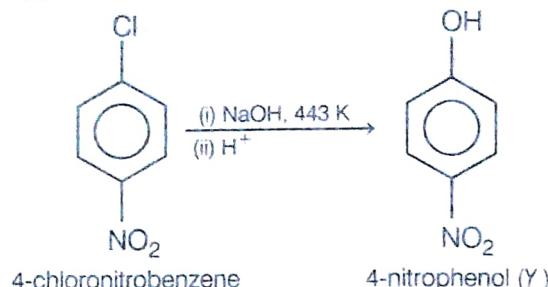
Both (A) and (R) are true and (R) is the correct explanation of (A).

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

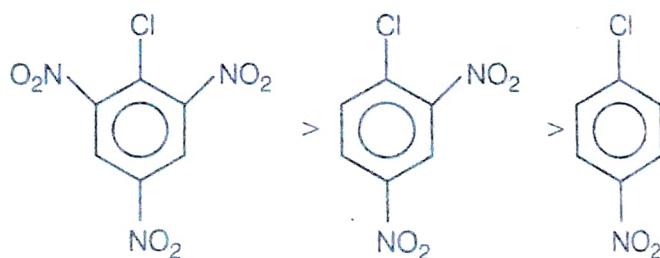
Or

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

- (iii) (c) Y is 4-nitrophenol. The reaction is as follows:



- (iv) (c) The correct order of reactivity towards nucleophilic substitution reaction of the given compounds is as follows :



3. (a) van't Hoff factor



$$1-\alpha \quad \alpha x \quad \alpha y$$

$$\text{Total amount of species} = 1 + (x + y - 1)\alpha$$

$$\text{van't Hoff factor (i)} = \frac{1 + (x + y - 1)\alpha}{1}$$

$$\alpha = \frac{i-1}{x+y-1}$$

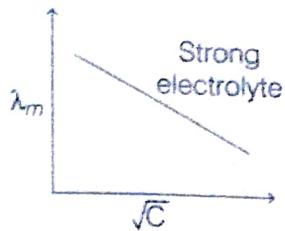
Or $\Delta n = (\text{number of moles of gaseous products}) - (\text{number of moles of gaseous reactants})$

For the reaction,



$$\Delta n = 2 - 0 = 2$$

4. (b) The plot of molar conductance (Λ_m) v/s \sqrt{C} is linear according to Debye-Hückel-Onsager equation.



5. (d) Electron releasing groups like $-\text{NH}_3$, $-\text{OCH}_3$, $-\text{CH}_3$ increase electron density at N-atom hence, each substituents increase basic nature of aromatic amines.

Or (b) Because this compound has α -hydrogen.

6. (a) Given,

The ratio of the O_2 and N_2

$$\text{So, } \rho_{\text{O}_2} = K_{\text{H}} \chi_{\text{O}_2} \\ 1 = K_{\text{H}}^2 \chi_{\text{O}_2}$$

$$\chi_{\text{O}_2} = \frac{1}{K_{\text{H}}^2}$$

$$\rho_{\text{N}_2} = K_{\text{H}} \chi_{\text{N}_2}$$

$$1 = K_{\text{H}}^{N_2} \chi_{\text{N}_2}$$

$$\chi_{\text{N}_2} = \frac{1}{K_{\text{H}}^{N_2}}$$

Thus, the ratio is

$$\frac{1}{K_{\text{H}}^2} / \frac{1}{K_{\text{H}}^{N_2}}$$

$$\chi_{\text{O}_2} : \chi_{\text{N}_2} = \frac{1}{3.33 \times 10^7} : \frac{1}{33 \times 10^7}$$

$$\chi_{\text{O}_2} : \chi_{\text{N}_2} = 1 : 2$$

7. (b) Using the concept of spectrochemical series ligands arranged in increasing order of crystal field strength are $\text{NH}_3 < \text{en} < \text{CN}^- < \text{CO}$.

8. (b) On heating glucose with Fehling solution, the presence of aldehyde functional group reduces the deep blue solution of copper to a red precipitate.

Or The amino acid becomes acidic and basic respectively.

9. (b) Complex which contain more than one type of ligand is called heterolytic complex. Only option (b) has two types of ligand.

10. (b) Arrhenius equation is given by

$$k = Ae^{-E_a/RT}$$

Taking log on both sides

$$\ln k = \ln A - \frac{E_a}{RT}$$

Comparing with straight line equation

$$y = mx + c$$

$$\text{Intercept} = \ln A \text{ and slope} = -\frac{E_a}{R}$$

- Or (a) As we know that $\Delta G^\circ = -RT \ln K$

At the stage of half completion of the reaction,

$$\Delta G^\circ = -RT \ln K$$

At the stage of half completion of the reaction,

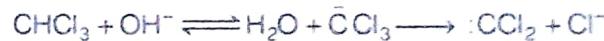


Therefore, $K = 1$,

Thus, $\Delta G^\circ = 0$

11. (b) Reimer-Tiemann reaction is an electrophilic substitution reaction

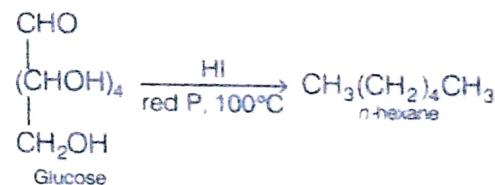
The first step is



Dichlorocarbene contains a sextet of electrons and thus is a strong electrophile.

12. (c) The pentacetate of glucose does not react with hydroxyl amine (NH_2OH), which shows that aldehyde ($-\text{CHO}$) group is not present in glucose pentacetate.

Or (c) *n*-hexane is formed.



13. (a) In case of optically active alkyl halides, S_N1 reactions are accompanied by racemisation. The carbocation formed in the slow step being sp^2 -hybridised is planar (achiral).

The attack of the nucleophile may be from either side resulting mixture of products. One product has same configuration, while other has opposite configuration.

Thus, both (A) and (R) are correct and (R) is the correct explanation of (A).

14. (a) Glucose can be prepared from sucrose and given reason is the correct explanation of Assertion. Both (A) and (R) are correct and (R) is correct explanation of (A).

15. (a) At the melting point, the solid phase of a substance is in dynamic equilibrium with its liquid phase. A solution will freeze when its vapour pressure becomes equal to the vapour pressure of the pure solid solvent.

When non-volatile solid is added to the solvent, its vapour pressure decreases and becomes equal to solid solvent at lower temperature. Thus, (A) is correct and (D) is incorrect.

16. (a) Ethanol molecules show hydrogen bonding. On adding acetone, its molecules get in between the host molecule and break some of hydrogen bonds between them. Due to weakening of interaction, the mixture of ethanol and acetone shows the positive deviation from Raoult's law. Hence, both (A) and (D) are correct and (D) is the correct explanation of (A).

17. The reactivity of all the three classes of alcohols with conc. HCl and $ZnCl_2$ is different because of the steric hindrance of alkyl groups and the stability of the carbocation.

Or

Due to smaller size of F as compared to Cl, the N—F bond is much stronger than N—Cl, while bond dissociation energy of F_2 is much lower than that of Cl.

Therefore, energy released during the formation of NF_3 molecule is more than the energy needed to break N_2 and F_2 molecules into individual atoms.

Thus, NF_3 is an exothermic compound.

While, energy released during the formation of NCl_3 molecule is less than the energy needed to break N_2 and Cl_2 molecules into individual atoms. Thus, formation of NCl_3 is an endothermic reaction.

18. Given, $\Delta T_f = 0.374\text{K}$

Concentration of sugar solution

$$= 34.2 \text{ g in } 500 \text{ cm}^3 = 68.4 \text{ g in } 1000 \text{ cm}^3$$

$$= 68.4 \text{ g in } 1000 \text{ g} = \frac{68.4}{342} = 0.2 \text{ m}$$

$$\Delta T_f = K_f \times m$$

$$K_f = \frac{\Delta T_f}{m}$$

$$= \frac{0.374}{0.2} = 187 \text{ K/m}$$

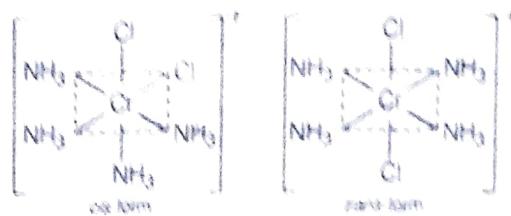
19. Aniline is not soluble in water, whereas ethylamine is soluble because ethylamine forms

intermolecular hydrogen bonds with water, while in aniline, due to presence of aryl group steric hindrance results and hence, it does not form H-bond with water.

20. IUPAC name of following complex is

- (a) $[Co(NH_3)_6]Cl_3$ - Hexaammincobalt (III) chloride
- (b) $K_3[Fe(CN)_6]$ - Potassium hexacyanoferrate (III)
- (c) $[Ag(NH_3)_2]Cl$ - Diamminesilver (I) chloride
- (d) $[Pt(NH_3)_2Cl_2]$ - Diamminedichloroplatinum (II)

- Or IUPAC name Tetraamminedichloridochromium (III) ion. It shows geometrical isomerism. The two isomers cis and trans are



21. The electronic configuration of M is $[Ar] 3d^4 4s^2$, here M is Ni. The outer configuration of Ni^{2+} is $3d^1$ means three unpaired electrons are present in an ion.

So, spin magnetic moment

$$\mu_s = \sqrt{n(n+2)} = \sqrt{3(3+2)} = 3.87 \text{ BM}$$

- Or In aqueous solution, copper (I) undergoes disproportionation reaction



The highest stability of Cu^{2+} ion in aqueous solution is due to negative enthalpy of hydration. Hence, Cu^+ is not known (or unstable) in aqueous solution.

22. Given $p^o = 238\text{mm of Hg}$, $W_2 = 50\text{ g}$, $W_1 = 850\text{ g}$

For solute, urea ((NH_2CONH_2) , $M_2 = 60\text{ g mol}^{-1}$

For solvent (H_2O), $M_1 = 18\text{ g mol}^{-1}$

$$\text{According to Raoult's law, } \frac{P_1^o - P_1}{P_1^o} = \frac{n_1}{n_1 + n_2}$$

$$\text{Or } \frac{P_1^o - P_1}{P_1^o} = \frac{n_1}{n_1} = \frac{W_2/M_2}{W_1/M_1}$$

(for dilute solution, $n_1 + n_2 \approx n_1$)

$$1 - \frac{P_1}{P_1^o} = \frac{W_2 \times M_1}{W_1 \times M_2}$$

Substituting the values, we get

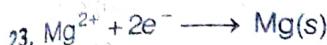
$$1 - \frac{P_1}{P_1^o} = \frac{50}{238} \times \frac{18}{60} \times \frac{850}{50} = \frac{3}{170}$$

$$\frac{P_1}{238} = 1 - \frac{3}{170} = \frac{167}{170}$$

$$P_1 = \frac{167 \times 23.8}{170} = \frac{3974.6}{170} = 23.38 \text{ mm of Hg}$$

Relative lowering of vapour pressure

$$=\frac{P_1^{\circ} - P_1}{P_1^{\circ}} = \frac{23.80 - 23.38}{23.80} = \frac{0.42}{23.80} = 0.018$$



$$2 \times 96500 \text{ C} \quad 24 \text{ g}$$

$$(x)^9 \quad 1.2 \text{ g}$$

$$\text{Now, } x = \frac{1.2 \times 2 \times 96500}{24} = 9650 \text{ C}$$

$$\therefore I = \frac{q}{t} \quad (\because t = 1 \text{ h})$$

$$I = \frac{9650}{3600} = 2.681 \text{ Å}$$

24. $k = \frac{0.693}{t_{1/2}}$, $t = \frac{2.303}{k} \log \frac{[A]_0}{[A]}$ [Ans 25%]

25. Haloarenes are more stable because they can donate their lone pair of electrons inside the rings for resonance. Due to resonance, the electron density increases more at *ortho* and *para* position.

Thus, the electrophile attack at *ortho* and *para* position.

26. (i) **Linkage isomerism** This type of isomerism arises in coordination compounds containing ambidentate ligand such as NO_2 , SCN , etc. SCN can bind to metal through N and S as $M-\text{NCS}$ and $M-\text{SCN}$, respectively. Similarly, NO_2 can bind either by N or by O of NO_2 .

e.g. $[\text{Co}(\text{NH}_3)_3(\text{NO}_2)]\text{Cl}_2$
Yellow

and $[\text{Co}(\text{NH}_3)_3\text{ONO}]\text{Cl}_2$
Blue

(ii) **Outer orbital complex** when complex entity uses outer orbital (nd) in hybridisation, it is called outer orbital or high spin complex. e.g. $[\text{CoF}_6]^{2-}$ has sp^3d^2 -hybridisation.

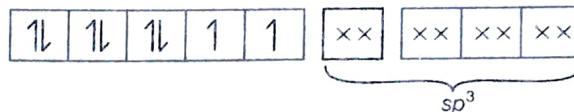
(iii) **Bidentate ligand** When a ligand is bonded with two donor sites to central metal atom/ion. The ligand is said to be bidentate ligand.

e.g. $\text{NH}_2-\text{CH}_2-\text{CH}_2-\text{NH}_2$ or $\text{C}_2\text{O}_4^{2-}$

Or (i) $[\text{NiCl}_4]^{2-}$

IUPAC name Tetrachloronickelate (II)

$$(\text{ii}) \text{ Ni}^{2+} = 3d^8.4s^0$$



(Cl^- being a weak field ligand cannot pair up the unpaired electrons of Ni.)

So, it is sp^3 hybridised.

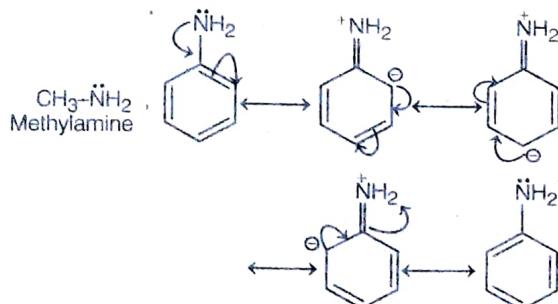
(iii) Because of sp^3 hybridisation, it has tetrahedral geometry.

27. (i) Carbon is more electronegative than silicon.
(ii) sp^2 -hybridised carbon is more electronegative than sp^3 -hybridised carbon.
(iii) sp -hybridised carbon of $\text{C}\equiv\text{N}$ is more electronegative than sp^2 hybridised carbon of $\text{C}=\text{O}$.

28. (i) Due to electron withdrawing effect of the acetyl group, the lone pair of electrons on N-atom is attracted by group.

As a result, lone pair of electrons on N-atom is not exclusively available for donation to the benzene ring and hence, activating effect of the $-\text{NH}_2$ group is reduced.

- (ii) In aniline ($\text{C}_6\text{H}_5\text{NH}_2$), the electron pair on nitrogen atom is involved in conjugation with ring and is less available for protonation than that in methylamine (CH_3NH_2). Therefore, aniline is less basic than methylamine.

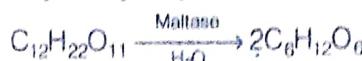


- (iii) Nitration is usually carried out with a mixture of conc. HNO_3 and conc. H_2SO_4 . So, in the presence of these acids, aniline gets protonated to form anilinium ion.

Therefore, the reaction mixture consists of aniline and anilinium ion. —NH₂ group in aniline is *o*, *p*-directing and activating, whereas the NH₃⁺ group in anilinium is *m*-directing and deactivating. Now, nitration of aniline mainly gives *p*-nitroaniline due to steric hindrance at *o*-position and the nitration of anilinium ion gives *m*-nitroaniline.

29. These are essential biological catalysts (or biocatalysts), which are needed to catalyse biochemical reaction. Almost all the enzymes are globular proteins. Enzymes are very specific for a particular reaction and for a particular substrate. They are generally named after the compound or class of compounds upon which they work, e.g. the enzyme that catalyses hydrolysis of maltose into glucose is named as maltase.

e.g.



Pompe (Pom-pay) disease, also known as glycogen storage disease or acid maltose deficiency, is a rare genetic disorder.

- Or Glycogen is a highly, chain condensation polymer of α-D-glucose. It is stored in the form of glucose in liver and muscles of human beings. In contrast, starch is a chief storage polysaccharide of plants and consists of a mixture of two components, amylose (water soluble component 15-20%) and amylopectin (water insoluble components 80-85%).

Amylose is a linear polymer of α-D-glucose, while amylopectin is a highly branched polymer of α-D-glucose. Thus, both glycogen and amylopectin are branched chain condensation polymer of α-D-glucose. The only difference is that amylopectin chain consists of 20-25 glucose units, whereas glycogen chain consists of 10-14 glucose units. (3)

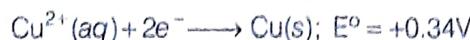
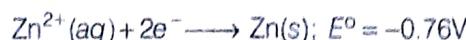
30. **Reaction with Phosphorus Trihalide** When alcohols react with phosphorus trichloride, the product haloalkanes are formed.



Reaction with Hydrogen Halide. When alcohols react with hydrogen halide, the product, alkanes are formed.



31. (i) No, zinc pot cannot store copper sulphate solution because the standard electrode potential (E°) value of zinc is less than that of copper. So, zinc is stronger reducing agent than copper.



So, zinc will lose electrons to Cu²⁺ ions and redox reaction will occur as follows :



- (ii) **Step I Calculation of degree of dissociation (α) of HCOOH.**

$$\Lambda_m = 46.1 \text{ S cm}^2 \text{ mol}^{-1}$$

$$\lambda_m^\circ_{(\text{HCOOH})} = \lambda_m^\circ_{(\text{HCOO}^-)} + \lambda_m^\circ_{(\text{H}^+)} = 54.6 + 349.6 \text{ S cm}^2 \text{ mol}^{-1} = 404.2 \text{ S cm}^2 \text{ mol}^{-1}$$

$$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ} = \frac{46.1 \text{ S cm}^2 \text{ mol}^{-1}}{404.2 \text{ S cm}^2 \text{ mol}^{-1}} = 0.1140$$

Step II Calculation of dissociation constant



Initial conc.	C	0	0
Equilibrium conc.	C(1 - α)	α	α

$$\text{Dissociation constant, } K_a = \frac{[\text{HCOO}^-][\text{H}^+]}{[\text{HCOOH}]} = \frac{C\alpha \times C\alpha}{C(1-\alpha)} = \frac{C\alpha^2}{(1-\alpha)}$$

$$\text{Putting values, } K_a = \frac{(0.025 \text{ mol L}^{-1}) \times (0.114)^2}{(1 - 0.114)} = \frac{(3.249 \times 10^{-4} \text{ mol L}^{-1})}{(0.886)} = 3.67 \times 10^{-4} \text{ mol L}^{-1}$$

- Or (i) The lower the reduction potential, the higher is the reducing power. The given standard electrode potentials are in the order.



Therefore, these metals arranged in the increasing reducing power as Ag < Hg < Cr < Mg < K

- (ii) Conductivity of methanoic acid = $5.25 \times 10^{-5} \text{ S cm}^{-1}$

$$\text{Concentration of methanoic acid} = 2.5 \times 10^{-4} \text{ M} = 2.5 \times 10^{-4} \times 1000 \text{ mol cm}^{-3} = 0.25 \text{ mol cm}^{-3}$$

$$\text{Molar conductivity, } \Lambda_m = \frac{\kappa}{C} = \frac{5.25 \times 10^{-5} \text{ S cm}^{-1}}{0.25 \text{ mol cm}^{-3}} = 21 \times 10^{-5} \text{ Scm}^2 \text{ mol}^{-1}$$

$$\text{Given, } \lambda_{(\text{H}^+)}^\circ = 349.5 \text{ Scm}^2 \text{ mol}^{-1}, \quad \lambda_{(\text{HCOO}^-)}^\circ = 50.5 \text{ Scm}^2 \text{ mol}^{-1}$$

$$\text{Degree of dissociation, } \alpha = \frac{\Lambda_m}{\Lambda_m^\circ}$$

$$\Lambda_m^\circ (\text{HCOOH}) = \lambda_{(\text{H}^+)}^\circ + \lambda_{(\text{HCOO}^-)}^\circ = 349.5 + 50.5 = 400 \text{ S cm}^2 \text{ mol}^{-1}$$

Substituting the value of Λ_m and $\Lambda_m^\circ (\text{HCOOH})$ in Eq. (i),

$$\text{we get } \alpha = \frac{21 \times 10^{-5} \text{ S cm}^2 \text{ mol}^{-1}}{400 \text{ S cm}^2 \text{ mol}^{-1}} = 5.25 \times 10^{-7}$$

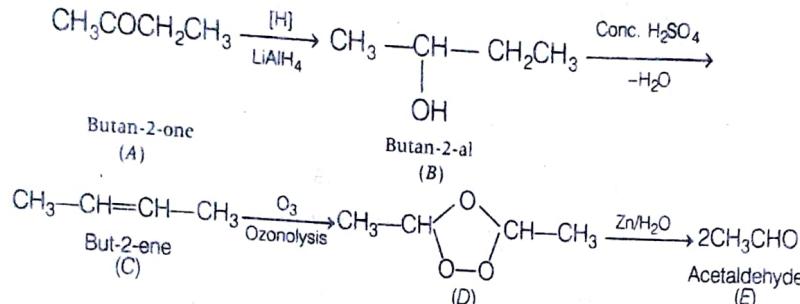
32. (i) Mn shows the highest number of oxidation states because its valence shell electronic configuration is $3d^5 4s^2$. As $3d$ and $4s$ are closer in energy, it has maximum number of electrons to lose or share. Hence, it shows all the oxidation states from +2 to +7.
(ii) Chromium has highest melting point among all the given elements.
(iii) Scandium shows only +3 oxidation state.
(iv) In the +3 oxidation state, Mn is a strong oxidising agent because in Mn^{3+} ion, Mn exists in $3d^4$ configuration which is less stable and it can reduce to Mn^{2+} giving a more stable $3d^5$ configuration. Hence, it acts as a strong oxidising agent.

- Or (i) (a) **Atomic radii** The atomic radii decreases gradually from Sc to Cr due to increased nuclear charge but from Cr to Cu, it remains almost constant.
(b) **Ionisation enthalpies** Due to increase in nuclear charge, there is an increase in ionisation enthalpy along each series of the transition elements from left to right. The irregular trend in the first ionisation enthalpy of the $3d$ metals is due to the irregular variation of atomic size.

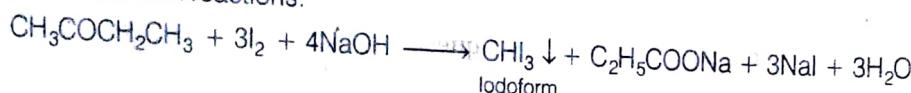
Ground state configuration		Possible oxidation states (Underlined oxidation states are stable)
(a)	$3d^3 4s^2$	+2, <u>+3</u> , +4, +5 (Vanadium)
(b)	$3d^5 4s^2$	+2, <u>+3</u> , +4, +5, +6, +7 (Manganese)
(c)	$3d^6 4s^2$	+2, <u>+3</u> , +4, +6 (Iron)

- (ii) The maximum oxidation states with reasonable stability correspond to value equal to the sum of the s and d electrons up to manganese. After Mn, there is a decrease in stability of higher oxidation states. Hence, most common oxidation states of Fe are + 2 and + 3 in its compounds.

33. Since, A gives haloform test, it must contain —COCH_3 group. Thus, its possible formula is $\text{C}_2\text{H}_5\text{COCH}_3$. On reduction, it gives butan-2-ol, i.e. compound B which on dehydration with sulphuric acid gives but-2-ene. (C). Ozonolysis of but-2-ene gives only acetaldehyde (E). The equations involved are Compound (A) undergoes reduction to give (B)



A gives iodoform reactions:



Or

