Code No. 043

Roll No. | | | | | | | |

- Please check that this question paper contains **6** printed pages.
- Code number given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.
- Please check that this question paper contains **33** questions.
- **Please write down the Serial Number of the question before attempting it.**
- 15 minutes time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a.m. to 10.30 a.m., the students will read the question paper only and will not write any answer on the answer-book during this period.

CHEMISTRY–XII
Sample Paper (Solved)

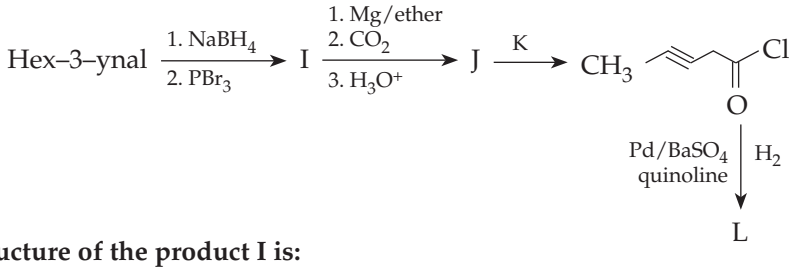
Time allowed: 3 hours *Maximum Marks: 70*

General Instructions:

SECTION A (Objective Type)

1. Read the passage given below and answer the following questions: **(1×4=4)**

In the following reaction sequence product I, J and L are formed, K represents a reagent.



(*i*) The structure of the product I is:

(*a*) H_3C Br **(*b*)** H_3C Br

(*c*) H_3C Br **(*d*)** H_3C Br

(*ii*) The structure of compound J is:

(*a*) H_3C COOH **(*b*)** H_3C OH O

(*c*) H_3C COOH **(*d*)** H_3C COOH

Or

The IUPAC name of structure J is:

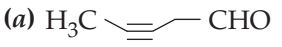
(*a*) Butan–3–oic acid **(*b*)** Pantan–3–yn–oic acid

(*c*) Hexane–3–en–oic acid **(*d*)** Butan–3–en–oic acid

(*iii*) The reagent K is:

(*a*) $SOCl_2$ **(*b*)** SO_2Cl_2 **(*c*)** CH_3SO_2Cl **(*d*)** CH_3SOCl_2

(*iv*) The structure of product L is:

(*a*)  **(*b*)** 

(*c*) **(*d*)** 

2. Read the passage given below and answer the following questions. (1×4=4)

Associated colloids aggregate spontaneously in a given solvent to form particles of colloidal dimensions. The molecules of soaps and detergents are usually smaller than the colloidal particles. However, in concentrated solutions, these molecules associate and form aggregates of colloidal size, which are called micelles. Their formation takes place only above a particular concentration called CMC (critical micelle concentration). These colloids have both lyophobic and lyophilic parts soaps and detergents are strong electrolytes and when dissolved in water they furnish ions. The charge on the micelle is responsible for the stability of the system and the cleansing action of soap is due to these micelles.

In these questions a statement 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 wrong statement.

(*d*) Assertion is wrong statement but reason is correct statement.

(*i*) ***Assertion:*** The micelle formed by sodium stearate in water has $–COO^–$ groups at the surface.
Reason: Surface tension of water is reduced by the addition of stearate.

(*ii*) ***Assertion:*** Surfactant molecules form micelles above the critical micelle concentration (CMC).
Reason: The conductance of solution of surfactant molecules decreases sharply at the (CMC).

(*iii*) ***Assertion:*** Soap and detergent are macro-molecular colloids.
Reason: Soap and detergent are molecules of large size.

(*iv*) ***Assertion:*** NH_3Cl and RCOONa are colloidal electrolyte.
Reason: The substances which behave as electrolyte below a certain concentration limit, beyond this limit colloidal sol is formed, are called colloidal electrolyte.

Or

Assertion: The micelle formed by Sodium Stearate in water has $–COO^–$ groups at the surface.
Reason: Surface tension of water is reduced by the addition of Stearate.

Following questions (No. 3-11) are Multiple Choice Questions carrying 1 mark each.

3. Zn gives H_2 gas with H_2SO_4 and HCl but not with HNO_3 because

(*a*) Zn acts as oxidizing agent when reacts with HNO_3.

(*b*) HNO_3 is weaker acid than H_2SO_4 and HCl.

(*c*) In electrochemical series, Zn is above hydrogen.

(*d*) $NO_3^–$ is reduced in preference to hydronium ion.

4. The number of tripeptides formed by three different amino acids are:

(*a*) Three **(*b*)** Four **(*c*)** Five **(*d*)** Six

Or

Subunits present in haemoglobin are:

(*a*) 2 **(*b*)** 3 **(*c*)** 4 **(*d*)** 5

5. Increasing the temperature of an aqueous solution will cause

(*a*) decrease in molality **(*b*)** decrease in molarity

(*c*) decrease in mole fraction **(*d*)** decrease in % (w/w)

6. The maximum oxidation state of osmium is

(*a*) +6 **(*b*)** +7 **(*c*)** +8 **(*d*)** +5

Or

Lanthanide contraction is observed in

(*a*) Gd **(*b*)** At **(*c*)** Xe **(*d*)** Ac

7. Among the following pairs of ions, the lower oxidation state in aqueous solution is more stable than the other, in

(*a*) Ti^+, Ti^{3+} **(*b*)** Cu^+, Cu^{2+} **(*c*)** Cr^{2+}, Cr^{3+} **(*d*)** V^{2+}, VO^{2+}

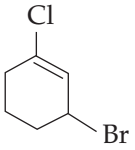
8. **When ethylamine is treated with CH_3MgBr, the product is:**
   (*a*) CH_3CH_3 **(*b*)** CH_4 **(*c*)** $CH_3CH_2CH_3$ **(*d*)** $CH_3CH_2CH_2CH_3$

   Or

   When aniline is heated with conc. H_2SO_4 at 455-475 K it forms:
   (*a*) Aniline hydrogen sulphate **(*b*)** m-Aminobenzensulphonic acid
   (*c*) Benzenesulphonic acid **(*d*)** Sulphanilic acid
9. **Which of the following is π-acid ligand?**
   (*a*) NH_3 **(*b*)** CO
   (*c*) F^- **(*d*)** Ethylene diamine

   Or

   The oxidation state of Fe in the brown ring complex $[Fe(H_2O)_5NO]\ SO_4$ is
   (*a*) +1 **(*b*)** +2 **(*c*)** +3 **(*d*)** +4
10. **The IUPAC name of the compound shown below:**



   (*a*) 2-bromo-6-chlorocyclohex-1-ene **(*b*)** 6-bromo-2-chlorocyclohexene
   (*c*) 3-bromo-1-chlorocyclohexene **(*d*)** 1-bromo-3-chlorocyclohexene
11. **The number of octahedral sites per sphere in fcc structure is**
   (*a*) 8 **(*b*)** 4 **(*c*)** 2 **(*d*)** 1

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 wrong statement.
(*d*) Assertion is wrong statement but reason is correct statement.

12. ***Assertion:*** Glucose gives a reddish brown precipitate with Fehling's solution.
    Reason: Reaction of glucose with Fehling's solution gives CuO and gluconic acid.
13. ***Assertion:*** CIF is more reactive than F_2.
    Reason: The F—F bond is weaker than Cl—F bond.
14. ***Assertion:*** 0.1 M HCl solution has higher osmotic pressure than 0.1 M NaCl solution.
    Reason: Cl^- ions being common, the small size H^+ ions have greater ionic mobility than larger size Na^+ ions.

    Or

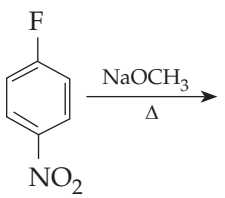
    Assertion: If on mixing the two liquids, the sol. become hot, it implies that it shows negative deviation from Raoult's law.
    Reason: Solution which shows negative deviation are accompanied by decrease in volume.
15. ***Assertion:*** p-Hydroxybenzoic acid has a lower boiling point than o-hydroxybenzoic acid.
    Reason: o-Hydroxybenzoic acid has intramolecular hydrogen bonding.
16. ***Assertion:*** Peracids are stronger acids than corresponding carboxylic acids.
    Reason: The anion of carboxylic acid is stabilized by resonance but not that of peracids.

SECTION B

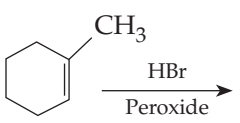
The following questions, Q. No. 17-25 are Short Answer Type I and carry 2 marks each.

17. **What would be the major products in the following reaction?**

(*i*)



(*ii*)



Or

Write down the structure of A and B in the following sequence of reaction:

$$PhC{\equiv}CH \xrightarrow{Na\,N_2,\ MeI} A \xrightarrow{Na/NH_3\,(l)} B$$

18. 0.5g of KCl was dissolved in 100 g of water and the solution originally at 20°C, froze at –0.24°C. Calculate the percentage dissociation of the salt.
(**Given :** K_f for water = 1.86 K kg/mol. Atomic mass : K = 39 u, Cl = 35.5 u)

19. Write the IUPAC name of the ionisation isomer of the coordination compound $[Co(NH_3)_5Br]\,SO_4$. Give *one* chemical test to distinguish between the two compounds.

Or

(*i*) Predict the number of unpaired electrons in the tetrahedral $[MnBr_4]^{2-}$ ion.

(*ii*) Draw structure of geometrical isomers of $[Co(NH_3)_4\,Cl_2]^+$.

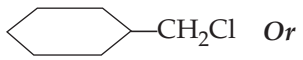
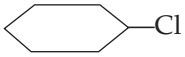
20. For the reaction A → B, the rate of reaction becomes twenty seven times when the concentration of A is increased three times. What is the order of the reaction?

Or

Write the rate law for a first order reaction. Justify the statement that half life for a first order reaction is independent of the initial concentration of the reactant.

21. For a first order reaction, show that the time required for 99% completion of a first order reaction is twice the time required for the completion of 90%.

22. Which ***one*** in the following pairs of substances undergoes S_N2 substitution reaction faster and why?

(*i*)  ***Or*** 

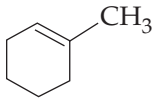
(*ii*)  ***Or*** 

23. Write balanced chemical equations for the following:

(*i*) Reaction of chlorine with hot and concentrated NaOH.

(*ii*) Sulphur dioxide is passed through an aqueous solution of Fe(III) salt.

24. Complete the following reaction equations:

(*i*)  + HI ⟶

(*ii*) $CH_3CH_2CH = CH_2 + HBr \longrightarrow$

25. Aluminium crystallizes in an fcc structure. Atomic radius of metal is 125 pm. What is the length of the side of the unit cell of the metal?

SECTION C

Q. No. 26-30 are Short Answer Type II carrying 3 marks each.

26. **(*i*)** $E°M^{3+}/M^{2+}$ values for the first series of transition elements are given below. Answer the question that follows:

E°(V)	Ti	V	Cr	Mn	Fe	Co
M^{3+}/M^{2+}	– 0.37	– 0.26	– 0.41	+ 1.57	+ 0.77	+ 1.97

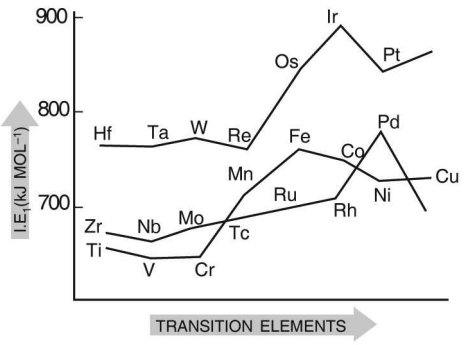
Identify the *two* strongest oxidizing agents in the aqueous solution from the above data.

(*ii*) Copper (I) ion is not known in aqueous solution.

(*iii*) The highest oxidation state of a metal is exhibited in its oxide.

Or

(*i*) The given figure illustrates the first ionization enthalpies of first, second and third series of transition elements. Which series amongst the first, second and third series of transition elements have the highest first ionization enthalpy and why?



(*ii*) Separation of lanthanide elements is difficult. Explain.

(*iii*) Sm^{2+}, Eu^{2+} and Yb^{2+} ions in solutions are good reducing agents but an aqueous solution of Ce^{4+} is a good oxidizing agent. Why?

27. **(*a*) Give *one* chemical test to distinguish between the following pairs of compounds:**
    (*i*) Methylamine and dimethylamine **(*ii*)** Aniline and benzylamine
    (*b*) Write the structures of different isomers corresponding to the molecular formula C_3H_9N, which will liberate nitrogen gas on treatment with nitrous acid.

Or

Write structures of different amines with the molecular formula $C_4H_{11}N$ which liberate nitrogen gas when treated with nitrous acid. Identify the isomer which will be optically active and write its IUPAC name.

28. **Examine the illustration of a portion of the defective crystal and answer the following:**
    (*i*) Identify the type of vacancy defect.
    (*ii*) How does this defect arise?
    (*iii*) How is the density of a crystal affected by this defect?
    (*iv*) What type of ionic crystals show this defect?

A^- B^- A^+ B^- A^+

B^- A^+ B^+ A^- B^+

A^+ B^- A^+ A^+ A^+

B^+ A^+ B^+ A^+ B^+

29. **(*i*)** Which of the following biomolecule is insoluble in water? Justify.
    Insulin, Haemoglobin, Keratin.
    (*ii*) Draw the Haworth structure for α-D-Glucopyranose.
    (*iii*) Write chemical reaction to show that glucose contains aldehyde as carbonyl group.
30. **Explain the following observations giving appropriate reasons:**
    (*i*) Ozone is thermodynamically unstable with respect to oxygen.
    (*ii*) The HEH bond angle of the hydrides of group 15 elements decrease as we move down the group.
    (*iii*) Bleaching effect of chlorine is permanent.

SECTION D

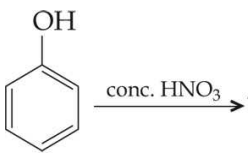
Q. No. 31 to 33 are Long Answer Type carrying 5 marks each.

31. **(*i*) Give reasons for the following:**
    (*a*) N has a pyramidal geometry in trimethylamine $N(CH_3)_3$ whereas it is planar in trisilylamine $N(SiH_3)_3$.
    (*b*) All the halogens undergo disproportionation reaction except fluorine.
    (*c*) Sulphur forms SF_6 whereas oxygen does not form OF_6.
    (*ii*) Draw the structures of the following compounds:
    (*a*) $XeOF_4$ **(*b*)** SF_4

Or

An orange solid A on heating gives a colourless gas B. B is reacted with H_2 in the presence of iron oxide to form an offensive smelling gas C. C is highly soluble in water and its aqueous solution is a weak base D. D is reacted with $ZnSO_4$ to form a white coloured solid E along with another compound F. Identify A, B, C, D, E and F. Give the reaction involved in conversion of D to E and F. Also write an industrial preparation of compound C.

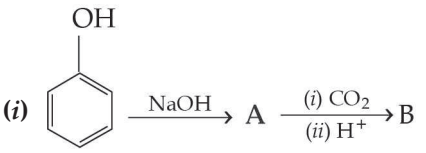
32. **(*a*)** Write the mechanism of hydration of ethene to form ethanol.
    (*b*) How are the following conversions carried out?
    (*i*) Propanol to propan-2-ol. **(*ii*)** Propanol to 1-propoxypropane.
    (*c*) Give the structure and the IUPAC name of the major product obtained in the given reaction:



Or

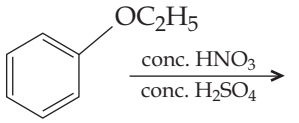
(*a*) Write the mechanism of the reaction of HI with methoxymethane.

(*b*) Identify A and B in the following reactions:

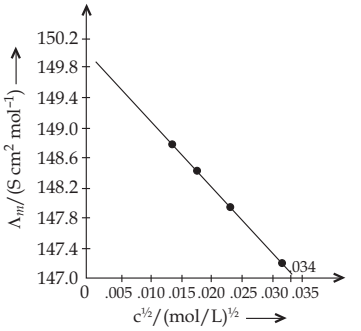
(*i*) 

(*ii*) $C_2H_5OH \xrightarrow{Cu,\ 573\ K} \mathbf{A} \xrightarrow[H_2O/H^+]{CH_3,\ MgBr} \mathbf{B}$

(*c*) Give the structure and the IUPAC name of the major product obtained in the following reaction:



33. (*i*) The molar conductivity (λ_m) of KCl solutions at different concentrations at 298 K is plotted as shown in the given figure.



Determine the value of Λ_m^0 and A for KCl.

(*ii*) Write the Nernst equation and calculate the emf for the following cell at 298 K:

$Mg(s)/Mg^{2+}$ (0.001 M) || Cu^{2+} (0.0001 M)/Cu(s)

How does E_{cell} very with the concentration of both Mg^{2+} and Cu^{2+} ions? (**Given:** $E^\circ_{cell} = 2.71$ V).

Or

(*a*) Conductivity of 0.00241 M acetic acid is 7.896×10^{-5} S cm^{-1}. Calculate its molar conductivity. If limiting molar conductivity for acetic acid is 390.5 S cm^2 mol^{-1}.

(*b*) Do as directed:

(*i*) Write the Nernst equation for reaction: $2Cr + 3Fe^{2+} \longrightarrow 2Cr^{3+} + 3\ Fe$

(*ii*) Three iron sheets have been coated separately with three metals A, B and C whose standard electrode potentials are given below:

Metal	A	B	C	Iron
E°	–0.46V	–0.66V	–0.20V	–0.44V

Identify in which case rusting will take place faster when coating is damaged.

(*iii*) Predicate the products when an aqueous solution of Sodium chloride is subject to electrolysis.

Answer Sheet

S	A	M	P	L	E							P	A	P	E	R		

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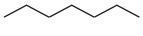
CHEMISTRY

SECTION A

1. (*i*) (*d*) $H_3C-C\equiv C-Br$

(*ii*) (*a*) $H_3C-C\equiv C-COOH$ *Or* (*b*) Pantan–3–yn–oic acid

(*iii*) (*a*) $SOCl_2$ (*iv*) (*c*) H_3C  CHO

2. (*i*) (*a*) Assertion and reason both are correct statements and reason is correct explanation for assertion.

(*ii*) (*b*) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

(*iii*) (*d*) Assertion is wrong statement but reason is correct statement.

(*iv*) (*a*) Assertion and reason both are correct statements and reason is correct explanation for assertion.

Or

(*b*) Assertion and reason both are correct statement but reason is not the correct explanation for assertion.

3. (*d*) NO_3^- is reduced in preference to hydronium ion.

4. (*d*) Six

Or

(*c*) 4

5. (*c*) decrease in mole fraction

6. (*c*) +8

Or

(*a*) Gd

7. (*a*) Ti^+, Ti^{3+}

8. (*b*) CH_4

Or

(*d*) Sulphanilic acid

9. (*b*) CO

Or

(*a*) +1

10. (*c*) 3-bromo-1-chlorocyclohexene

11. (*d*) 1

12. (*c*) Assertion is correct statement but reason is wrong statement.

13. (*d*) Assertion is wrong statement but reason is correct statement.

14. **(*d*)** Assertion is wrong statement but reason is correct statement.

Or

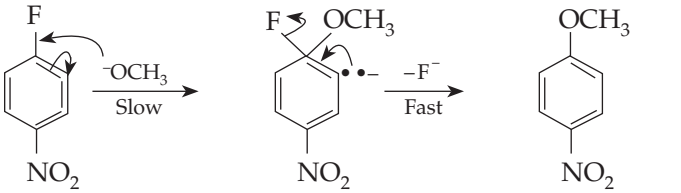
(*b*) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

15. **(*d*)** Assertion is wrong statement but reason is correct statement.

16. **(*d*)** Assertion is wrong statement but reason is correct statement.

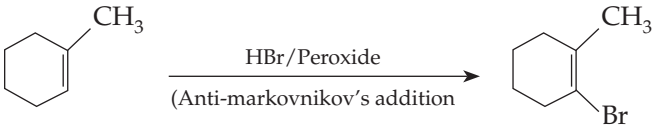
SECTION B

17. **(*i*)**



I P-Nitroanisole

(*ii*)



Or

$$\underset{\text{Phenylacetylene}}{PhC \equiv CH} \xrightarrow[NH_3]{NaNH_2} \underset{\text{Sod. Phenylacetylide}}{PhC \equiv \bar{C}Na^{+}} \xrightarrow[-Na]{MeI} \underset{\text{1-Phenylpropylene}}{Ph - C \equiv \bar{C}Me}$$

$$\xrightarrow[\text{(Birch reduction)}]{Na/NH_3(l)} \underset{\text{trans-1-phenylprop 1-ene(R)}}{\overset{Ph}{H}\!>\!C=C<\!\overset{H}{Me}}$$

18. **Given:** $\Delta T_f = 24^{\circ}C$, $M = 74.5$, $\omega = 0.5$ g, $W = 100$g, $\Delta T_f = iK_f \times m$

$$\therefore \quad \Delta T_f = iK_f \times \frac{\omega \times 1000}{W \times M}$$

Stepwise

$$0.24 = i \times 1.86 \times \frac{0.5}{74.5} \times \frac{1000}{100}$$

$$0.24 = \frac{i \times 1.86 \times 5}{74.5}$$

$$i = \frac{0.24 \times 74.5}{1.86 \times 5} = 1.922$$

$$\text{Now, } \alpha = \frac{i-1}{n-1} = \frac{1.922-1}{2-1} = 0.922$$

$\therefore$ Percentage (α) = 0.922×100 = **92.2**

19. The ionisation isomer is $[Co(NH_3)_5SO_4]Br$.

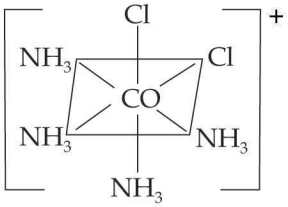
IUPAC name: *Pentaamminesulphatocobalt (III) bromide.*

Test: The isomer $[Co(NH_3)_5Br]SO_4$ gives a white precipitate of $BaSO_4$ with $BaCl_2$ solution whereas the isomer $[Co(NH_3)_5 SO_4]Br$ does not form this precipitate.

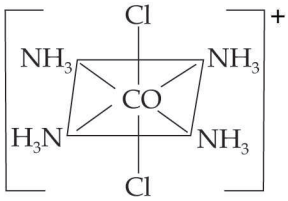
Or

(*i*) In $[MnBr_4]^{2-}$, Mn is in +2 oxidation state. It has **five** unpaired electrons.

(ii) $[Co(NH_3)_4Cl_2]^+$ (Tetraammine dichlorido cobalt (III) ion)



***Cis* form**



***Trans* form**

20. Let the rate law for the reaction be $r = k[R]^n$ …(*i*)

When concentration is increased three times, $[R] = 3a$

$\therefore \quad 27r = k(3a)^n$ …(*ii*)

$$\frac{27r}{r} = \frac{k(3a)^n}{ka^n}$$ **…[Dividing (*ii*) by (*i*)**

or $27 = 3^n$ or $3^3 = 3^n$

$\therefore$ Order of reaction, $\boldsymbol{n = 3}$

Or

For a first order reaction

$$k = \frac{2.303}{t}\log\frac{[R]_0}{[R]}$$ **…where** $[[R]_0$ = initial concentration, [R] = conc. after time t

When half of the reaction is completed, $[R] = [R]_0/2$. Representing the time taken for half of the reaction to be completed, by $t_{½}$, equation becomes:

$$k = \frac{2.303}{t_{1/2}}\log\frac{[R]_0}{[R]_0\ /\ 2}$$

$$t_{½} = \frac{2.303}{k}\log 2 = \frac{2.303}{k} \times 0.3010 = \frac{0.693}{k}$$

The above equation shows that half life first of order reaction is independent of the initial concentration of the reactant.

21. For a first order reaction

$$t = \frac{2.303}{k}\log\frac{a}{a-x}$$

$$t_{99\%} = \frac{2.303}{k}\log\frac{a}{a-0.99a} \quad \Rightarrow t_{99\%} = \frac{2.303}{k}\log 100$$

$$t_{90\%} = \frac{2.303}{k}\log\frac{a}{a-0.90a} \quad \Rightarrow t_{90\%} = \frac{2.303}{k}\log 10$$

$$\frac{t_{99\%}}{t_{90\%}} = \frac{2.303}{k}.\ \log 100 \times \frac{k}{2.303 \times \log 10} = \frac{\log 100}{\log 10} = \frac{2\log 10}{\log 10} = \mathbf{2}$$ …[$\because \log 10^2 = 2 \log 10$

$\therefore \quad \boldsymbol{t_{99\%} = 2 \times t_{90\%}}$

22. ***(i)***  CH_2Cl is a primary halide and therefore undergoes S_N2 reaction faster.

(ii)  : As iodine is a better leaving group because of its large size, therefore undergoes S_N2 reaction faster.

23. ***(i)*** $3Cl_2 + 6\,NaOH \longrightarrow 5\,NaCl + \underset{\text{(Sodium Chlorate)}}{NaClO_3} + 3\,H_2O$

(ii) $2Fe^{+3} + SO_2 + 2H_2O \longrightarrow \underset{\text{(Reduction of ferric ion into ferrous ion)}}{2Fe^{+2}} + SO_4^{-2} + 4H^+$

24. (*i*) 

1-Methyl-1-cyclohexene 1-Iodo-1-methyl cyclohexane

(*ii*) $CH_3CH_2CH = \underset{\text{1-Butene}}{CH_2} + HBr \xrightarrow{\text{Mark. addn.}} CH_3—\underset{\underset{\text{Br}}{|}}{CH_2CH}—CH_3$

2-Bromobutane

25. For the Fcc structure. Let us consider relation of side length and radius for Fcc

$a = 2\sqrt{2}\, r \Rightarrow a = 2 \times 1.1414 \times 125 \text{ pm} = 353.5 \text{ pm}$ **...[Given, *r* = 125 pm**

$\therefore \quad a \approx 354$ pm

So, the length of unit cell of the metal is 354 pm

SECTION C

26. (***i***) Co and Mn

(***ii***) Because Cu(I) undergoes disproportionation reaction in aqueous solution.

$$2Cu^+ (aq) \longrightarrow Cu^{2+} (aq) + Cu (s)$$

(***iii***) Highest oxidation state is exhibited in metal oxides because oxygen has the ability to form multiple bonds with metals.

Or

(***i***) Third series of transition elements have highest ionization enthalpy due to poor shielding of 4f orbital electrons.

(***ii***) Separation of lanthanide elements is difficult because they have approximately equal size due to lanthanide contraction.

(***iii***) Sm^{2+}, Eu^{2+}, Yb^{2+} ions in solutions are good reducing agents because they change into +3 oxidation state. Similarly an aqueous solution of Ce^{4+} is a good oxidising agent after gaining electron. It changes to +3 oxidation state which is more stable.

27. (***a***) (***i***) Methylamine and dimethylamine can be distinguished by the **Carbylamine test**.

Carbylamine test. Aliphatic and aromatic primary amines on heating with chloroform and ethanolic potassium hydroxide form foul-smelling isocyanides or carbylamines. Methylamine (being an aliphatic primary amine) gives a positive carbylamine test, but dimethylamine does not.

$$\underset{\text{Methylamine (1°)}}{CH_3 - NH_2} + CHCl_3 + 3KOH \xrightarrow{\Delta} \underset{\substack{\text{Methyl isocyanide}\\\text{(foul smell)}}}{CH_3 - NC} + 3KCl + 3H_2O$$

$$\underset{\text{Dimethylamine}}{(CH_3)_2NH} + CHCl_3 + 3KOH \xrightarrow{\Delta} \text{No reaction}$$

(***ii***) Aniline and Benzylamine can be distinguished by the **Nitrous acid test**.

Benzylamine reacts with HNO_2 to form a diazonium salt which being unstable even at low temperature, decomposes with evolution of N_2 gas.

$$\underset{\text{Benzylamine}}{C_6H_5CH_2NH_2} + HNO_2 \xrightarrow{NaNO_2 + HCl} \underset{\text{(Unstable)}}{[C_6H_5CH_2 - N_2^+Cl^-]} \xrightarrow[\text{Decompose}]{H_2O} \underset{\text{Benzyl alcohol}}{C_6H_5CH_2OH} + N_2\uparrow + HCl$$

Aniline on the other hand, reacts with HNO_2 to form benzenediazonium chloride which is stable at 273–278 K and hence does not decompose to evolve N_2 gas.

$$C_6H_5NH_2 \xrightarrow[273-278K]{NaNO_2 + HCl} C_6H_5{}^-N_2^+Cl^- + NaCl + 2H_2O$$

(*b*) ***Isomers of formula C_3H_9N are:***

(*i*) $CH_3CH_2CH_2NH_2$
Propan-1 amine

(*ii*) $CH_3CH(NH_2)CH_3$
Propan-2 amine

(*iii*) $CH_3CH_2NHCH_3$
N methylethanamine

(*iv*) $(CH_3)_2N-CH_3$
N, N dimethylmethanamine

(*i*) and (*ii*) liberate nitrogen gas with HNO_2

$$CH_3CH_2CH_2-NH_2 \xrightarrow{HNO_2} CH_3CH_2CH_2-OH + N_2 + H_2O$$

$$CH_3-CH(NH_2)-CH_3 \xrightarrow{HNO_2} CH_3-CH(OH)-CH_3 + N_2 + H_2O$$

Or

Isomers:

$CH_3-CH_2-CH_2-CH_2-NH_2$ Butanamine

$CH_3-CH(NH_2)-CH_2-CH_3$ Butan-2-amine

$CH_3-CH(CH_3)-CH_2-NH_2$ 2-Methylpropanamine

$CH_3-C(CH_3)_2-NH_2$ 2,2-dimethylethanamine

Optical active isomer:

$CH_3-CH(NH_2)-CH_2-CH_3$

IUPAC name: Butan-2-amine

28. (*i*) Frenkel defect

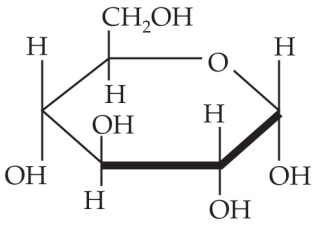
(*ii*) This defect arises when some of the ions of the lattice occupy interstitial sites leaving lattice sites vacant.

(*iii*) It does not affect the density of the crystal.

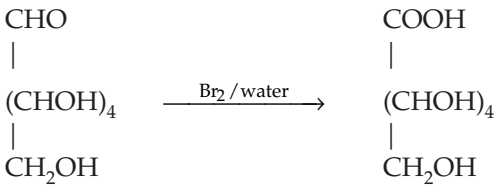
(*iv*) This defect is found in ionic crystals where anion is much larger in size than the cation.

29. (*i*) **Keratin** is insoluble in water as it is fibrous protein.

(*ii*)



(*iii*) Glucose on oxidation with Br_2 gives glyconic acid.



30. **(*i*)** Formation of ozone is an endothermic process.

$$3O_2 \longrightarrow 2O_3 \qquad (\Delta H = +ve)$$

Ozone is thermodynamically unstable with respect to oxygen since its decomposition into oxygen results in the liberation of heat (ΔH is negative).

$$O_3 \longrightarrow O_2 + O$$

(*ii*) As the size of the central atom increases, force between the bonding electrons decreases. Hence bond angle decreases.

(*iii*) Chlorine bleaches the colour due to its oxidising property.

$$H_2O + Cl_2 \longrightarrow 2HCl + \underset{\text{Nascent oxygen}}{[O]}$$

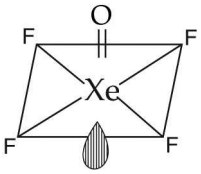
SECTION D

31. **(*i*)** **(*a*)** N is sp^3 hybridized and has pyramidal geometry in trimethylamnine whereas it is sp^2 hybridized in trisilylamine because of $p\pi$–$d\pi$ bonding.

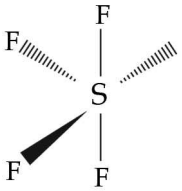
(*b*) F being the most electronegative element can undergo only reduction but not oxidation.

(*c*) Since oxygen belongs to the 2nd period, there is absence of *d* orbitals in oxygen, so it cannot extend its covalency.

(*ii*) **(*a*)** **$XeOF_4$ (*Square pyramidal structure*):**



(*b*) **SF_4 (*See-Saw structure*):**



Or

A = $(NH_4)_2Cr_2O_7$ (Ammonium dichromate)

B = N_2 (Nitrogen)

C = NH_3 (Ammonia)

D = NH_4OH (Hydroxyl amine)

E = $Zn(OH)_2$ (Zinc hydroxide)

F = $(NH_4)_2SO_4$ (Ammonium sulphate)

$$\underset{\textbf{(A)}}{(NH_4)_2Cr_2O_7} \xrightarrow{\Delta} Cr_2O_3 + 4H_2O + \underset{\textbf{(B)}}{N_2\uparrow}$$

$$\underset{\textbf{(B)}}{2N_2} + 3H_2 \xrightarrow{FeO} \underset{\textbf{(C)}}{2NH_3} \quad \text{(Haber's process)}$$

$$\underset{\textbf{(C)}}{NH_3} + H_2O \longrightarrow \underset{\textbf{(D)}}{NH_4OH}$$

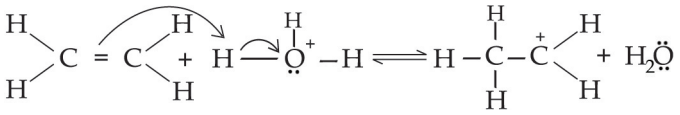
$$\underset{\textbf{(D)}}{NH_4OH} + ZnSO_4 \longrightarrow \underset{\textbf{(E)}}{Zn(OH)_2} + \underset{\textbf{(F)}}{(NH_4)_2SO_4}$$

32. **(*a*)** ***Acid catalysed hydration.*** Alkenes react with water in the presence of acid as catalyst to form alcohols as in the case of hydration of ethene to form ethanol.

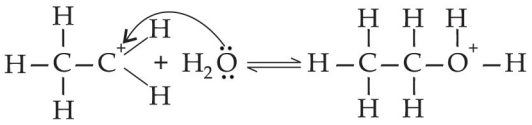
Mechanism. It involves the following three steps:

Step 1: Protonation of ethene to form carbocation by electrophilic attack of H_3O^+

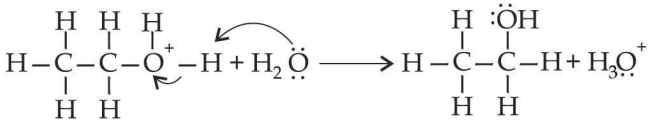
$$H_2O + H^+ \rightarrow H_3O^+$$



Step 2: Nucleophillic attack of water on carbocation



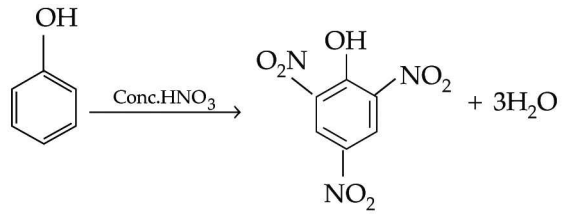
Step 3: Deprotonation to form an ethanol



(*b*) **(*i*)** $\underset{\text{Propanol}}{CH_3CH_2CH_2OH} \xrightarrow[\text{Dehydration}]{\text{Conc. } H_2SO_4} \underset{\text{Propene}}{CH_3CH = CH_2} \xrightarrow{H_2O/H^+} \underset{\text{Propan-2-ol}}{CH_3 - \overset{\overset{OH}{|}}{CH} - CH_3}$

(*ii*) $\underset{\text{Propanol}}{CH_3CH_2CH_2OH} \xrightarrow{PCl_5} \underset{\text{Propyl Chloride}}{CH_3CH_2CH_2Cl} \xrightarrow{CH_3CH_2CH_2ONa}$

$$\underset{\text{1-propoxypropane}}{CH_3CH_2 - CH_2 - OCH_2CH_2 - CH_3}$$

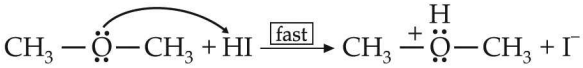
(*c*) 

Name: 2, 4, 6—Trinitrophenol

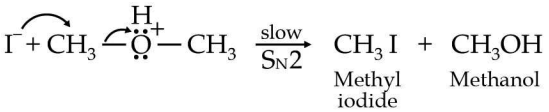
Or

(*a*) Mechanism of the reaction of HI with methoxymethane

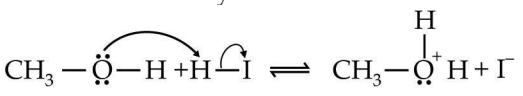
Step 1: Protonation of methoxymethane



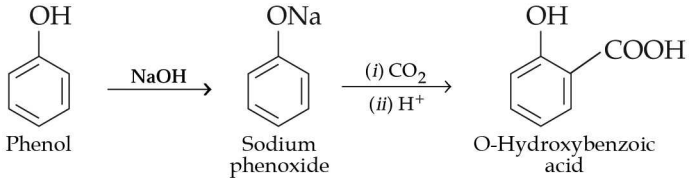
Step 2: Nucleophilic Attack of I^-



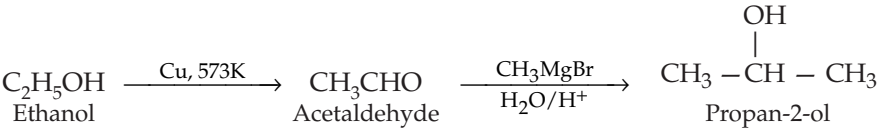
Step 3: When HI is in excess and the reaction is carried out at a high temperature, the methanol formed in the second step reacts with another HI molecule and gets converted to methyl iodide.



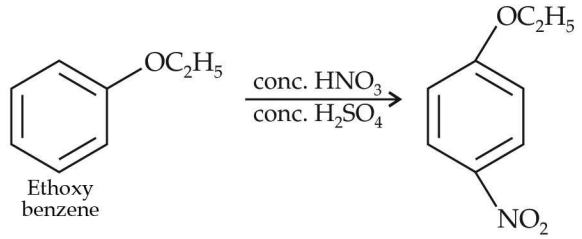
(*b*) (*i*)



(*ii*)



(*c*)



IUPAC Name: 4-Nitro Ethoxy Benzene

33. **(*i*)** **(*a*)** The graph is a straight line from the intercept (c½ = 0) Λ_m^0 = 150 $Scm^2\ mol^{-1}$.

(*b*) A = Slope = 87.46 $Scm^2\ mol^{-1}/(mol/L^{-1})^{1/2}$

(*ii*) The Nernst equation for the cell, $n = 2$

$$E_{cell} = E^o_{cell} - \frac{0.0591}{n}\log\frac{|\ Mg^{+2}\ |}{|\ Cu^{+2}\ |} \qquad E_{cell} = 2.71 - \frac{0.0591}{2}\log\frac{0.001}{0.0001}$$

$$E_{cell} = 2.71 - \frac{0.0591}{2} \times \log 10 = (2.71 - 0.0295)\ \text{volts} = \mathbf{2.68\ volts}$$

Or

(*a*) Molar conductivity: $\Lambda_m = \frac{k \times 100}{M} = \frac{7.896 \times 10^{-5} \times 1000}{0.00241}$

$= \mathbf{32.76\ Scm^2\ mol^{-1}}$

Degree of dissociation: $\alpha = \frac{\Lambda^c}{\Lambda^o} = \frac{32.76}{390.5} = \mathbf{0.0839}$

(*b*) (*i*) $E_{cell} = E^0_{cell} - \frac{RT}{6F} ln \frac{[Cr^{3+}]^2}{[Fe^{2+}]^3}$

(*ii*) As Iron has lower reduction potential than Metal 'C' only, therefore when coating is broken, rusting will take place faster in C.

(*iii*) **Anode:** Chlorine gas; **Cathode:** Hydrogen gas

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