Sample Question Paper-2

CHEMISTRY (862)

Class-12

SOLVED

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

*This paper is divided into **four** sections – A, B, C and D.*

*Answer **all** questions.*

***Section A** consists of **one** question having **sub-parts** of **one** mark each.*

***Section B** consists of **ten** questions of **two** marks each.*

***Section C** consists of **seven** questions of **three** marks each, and*

***Section D** consists of **three** questions of **five** marks each.*

Internal choices have been provided in one question each in Section B, Section C and Section D.

All working, including rough work, should be done on the same sheet as, and adjacent to the rest of the answer.

The intended marks for questions or parts of questions are given in brackets [ ].

Balanced equations must be given wherever possible and diagrams where they are helpful.

When solving numerical problems, all essential working must be shown.

In working out problems, use the following data:

Gas constant $R = 1.987$ cal deg^{-1} mol^{-1} = 8.314 JK^{-1} mol^{-1}

= 0.0821 dm^3 atm K^{-1} mol^{-1}

1 l atm = 1 dm^3 atm = 101.3 J. 1 Faraday = 96500 coulombs.

Avogadro's number = 6.022×10^{23}.

Section - A

(14 Marks)

Question 1

(A) **Fill in the blanks by choosing the appropriate word(s) from those given in the brackets.** **[4 × 1]**

(i) When acetamide is treated with bromine and caustic soda, it gives ..... as the main product and the reaction is called ..... . (methylamine/ Hoffmann's degradation/ethylamine/ Cannizaro reaction)

(ii) Dextro rotatory complexes are those which rotate plane of polarized light to ..... . (right/ left)

(iii) Haloarenes are .....reactive than haloalkanes (more / less).

(iv) Tertiary alcohols when passed over heated copper at 573 K undergo dehydration to give ..... (alkene / alkyne).

(B) **Select and write the correct alternative from the choices given below:** **[7 × 1]**

(i) The molar conductivity of a solution at infinite dilution is called:

(A) Limiting molar conductivity (B) Specific conductivity.

(C) Equivalent conductivity. (D) Molar conductivity

(ii) Which one of the following has a square planar geometry?

(At. No. Co=27, Ni = 28, Fe = 26, Pt = 78)

(A) $[CoCl_4]^{2-}$ (B) $[FeCl_4]^{2-}$ (C) $[NiCl_4]^{2-}$ (D) $[PtCl_4]^{2-}$

(iii) When $KMnO_4$ solution is added to oxalic acid solution, the decolourisation is slow at the start but becomes instantaneous after some time as:

(A) CO_2 is formed as the product. (B) Reaction is exothermic.

(C) MnO_4^- catalyses the reaction. (D) Mn^{2+} acts as catalyst.

(iv) Formation of diethyl ether from ethanol is based on a: A|I

(A) dehydration reaction (B) dehydrogenation reaction
(C) hydrogenation reaction (D) heterolytic fission reaction

(v) Which of the following liquid pairs shows a positive deviation from Raoult's law?

(A) Water – hydrochloric acid (B) Acetone – chloroform
(C) Water – nitric acid (D) Benzene – methanol

(vi) **Assertion:** Dry cell is a primary cell.
Reason: Primary cells are rechargeable, they can be recharged by passing current through it from an external source.

(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(B) Both Assertion and Reason are true but Reason is not the correct explanation for Assertion.
(C) Assertion is true but Reason is false.
(D) Assertion is false but Reason is true.

(vii) **Assertion:** The correct order of basicity in polar solvent is $2° > 3° > 1°$.
Reason: There is maximum steric strain in tertiary amines.

(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(B) Both Assertion and Reason are true but Reason is not the correct explanation for Assertion.
(C) Assertion is true but Reason is false.
(D) Assertion is false but Reason is true.

(C) **Read the passage given below carefully and answer the questions that follow:** [3 × 1]

An ideal solution may be defined as the solution which obey Raoult's Law exactly over the entire range of concentration. The solutions for which vapour pressure is either higher or lower than that predicted by Raoult's law is called non - ideal solution.

(i) Define Raoult's law. A|I
(ii) Give an example where non ideal solution shows negative deviation from Raoult's law
(ii) Why does aqueous solution of sodium chloride freeze below 273K?

Section - B

(20 Marks)

Question 2 [2]

How will you obtain the following (give balanced chemical equations):

(i) Salicylaldehyde from phenol (ii) Propan–2–ol from Grignard's reagent

Question 3 [2]

(i) Why does the density of transition elements increase from Titanium to Copper? (at. no. Ti = 22, Cu = 2)
(ii) Why is zinc not regarded as a transition element? (at. no. Zn = 30)

Question 4 [2]

(i) Complete the reaction given :

$$CH_3NH_2 + CHCl_3 + 3KOH\ (alc) \xrightarrow{heat} \_\_\_ + 3KCl + 3H_2O$$

(ii) Name the reaction given above.

Question 5 [2]

(i) What is the basic difference between the electronic configuration of transition and inner transition elements?
(ii) Transition metals and their compounds generally exhibit a paramagnetic behaviour. Why?

Question 6 [2]

For the coordination complex ion $[Co(NH_3)_6]^{3+}$

(i) Give the IUPAC name of the complex ion.
(ii) What is the oxidation number of cobalt in the complex ion?

Question 7 [2]

(i) The following electrochemical cell is set up at 298 K: A|I

$$Zn|Zn^{2+}\ (1M)\ ||\ Cu^{2+}(aq)\ (1M)\ |Cu$$

Given: $E°\ Zn^{2+}/Zn = 0.761$ V,
$E°\ Cu^{2+}/Cu = +0.339$ V

(a) Write the half cell reaction at cathode. [½]

(b) Write the half cell reaction at anode. [½]

(ii) Calculate the emf and free energy change at 298 K in the above given cell. [1]

Question 8 [2]

(i) Answer the following questions:

(a) Give the preparation of Iodoform from ethanol

(b) State any one use of Iodoform

OR

✓ (ii) An alcohol A ($C_4H_{10}O$) on oxidation with acidified $K_2Cr_2O_7$ gives a carboxylic acid B ($C_4H_8O_2$).Compound (A) on oxidation in presence of heat gives an alkene C (C_4H_8) Treatment of C with warm aq. H_2SO_4 gives D ($C_4H_{10}O$), an isomer of A. The compound D is resistant to oxidation. Identify compound A, B, C and D. Write all reactions.

Question 9 [2]

46 g of ethyl alcohol is dissolved in 18 g of water. Calculate the mole fraction of ethyl alcohol.
(at. wt. of C = 12, O = 16, H = 1)

Question 10 [2]

How will you convert the following:

(i) Benzoyl chloride to benzaldehyde (ii) acetic acid to methane.

Question 11 [2]

Based on Lanthanoid contraction, explain the following:

(i) Nature of bonding in Lu_2O_3 and La_2O_3.

(ii) Trends in the stability of oxo-salts of lanthanides from La to Lu.

Section - C (21 Marks)

Question 12 [3]

A study of chemical kinetics of the reaction A + B → products, gave the following data at 25° C.

Experiment	[A]	[B]	$\frac{d[\text{Products}]}{dt}$
1	1.0	0.15	4.20×10^{-6}
2	2.0	0.15	8.40×10^{-6}
3	1.0	0.20	5.60×10^{-6}

Find:

(a) The order of reaction with respect to A.

(b) The order of reaction with respect to B.

(c) The rate law

Question 13 [3]

Arrange the following as directed:

(a) Increasing order of basic strength: Aniline, *p* - nitroaniline and *p* - toluidine.

(b) Decreasing order of basic strength in gas phase: $C_2H_5NH_2$, $(C_2H_5)_2NH$, $(C_2H_5)_3N$ and NH_3.

(c) Increasing order of solubility in water: $C_6H_5NH_2$, $(C_2H_5)_2NH$, $C_2H_5NH_2$.

Question 14 [3]

(i) Write the chemical equation for the reaction of glucose with bromine water.

(ii) Write the zwitter ion structure of glycine.

(iii) How will you bring about the conversion-Glucose to Saccharic acid ?

Question 15 [3]

(i) A 10% aqueous solution of cane sugar (mol. wt. 342) is isotonic with 1.754% aqueous solution of urea. Find the molecular mass of urea.

(ii) A solution contains 54 g of glucose (molecular mass = 180 g mol^{-1}) in 250 g of water (K_f for water = 1.86 K kg mol^{-1}). What will be the molality of this glucose solution?

Question 16 [3]

(i) Why pK*a* of $F-CH_2-COOH$ is lower than that of $Cl-CH_2-COOH$?

(ii) Although phenoxide ion has more number of resonating structures than carboxylate ion, carboxylic acid is a stronger acid than phenol. Why?

Question 17 [3]

(i) How can the following conversions be brought about:

(a) Glycerol to formic acid

(b) Chlorobenzene to phenol

(c) Diethyl ether to ethanol

OR

(ii) Write the names and structures of three isomers which have the same molecular formula C_3H_8O?

Question 18 [3]

(i) 25% of a first-order reaction is completed in 30 minutes.
Calculate the time taken in minutes for the reaction to go to 90% completion.

(ii) Write the rate law expression for the reaction A + B + C → D + E, if the order of reaction is first, second and zero with respect to A, B and C, respectively.

Section - D (15 Marks)

Question 19 [5]

(i) Give balanced chemical equations for the following reactions:

(a) Acetaldehyde reacts with hydrogen cyanide.

(b) Acetone reacts with phenyl hydrazine

(c) Acetic acid is treated with ethanol and a drop of conc. H_2SO_4.

(ii) Identify the product A, B, C and D.

$$C_6H_6 \xrightarrow[\text{Anhyd. } AlCl_3]{CH_3Cl} A \xrightarrow[CCl_4]{CrO_2Cl_2} B \xrightarrow[NaOH]{\text{Conc.}} C+D$$

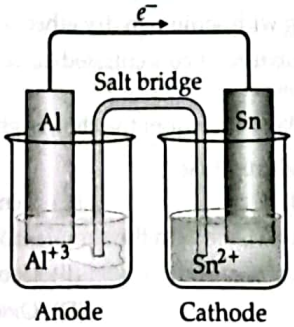
Question 20 [5]

(i) A metal complex having composition $Cr(NH_3)_4Cl_2Br$ has been isolated in two forms A and B. Form A reacts with $AgNO_3$ to give a white precipitate readily soluble in dilute aqueous ammonia whereas B gives a pale yellow precipitate soluble in concentrated ammonia.
State the hybridisation of chromium in each of them and calculate the magnetic moment (spin only value) of the isomer A.

(ii) When a coordination compound $CoCl_3.6NH_3$ is mixed with $AgNO_3$, three moles of AgCl are precipitated per mole of the compound. Write the structural formula and IUPAC name of the coordination compound.

Question 21 [5]

(i) (a) Calculate the value of E°_{cell} and E_{cell} at 298K for the following cell:
$Al|Al^{3+}(0.01M)||Sn^{2+}(0.05M)|Sn$
$E^\circ Al^{3+}/Al = -1.66V$ and $E^\circ_{Sn^{2+}/Sn} = -0.14V$
Also write the net cell reaction for the same.



(b) Mention any two factors affecting the electrode potential of a metal. [2]

OR

(ii) (a) In the button cell, widely used in watches, the following reaction takes place. [2]
$Zn(s) + Ag_2O(s) \rightarrow Zn^{2+}(aq) + 2Ag(s) + 2OH^-(aq)$
Determine E° and ΔG° for the reaction.
(Given $E^\circ_{Ag^+/Ag} = +0.80V$, $E^\circ_{Zn^{+2}/Zn} = -0.76V$)

(b) 0.05 M NaOH solution offered resistance of 31.6 ohms in a conductivity cell at 298 K. If the cell constant of the cell is 0.367 cm^{-1}, calculate the molar conductivity of the NaOH solution. [3]

ANSWERS

Sample Question Paper-2

CHEMISTRY (862)

Section - A

1. **(A)** **(i)** Methylamine, Hoffmann's degradation

(ii) right

(iii) less

(iv) alkene

(B) **(i)** **Option (A) is correct.**

Explanation: Limiting molar conductivity is the molar conductivity at infinite dilution, it occurs when electrolyte concentration approaches zero.

(ii) **Option (D) is correct.**

Explanation: Cl^- is a weak field ligand which cause pairing of electrons when form bonds with Pt^{2+}. Hence, form square planar geometry.

(iii) **Option (D) is correct.**

Explanation: $KMnO_4$ is a reactant which converted into Mn^{2+}. Mn^{2+} act as auto-catalyst. Hence, initially the reaction is slow at the start but becomes instantaneous after some time as Mn^{2+} formed as a product.

(iv) **Option (A) is correct.**

Explanation: Alcohols undergo dehydration in the presence of conc. H_2SO_4 at 413K, ether is formed.

(v) **Option (D) is correct.**

Explanation: The vapour pressure of solution is greater than pure components. Hence, it shows positive deviation from Raoult's Law.

(vi) **Option (C) is correct.**

Explanation: Primary cells are non rechargeable cells.

(vii) **Option (A) is correct.**

Explanation: There is maximum steric strain in tertiary amines, due to which tertiary amine show anomalous behaviour.

(C) **(i)** It states that for a solution of volatile liquids, the partial vapour pressure of each components in the solution is directly proportional to its mole fraction. 1

(ii) $CHCl_3$(chloroform) and CH_3COCH_3 (acetone) (Any other correct answer) 1

(iii) The vapour pressure decreases when a non-volatile solute(NaCl) is dissolved in solvent (water).This is due to lowering of freezing point. Hence, the solvent (aq.NaCl) freezes below 273K. 1

Examiner's Comment

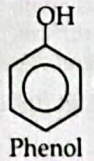
- Some students do not write precise definition. Some students got confused with positive and negative deviation example,

Answering Tip

- Be very precise with definition. Learn examples properly understanding the concept of positive and negative deviation.

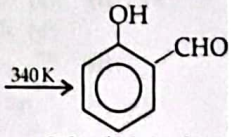
Section - B

2. **(i)**



Phenol

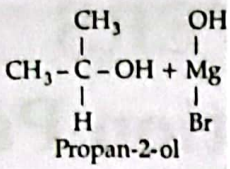
$+ CHCl_3 + 3KOH$



Salicyladehyde

$+ 3KCl + 2H_2O$ 1

(ii) $CH_3COCH_3 + CH_3MgBr \xrightarrow[\text{Acetaldehyde}]{HOH/H^+}$



Propan-2-ol

[ISC Marking Scheme, 2019] 1

3. (i) On moving from Ti to Cu, the atomic radii decrease due to increase in nuclear charge. Therefore, atomic volume decreases with increase in atomic mass. Hence, density increases.

(ii) The orbitals in zinc are completely filled in the ground state as well as in their oxidation states. Therefore, Zn is not regarded as a transition element. 2

4. (i) $CH_3NH_2 + CHCl_3 + 3KOH \xrightarrow{\text{alc.}} CH_3NC + 3KCl + 3H_2O$

Methyl isocyanide

(ii) Carbyl amine reaction. (It is also used to detect primary amines. This, is also an example of the Isocyanide test.) 2

Examiner's Comment

- Some students do not write correct equations.

Answering Tip

- Write the equations few times for thorough learning.
  Make sure you write balanced chemical equation.

5. (i) Transition metal atoms have their valence electrons in the outermost *d*-orbital whereas inner transition metal atoms have their valence electrons in the of orbital of the inner penultimate electron shell.

(ii) Transition metal ions have unpaired electrons in d-orbitals ($d^1 - d^9$). They exhibit para-magnetic behaviour. 2

6. (i) Hexaamminecobalt (III) ion. 1

(ii) +3 1

7. (i) (a) $Cu^{2+} + 2e^- \rightarrow Cu$

(b) $Zn - 2e^- \rightarrow Zn^{2+}$ 2

(ii) $E^0_{cell} = E^0_R - E^0_L$

$E^0_{cell} = 0.339 - (-0.761)$

$= 1.1V$

Free energy change $\Delta G^0 = -nFE^0_{cell}$

$n = 2$

$\Delta G^0 = -2 \times 96500 \times 1.10$

$= -212300\ J$

$= -212.3\ kJ$

OR

(1) The given cell is
$Zn \mid Zn^{++}(aq)\ (1M) \parallel Cu^{++}(aq)\ 1M \mid Cu$

The half cell reactions corresponding to this cell are:
$Zn : 2e^- \rightarrow Zn^{++}$ (oxidation half cell)
$Cu^{++} + 2e^- \rightarrow Cu$ (reduction half cell)
∴ The net cell reaction can be obtained as follows:
$Zn + Cu^{++} \rightarrow Zn^{++} + Cu$

(2) $E^\circ cell = E^\circ_R - E^\circ_L$
$= E^\circ_{Cu^{2+}/Cu} - E^\circ_{Zn^{2+}/Zn}$
$= 0.339 - (-0.761)\ V$
$= 1.1\ V$
free energy change $\Delta G^\circ = -nFE^\circ_{cell}$
This reaction involves a transfer of 2 moles of e^-
∴ $n = 2$
∴ $\Delta G^\circ = -2 \times 96500 \times 1.10$
$= -212300\ J$
$= -212.3\ kJ$

[Topper's Answer 2017]

8. (i) (a)

$CH_3CH_2OH + 4I_2 + 6NaOH \xrightarrow{\text{Heat}} CHI_3 + HCOONa + 5NaI + 5H_2O$

Ethanol — Iodoform — Sodium formate

(b) Uses:

(i) Used as an antiseptic.

(ii) Sterilising instruments used for surgery.

(iii) As a disinfectant.

OR

(ii)

$CH_3-CH(CH_3)-CH_2OH \xrightarrow[H_2SO_4]{K_2Cr_2O_7} CH_3-CH(CH_3)-COOH$

(A) 2-Methyl proponal — (B) 2-Methyl Propanoic acid

$\downarrow H_2SO_4$/ Heat

$CH_3-C(CH_3)=CH_2 \xrightarrow[H_2O/H^+]{H_2SO_4} CH_3-C(OH)(CH_3)-CH_3$

(C) 2-Methyl propene — (D) 2-Methyl 2-propanol

2

Examiner's Comment

- Some students get confused and cannot go ahead with the reaction.

Answering Tip

- Understand the question. Learn all such questions thoroughly.

9. Molecular weight of ethyl alcohol = 46 g

$\because$ no. of moles of ethyl alcohol, $x_B = \frac{46}{46} = 1g$

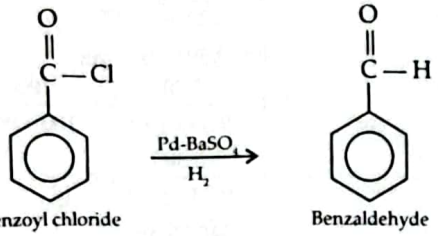
no. of moles of water, $x_A = \frac{1000}{18} = 55.5$ g

$\therefore$ mole fraction of x_B (ethyl alcohol)

$$x_B = \frac{1}{1+55.5} = \frac{1}{56.5}$$

$$= 0.0176. \quad 2$$

10. (i)



Benzoyl chloride Benzaldehyde

(ii) $CH_3COOH + NaOH \rightarrow \underset{\text{Sodium acetate}}{CH_3COONa} + H_2O$

$$CH_3COONa + NaOH \xrightarrow{CaO} \underset{\text{Methane}}{CH_4} + NaCO_3 \quad 2$$

11. (i) Due to lanthanide contraction, size reduces. With the size reduction, the covalent character increases. Therefore, Lu_2O_3 is more covalent than La_2O_3.

(ii) As the size of the cation reduces from La to Lu, according to Fajan's rules, the polarising power of the cation will increase, and it will distort the cloud of oxygen(anion) significantly. Thus, the bond weakens, and the stability also reduces. 2

Section - C

12. Suppose the given reaction is of order m with respect to A and n with respect to B. The rate of formation of product can be written as

$4.20 \times 10^{-6} = k[1.0]^m[0.15]^n$ ...(1)

$8.40 \times 10^{-6} = k[2.0]^m[0.15]^n$ ...(2)

$5.60 \times 10^{-6} = k[1.0]^m[0.20]^n$ ...(3)

On dividing equation (2) by (1) we get

$$\frac{8.40\times10^{-6}}{4.20\times10^{-6}} = \frac{k[2.0]^m[0.15]^n}{k[1.0]^m[0.15]^n} = \left[\frac{2.0}{1.0}\right]^m$$

$$(2)^1 = 2^m$$

$$m = 1$$

On dividing equation (3) by (1) we get,

$$\frac{5.6\times10^{-6}}{4.2\times10^{-6}} = \frac{k[1.0]^m[0.20]^n}{k[1.0]^m[0.15]^n} = \left[\frac{0.20}{0.15}\right]^n$$

$$\left(\frac{4}{3}\right)^1 = \left(\frac{4}{3}\right)^n$$

$$n = 1$$

(a) The order of reaction with respect to A is 1.

(b) The order of reaction with respect to B is 1.

(c) The rate of law can be written as,

Rate = $k[A][B]$ 3

13. (a) p-nitroaniline < aniline < p-toluidine
Presence of electron donating $-CH_3$ group increases the electron density on N-atom in p-toluidine making it more basic than aniline. Presence of electron withdrawing group $-NO_2$ decreases the electron density over the N-atom in p-nitroaniline making it less basic than aniline.

(b) $(C_2H_5)_3N > (C_2H_5)_2NH > C_2H_5NH_2 > NH_3$.
Greater the +I effect, higher is the basic strength. Also, greater the alkyl groups, higher is the basic strength.

(c) $C_6H_5NH_2 < (C_2H_5)_2NH < C_2H_5NH_2$
Greater the H-bonding, greater is the solubility. Also, solubility of amines decreases with increase in the molecular mass. 3

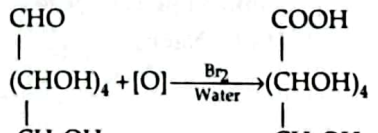
Examiner's Comment

- Some students get confused in increasing and decreasing order.

Answering Tip

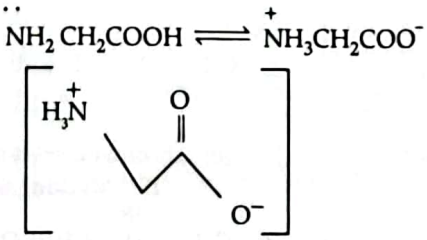
- Learn the concepts of stearic effect, inductive effect, H bonding properly.
  Choose your series based on your understanding.

14. (i)

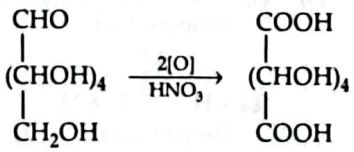


Gluconic acid

(ii) Zwitter ion structure of glycine



(iii)



Glucose Saccharic acid 3

15. (i) Number of moles of cane sugar $= \frac{10}{342}$
$= 0.0292$

Number of moles of urea $= \frac{1.754}{x}$

$\pi_{\text{cane sugar}} = \pi_{\text{urea (isotonic solution)}}$

$n_1 \frac{RT}{V} = n_2 \frac{RT}{V}$, $0.0292 = \frac{1.754}{x}$

$x = 60.07$

[ISC Marking Scheme, 2016]

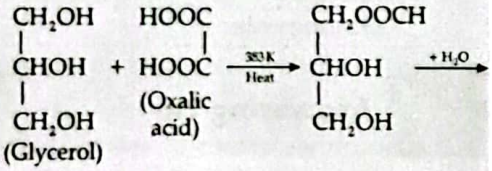
(ii) Molality = Moles per kg

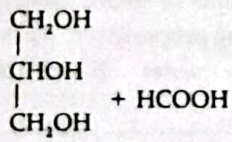
$$m = \frac{54 \times 1000}{180 \times 250} = 1.20 \text{ M}$$ 3

16. (i) In FCH_2COOH, fluorine is more electrons withdrawing and has stronger -I effect than chlorine in $ClCH_2COOH$. So, FCH_2COOH is more acidic than $ClCH_2COOH$ hence, its pK_a value is lesser than $ClCH_2COOH$.

(ii) The resonating structures of carboxylate ion contribute more towards its stability than those of phenoxide ion. As a result, carboxylate ion is more resonance-stabilised than phenoxide ion. Hence, carboxylic acid is a stronger acid than phenol. 3

17. (i) (a) Glycerol to Formic acid





(b) Chlorobenzene to Phenol

$$C_6H_5Cl + NaOH \xrightarrow[200\text{ atm}]{573-623\text{K}} C_6H_5ONa \xrightarrow[-NaCl]{+HCl} C_6H_5OH$$

(c) Diethyl ether to ethanol

$$C_2H_5-O-C_2H_5 + HI \xrightarrow{\text{cold}} C_2H_5I + C_2H_5OH$$

or

$$C_2H_5-O-C_2H_5 + HI \xrightarrow{\text{heat}} C_2H_5I \xrightarrow[-NaI]{NaOH} C_2H_5OH$$

(or any other correct method)

[ISC Marking Scheme, 2015] 3

OR

(ii) (a) $CH_3—CH_2—CH_2—OH$
Propan-1-ol

(b) $CH_3—\underset{\displaystyle OH}{\underset{|}{CH}}—CH_3$
Propan-2-ol

(c) $CH_3—CH_2—O—CH_3$
Methoxyethane

(a) and (b) are the position isomers while (b) and (c) or (a) and (c) are functional isomers.

18. (i) $a = 100$, $x = 25$, $t = 30$ min

According to first order kinetics,

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

$$k = \frac{2.303}{30}\log\frac{100}{100-25}$$

$$k = \frac{2.303}{30}\log\frac{100}{75}$$

$k = 9.59 \times 10^{-3}$ min^{-1}

$$t = \frac{2.303}{9.59\times10^{-3}}\log\frac{100}{100-90}$$

$$t = \frac{2.303}{9.59\times10^{-3}}\log\frac{100}{10}$$

$t = 240.15$ min

$k = 0.0042$ min^{-1}.

(ii) Rate $= k[A]^1[B]^2[C]^0$

OR Rate $= k[A]^1[B]^2$. 3

Examiner's Comment

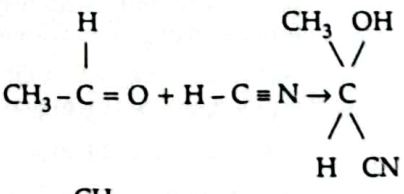
- Students get confused in formulae. Some don't understand how to incorporate the concept of order of reaction.

Answering Tip

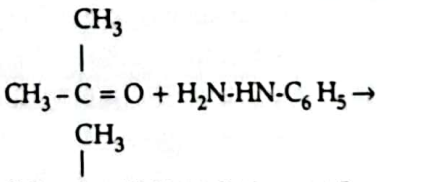
- Learn carefully Understand. Practice by doing plenty of sums.

Section - D

19. (i) (a)



(b)



(c) $CH_3-COOH + C_2H_5OH \xrightleftharpoons{\text{Conc.}H_2SO_4} CH_3COOC_2H_5 + H_2O$

(ii) $C_6H_6 \xrightarrow[\text{Anhyd. } AlCl_3]{CH_3Cl} \underset{\text{Toluene}}{\underset{[A]}{C_6H_5CH_3}}$

$$\xrightarrow[CCl_4]{CrO_2Cl_2} \underset{\text{Benzaldehyde}}{\underset{[B]}{C_6H_5CHO}}$$

$$\xrightarrow[NaOH]{Conc.} \underset{\text{Benzyl alcohol}}{\underset{[C]}{C_6H_5CH_2OH}} + \underset{\text{Sodium benzoate}}{\underset{[D]}{C_6H_5COONa}}$$

5

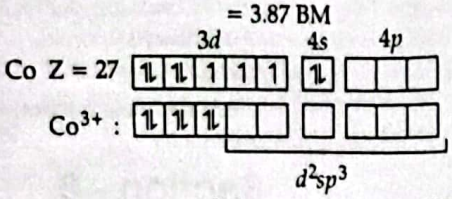
20. (i) Hybridisation of Cr in isomer A and B is d^2sp^3.

Number of unpaired electrons in $Cr^{3+}(3d^3)$ is 3

Magnetic moment = $\sqrt{n(n+2)}$

$= \sqrt{3(3+2)}$

$= 3.87$ BM



six pairs of electrons from six NH_3

(ii) $[Co(NH_3)_6]Cl_3$ - Hexaammine cobalt (III) chloride

[ISC Marking Scheme, 2019] 5

21. (i) (a) $Al|Al^{3+}(0.01\ M)\ ||\ Sn^{2+}(0.015\ M)|Sn$

Given : $E^\circ_{Al^{3+}/Al} = -1.66$ V; $E^\circ_{Sn^{2+}/Sn} = -0.14$ V

$E^\circ_{cell} = E^\circ_R - E^\circ_L$

$= -0.14 - (-1.66)$

$= -0.14 + 1.66$

$= 1.52$ V

Net cell reaction :

$2Al + 3Sn^{2+} \longrightarrow 2Al^{3+} + 3Sn$

It involves transfer of 6 electrons, $n = 6$

$$E_{cell} = E^\circ_{cell} - \frac{0.059}{n}\log\frac{[Al^{3+}]^2}{[Sn^{2+}]^3}$$

$$= 1.52 - \frac{0.059}{6}\log\frac{[0.01]^2}{[0.015]^3}$$

$= 1.52 - 0.01447$

$= 1.50553$ V

(b) Factors affecting the electrode potential of a metal:

(i) **Nature of metal:** Extremely active metals have low electrode potential, whereas less active metals have high electrode potential.

(ii) **Temperature:** Change in temperature of the solution also changes the electrode potential.

Examiner's Comment

- Students often make mistake in understanding cathode and anode.
- Some students miss out on correct formulae.

Answering Tip

- Understand the concept of electrolysis.
- Practice using different cell combination.

(ii) (a) $E^o_{cell} = E^o_{cathode} - E^o_{anode}$

$\Rightarrow E^o_{cell} = 0.80\ V - (-0.76)\ V = +1.56V$

$\Delta_r G = -nF\ E^0_{cell}$

$= -2 \times 96500\ C\ mol^{-1} \times 1.56\ V$

$= -301080\ J\ mol^{-1} = -301.08\ kJ\ mol^{-1}$

(c) Conductance = $1/R = 1/31.6\ ohm^{-1}$

Specific conductance, $\kappa = 1/31.6\ ohm^{-1} \times 0.367\ cm^{-1} = 0.0116$

Molar conductance

$$= \frac{\kappa \times 1000}{C} = \frac{0.0116 \times 1000}{0.05}$$

$= 232\ ohm^{-1}\ cm^2\ mol^{-1}$. 5

❑❑