Sample Question Paper-3

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 $= 6.022 \times 10^{23}$.

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) Aliphatic diazonium salts are highly ..... whereas arene diazonium salts are ..... for a short time in solution at low temperature.

(ii) Chelates are formed when a ..... is attached with ..... ligands.

(iii) Aryl halides on reacting with sodium in dry ether is called as _____reaction.

(iv) Anisole reacts with a mixture of concentrated ..... acid and..... acid to yield a mixture of ortho and para nitroanisole.

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

(i) The unit of specific conductivity is:
(A) cm (B) S cm^{-1} (C) S cm^2 mol^{-1} (D) S cm^{-2} mol

(ii) The number of unidentate ligands in the complex ion is called:
(A) EAN (B) Coordination number
(C) Primary valency (D) Oxidation number

(iii) The transition elements have the ability to form complexes because they:
(A) have small size of an atom (B) highly charged ion
(C) contain vacant d-orbitals (D) All of these

(iv) Acetyl chloride on heating with diethyl ether in the presence of anhydrous $ZnCl_2$ gives:
(A) Ethyl alcohol and acetic acid (B) Methyl chloride and methyl alcohol
(C) Methyl acetate and methyl alcohol (D) Ethyl acetate and ethyl chloride

(v) In positive deviation from Raoult's law:
(A) $\Delta H_{mix} > 0$ (B) $\Delta H_{mix} < 0$
(C) $1 > \Delta H_{mix} > 0$ (D) $1 < \Delta H_{mix} < 0$

(vi) **Assertion:** Molar conductivity at infinite solution is called limiting molar conductivity.
Reason: Catalyst alters Gibbs free energy in a reaction.
(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:** Aniline undergoes Friedel crafts reaction.
Reason: Aniline forms a salt with ammonium chloride on alkylation.
(A) Both Assertion and Reason are true and Reason is the Aniline forms a salt with ammonium chloride on alkylation 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]

In a very dilute solution, a solute molecule will (with rare exceptions) have only solvent molecules as near neighbours, and the probability of escape of a particular solute molecule into the gas phase is expected to be independent of the total concentration of solute molecules.

(i) State Henry's law.
(ii) What is the effect of temperature on the solubility of a gas in a liquid?
(iii) Henry's law constant for the molality of methane in benzene at 298 K is 4.27×10^5 mm Hg. Calculate the solubility of methane in benzene at 298 K under 760 mm Hg.

Section - B (20 Marks)

Question 2 [2]

Give one chemical test to distinguish between

(i) 1-propanol and 2-propanol.
(ii) *n*-oxalic acid and benzoic acid

Question 3 [2]

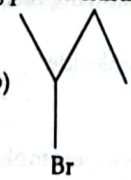
Complete and balance the following equations:

(i) $KMnO_4 + H_2SO_4 + H_2C_2O_4 \rightarrow$ ____ + _____ + _____ + _____
(ii) $K_2Cr_2O_7 + H_2SO_4 + KI \rightarrow$ _____ + ____ + _____ + _____

Question 4 [2]

(i) Which alkyl halide from the following pair is chiral and undergoes faster S_N2 reaction?

(a) 

(b) 

(ii) Out of S_N1 and S_N2 reaction occurs with:
(a) Inversion of configuration
(b) Racemisation

Question 5 [2]

Explain the following observations:

(i) Many of the transition elements are known to form interstitial compounds.
(ii) The numbers of the actinoid series exhibit a larger number of oxidation states than the corresponding members of the lanthanoid series.

Question 6 [2]

(i) Explain why:
$[Fe(H_2O)_6]^{3+}$ is strongly paramagnetic whereas $[Fe(CN)_6]^{3-}$ is weakly paramagnetic.
(ii) The p-complexes are known for transition elements only.

Question 7 [2]

(i) A current of 10 A is passed for 80 min and 27 seconds through a cell containing dilute sulphuric acid.
(a) Calculate the weight of oxygen liberated?
(b) How many moles of oxygen gas will be liberated at the anode?
(ii) Calculate the amount of zinc deposited at the cathode when another cell containing $ZnSO_4$ solution is connected in series (Zn=65).

Question 8 [2]

(i) Write the formula of reagents used in the following reactions:

(a) Bromination of phenol to 2, 4, 6-tribromo-phenol

(b) Hydroboration of propene and then oxidation to propanol.

OR

(ii) Write the chemical equations for the dehydration of ethanol with conc. H_2SO_4 at 140°C and 170°C.

Question 9 [2]

100 mg of a protein is dissolved in just enough water to make 10.0 mL of solution. If this solution has an osmotic pressure of 13.3 mm Hg at 25°C, what is the molar mass of the protein?
(R = 0.0821 L atm mol^{-1} K^{-1} and 760 mm Hg = 1 atm.)

Question 10 [2]

Give balanced equations for the following reactions:

(i) Benzaldehyde reacts with hydrazine

(ii) Acetic acid reacts with phosphorus pentachloride

Question 11 [2]

(i) Out of Cr^{3+} and Mn^{3+}, which is a stronger oxidising agent and why?

(ii) Why is zinc not regarded as a transition element? (At. no. Zn = 30)

Section - C

(21 Marks)

Question 12 [3]

For the reaction: $2H_2+2NO \rightleftharpoons 2H_2O+N_2$, the following rate data was obtained:

S.No.	[NO] mol L^{-1}	[H_2] mol L^{-1}	Rate: mol L^{-1} s^{-1}
1	0.40	0.40	4.6×10^{-3}
2	0.80	0.40	18.4×10^{-3}
3	0.40	0.80	9.2×10^{-3}

Calculate the following:

(i) The overall order of reaction.

(ii) The rate law.

(iii) The value of rate constant (k).

Question 13 [3]

Give balanced chemical equations for the following reactions:

(i) Ethylamine with nitrous acid.

(ii) Diethyl ether with phosphorus pentachloride

(iii) Aniline with acetyl chloride.

Question 14 [3]

(i) What are essential amino acids? Give two examples.

(ii) What are non-essential amino acids? Give two examples

(iii) What are the hydrolysis products of sucrose?

Question 15 [3]

(i) The molecular weight of an organic compound is 58 g mol^{-1}. What will be the boiling point of a solution containing 48 gram of the solute in 1200 gram of water?
[K_b for water = 0.513 °C kg mol^{-1}; Boiling point of water = 100°C]

(ii) 0.76 g of glucose (molecular mass = 180 g mol^{-1}) is dissolved in 20 mL of aqueous solution at 298 K. What is the molarity of the glucose solution ?
(R = 0.0821 L-atm K^{-1} mol^{-1})

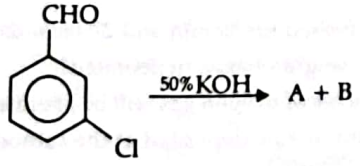
Question 16 [3]

(i) Write balanced chemical equations for the following and name the reactions occurring in each case:

(a) Benzaldehyde reacts with an alcoholic solution of potassium cyanide.

(b) Propanone is treated with iodine and excess of alkali and warmed.

(ii) Predict the product in the given reaction.



Question 17 [3]

How will you obtain the following? (Give balanced equation.)

(a) Ethyl chloride from diethyl ether

(b) Anisole from phenol

(c) Ethanol from formaldehyde

OR

The following is not an appropriate reaction for the preparation of tert-butyl ethyl ether.

$C_2H_5ONa + (CH_3)_3\,C\text{–}Cl \rightarrow (CH_3)_3\,C\text{–}OC_2H_5$

(a) What would be the major product of the given reaction?

(b) Write a suitable reaction for the preparation of tert-butyl ethyl ether, specifying the names of reagents used. Justify your answer in both cases.

Question 18 [3]

(i) A first order reaction has a rate constant of 0.0051 min^{-1}. If we begin with 0.10 M concentration of the reactant,what concentration of reactant will remain in solution after 3 hours?

(ii) For reaction $2N_2O_5 \rightarrow 2NO_2 + O_2$, the rate and rate constants are 1.02×10^{-4} mol $L^{-1}\,s^{-1}$ and $3.4 \times 10^{-5}\,s^{-1}$ respectively. Calculate the concentration of N_2O_5 at that time.

Section - D

(15 Marks)

Question 19 [5]

(i) Convert

(a) Benzoic acid to benzaldehyde

(b) Ethyl benzene to benzoic acid

(c) Propanone to propene [3]

(ii) Arrange the following in an increasing order of their acidic strength:
Benzoic acid, 4-Nitrobenzoic acid, 3, 4-Dinitrobenzoic acid, 4-Methoxybenzoic acid [2]

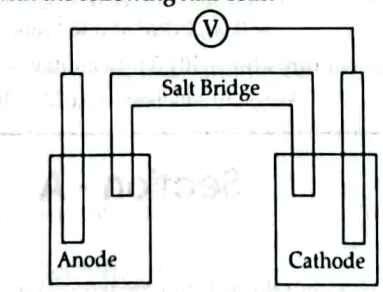
Question 20 [5]

(i) Identify the type of hybridisation, magnetic behaviour and spin only magnetic value in $[Mn(CN)_6]^{3-}$ and $[Co(NH_3)_6]^{3+}$. [3]

(ii) Explain why an aqueous solution of potassium hexacyanoferrate (II) does not give the test for ferrous ion. [2]

Question 21 [5]

(a) A voltaic cell is set up at 25°C with the following half cells:



$Al \rightarrow Al^{+3}$ $\qquad$ Al/Al^{+3} (0.001 M)

$Ni^{+2} \rightarrow Ni$ $\qquad$ Ni/Ni^{2+} (0.50 M)

$E^0_{Al/Al^{3+}} = -0.25$ V and $E^0_{Ni^{+2}/Ni} = -1.66$V

Write an equation for the reaction that occurs when the cell generates an electric current and determine the cell potential. [3]

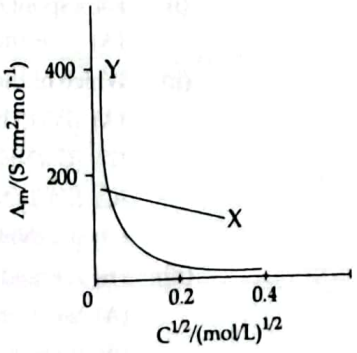
(b) The cell in which the following reaction occurs:

$2Fe^{3+}(aq) + 2I^-(aq) \rightarrow 2Fe^{2+}(aq) + I_2(s)$

where E^0cell = 0.236 V at 298 K. Calculate the Standard gibbs energy and the equilibrium constant of the cell reaction. [2]

OR

(a) The following curve is obtained when molar conductivity, Λ_m is plotted against the square root of concentration, $C^{1/2}$ along *y* and *x*-axis respectively for the two electrolytes X and Y.



(i) What can you say about the nature of these two electrolytes ?

(ii) How do you account for the increases in Λ_m for the electrolytes X and Y with dilution ?

(iii) How can you determine Λ_m^∞ for these electrolytes ?

(b) Calculate the degree of dissociation (α) of acetic acid if its molar conductivity (Λ_m) is 39.05 S cm^2 mol^{-1}.

Given: $\lambda^\circ_{(H^+)} = 349.6$ S cm^2 mol^{-1} and $\lambda^\circ_{(CH_3COO^-)} = 40.9$ S cm^2

□□

ANSWERS

Sample Question Paper-3

CHEMISTRY (862)

Section - A

1. **(A)** **(i)** Unstable, stable

(ii) central metal atom, polydentate

(iii) Fittig

(iv) sulphuric, nitric

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

(ii) **Option (B) is correct.**
Explanation: The number of ions, molecules and ligands attached to central metal is called coordination number.

(iii) **Option (D) is correct.**
Explanation: The transition elements have the ability to form complexes. This is because these elements:
(a) have small highly charged ions, and
(b) contain vacant d-orbitals.

(iv) **Option (D) is correct.**
Explanation: Acetyl chloride react with ethers in presence of $ZnCl_2$ to form alkyl halide and ester.

(v) **Option (A) is correct.**
Explanation: Positive deviation take place when vapour pressure of a solution is greater than pure components.

(vi) **Option (C) is correct.**
Explanation: Catalyst does not alter Gibbs free energy. It is used to change the reaction rates.

(vii) **Option (D) is correct.**
Explanation: Aniline forms a salt with ammonium chloride on alkylation and thus do not undergo Friedel crafts reaction.

(C) **(i)** Henry's law states that, "The solubility of a gas in a liquid at a particular temperature is directly proportional to the pressure of the gas in equilibrium with the liquid at that temperature." 1

(ii) Solubility of gas decreases with increase of temperature at the same pressure. 1

(iii) P = 760 mm Hg, $k_H = 4.27 \times 10^5$ mm Hg
According to Henry's law
$p = k_H x$
$x = p / k_H$
$= 760 \text{ mm Hg} / 4.27 \times 10^5 \text{ mm Hg}$
$= 178 \times 10^{-5}$
$= 1.78 \times 10^{-3}$
It is the mole fraction of methane in benzene 1

Section - B

2. **(i)** **Lucas test:** When Lucas reagent (conc. HCl + $ZnCl_2$) is added to 2-propanol, turbidity appears within five minutes whereas with 1 – propanol, no turbidity appears and remains clear. 1

(ii) Oxalic acid decolourises hot solution of acidified $KMnO_4$ whereas benzoic acid does not. 1

3. **(i)** $2KMnO_4 + 3H_2SO_4 + 5H_2C_2O_4 \rightarrow K_2SO_4 + 2Mn_2SO_4 + 8H_2O + 10CO_2$

(ii) $K_2Cr_2O_7 + 7H_2SO_4 + 6KI \rightarrow 4K_2SO_4 + Cr_2(SO_4)3 + 7H_2O + 3I_2$
2

4. **(i)** (a) undergoes faster S_N2 reaction and
(b) is chiral 2

(ii) (a) S_N2
(b) S_N1 2

5. **(i)** Due to presence of unpaired electrons in the *d*-orbital. Transition elements have vacant interstitial sites and are able to trap small atoms like H, C or N to form such compounds.

(ii) Actinoids exhibit a large number of oxidation states because 5*f*, 6*d* and 7*s* levels have almost comparable energies (very small energy difference between sub-shells) than the energy difference between 4*f* and 5*d* orbitals in case of lanthanoids. 2

Examiner's Comment

- Some students do not give proper reasoning.

Answering Tip

- Teach students to use correct reasoning. Students must practice for characteristics of lanthanoid and actinoid series.

6. (i) Due to the presence of a strong field ligand (CN^-), the 3*d* electrons pair up leaving only one unpaired electron. Thus, hybridisation is d^2sp^3 forming inner orbital complex. Therefore, it is weakly paramagnetic whereas due to the presence of weak field ligand (H_2O), 3*d* electrons do not pair up. Thus, hybridisation involved is sp^3d^2 forming an outer orbital complex. As it contains five unpaired electrons so it is strongly paramagnetic.

(ii) Due to presence of empty *d*-orbitals in transition metals, they can accept electron pairs from ligands containing p electrons and hence can form coordinate bond complexes. 2

7. (i) $i = 10$ A, $t = 80$ min 27 s
$= 80 \times 60 + 27$ s $= 4827$ s
$Q = i \times t = 10 \times 4827$ C $= 48270$ C
Equivalent weight of oxygen = 8

(a) Weight of O_2 liberated $= \frac{8 \times 48270}{96500} = 4$ g

(b) Moles of oxygen $= \frac{\text{Weight}}{\text{Molecular weight}}$

$= \frac{4}{32} = 0.125$ moles of O_2

(ii) According to Faraday's Second Law of Electrolysis,

$$\frac{\text{Mass of } O_2}{\text{Mass of Zn}} = \frac{\text{Equivalent weight of } O_2}{\text{Equivalent weight of Zn}}$$

Let *x* be the amount of Zn deposited

$$\therefore \quad \frac{4}{x} = \frac{8}{65/2}$$

$$x = 4 \times \frac{65}{2 \times 8} = 16.25 \text{ g}$$

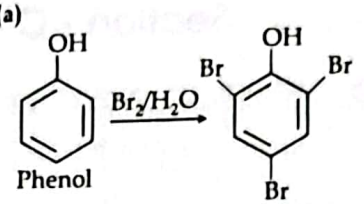
Examiner's Comment

- Students make mistakes in using correct formula. Some students wrote wrong formula.

Answering Tip

- Practice numerical again and again. While solving the problems, write correct formula. Proceed systematically.

8. (i) (a)



Phenol — 2,4,6-tribromophenol

(b)

$$3CH_3 - CH = CH_2 \xrightarrow{B_2H_6} (CH_3 - CH_2 - CH_2)_3 - B \xrightarrow[H_2O_2/3OH]{} 3CH_3 - CH_2 - CH_2OH$$

OR

(ii) At 170°C (443K):

$$\underset{\text{Ethyl alcohol}}{CH_3 - CH_2 - OH} \xrightarrow[\text{at 443 K}]{\text{conc.}H_2SO_4} \underset{\text{Ethene}}{CH_2 = CH_2} + H_2O$$

At 140°C (413 K):

$$\underset{\text{Ethyl alcohol}}{2CH_3CH_2OH} \xrightarrow[\text{at 413 K}]{\text{conc.}H_2SO_4} \underset{\text{Diethyl ether}}{CH_3 - CH_2 - O - CH_2 - CH_3} + H_2O$$

9. $w = 100$ mg $= 0.100 = 0.1$ g,
$V = 10.0$ mL $= 0.01$ L
$\pi = 13.3$ mm Hg $= 13.3760$ atm,
$T = 25°C = 25 + 273 = 298$ K
$R = 0.0821$ L atm mol^{-1} K^{-1}, $M = ?$

Using formula: $M = \frac{wRT}{\pi V}$

$$\Rightarrow M = \frac{0.1 \times 0.0821 \times 298 \times 760}{13.3 \times 0.01}$$

$$\Rightarrow M = \frac{1859.4008}{0.133} = 13980.4$$

$M = 13980.4$ g mol^{-1} 2

10. (i)

$$\underset{\text{Benzaldehyde}}{C_6H_5 - \overset{H}{\overset{|}{C}} = O} + NH_2NH_2 \rightarrow \underset{\text{Benzaldehydehydrazone}}{C_6H_5 - \overset{H}{\overset{|}{C}} = N.NH_2} + H_2O$$

(ii)

$$CH_3 - \overset{O}{\overset{\|}{C}} - OH + PCl_5 \rightarrow CH_3 - \overset{O}{\overset{\|}{C}} - Cl + POCl_3 + HCl$$

2

11. (i) Mn^{3+} is stronger oxidising agent because Mn^{3+} is more stable due to its half-filled ($3d^5$) configuration.

(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

Section - C

12. For reaction $2NO + 2H_2 \rightarrow 2H_2O + N_2$

$Rate = k[NO]^p[H_2]^q$

(1) $4.6 \times 10^{-3} = k(0.4)^p(0.4)^q$

(2) $18.4 \times 10^{-3} = k(0.8)^p(0.4)^q$

(3) $9.2 \times 10^{-3} = k(0.4)^p(0.8)^q$

Dividing eq (ii) by eq (i)

$$\frac{18.4 \times 10^{-3}}{4.6 \times (2)^p} = \left(\frac{0.8}{0.4}\right)^p$$

$$4 = (2)^p$$

$$p = 2$$

Dividing eq (iii) by eq (i)

$$\frac{9.2 \times 10^{-3}}{4.6 \times 10^{-3}} = \left(\frac{0.8}{0.4}\right)^q$$

$$2 = (2)^q$$

$$q = 1$$

(i) Overall order of reaction

$$Rate = k[NO]^2[H_2]^1$$

Order of reaction = 2+1=3

(ii) Rate law = rate = $k[NO]^2[H_2]^1$

(iii) Rate constant $(k) = \frac{rate}{A^3} = \frac{4.6 \times 10^{-3}}{0.4^3}$

$$k = 0.071875 \text{ mol}^{-2}L^2s^{-1}$$

[ISC Marking Scheme 2017]

13. (i) $C_2H_5NH_2 + HONO \rightarrow C_2H_5OH + N_2 + H_2O$

(ii) $C_2H_5 - O - C_2H_5 + PCl_5 \rightarrow 2C_2H_5Cl + POCl_3$

(iii) $CH_3COCl + H - NHC_6H_5 \rightarrow CH_3CONHC_6H_5 + HCl$

[ISC Marking Scheme 2016]

Examiner's Comments

- Incomplete equations was given by some candidates. A few candidates could not write C_2H_5OH as product.
- A number of candidates wrote wrong products such as C_2H_5COCl Or C_2Cl_5-O-C_2Cl_5 although correct answer was C_2H_5Cl and $POCl_3$.
- In some cases wrong formula of the product was written - instead of $C_6H_5NHCOCH_3$, several candidates wrote $C_6H_5NHCH_3CO$.

Answering Tip

- Write balanced equations with correct reactants and products.

14. (i) **Essential amino acids:** The amino acids which cannot be synthesised in the body and must be obtained through diet. Example: Valine, Lucine, etc. 1

(ii) **Non-essential amino acids:** The amino acids which can be synthesised in the body, are known as non-essential amino acids. 1

Example: Glycine, Alanine, etc

(iii) Sucrose on hydrolysis gives equimolar mixture of D(+) glucose and D(–) fructose.

$C_{12}H_{22}O_{11} + H_2O \rightarrow C_6H_{12}O_6$ + $C_6H_{12}O6$

Sucrose Glucose Fructose 1

15. (i) 1200 g of water contains 48 g of solute

1000 g contains $48 \times \frac{1000}{1200} = 40$ g of solute

$$\text{Molality} = \frac{40}{58} = 0.689 \text{ mol/kg}$$

$$\Delta T_b = K_b\, m = 0.513 \times 0.689$$

$$= 0.353°C$$

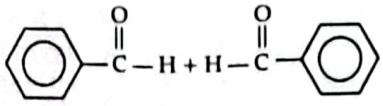
Boiling point = 100 + 0.353 = 100.353°C

[ISC Marking Scheme 2016]

(ii) $C = \frac{\text{Moles of solute}}{\text{Volume of solution}}$

$$C = \frac{0.76 \times 1000}{180 \times 20} = 0.21 \text{ M}$$

16. (i) (a)



Benzoin

This reaction is Benzoin condensation.

(b) $CH_3COCH_3 + 3I_2 + 4NaOH \xrightarrow{\Delta}$

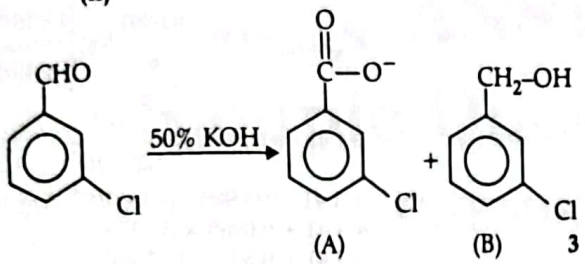
Propanone

$CHI_3 \downarrow + CH_3COONa + 3NaI + 4H_2O$

Iodoform (yellow ppt.)

This reaction is iodoform reaction.

(ii)



(A) (B) 3

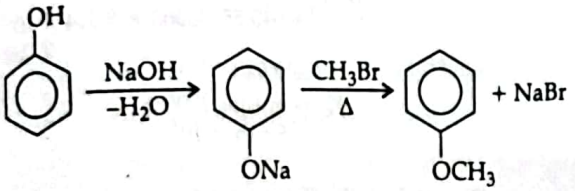
17. (i) (a)

$$C_2H_5OC_2H_5 + PCl_5 \rightarrow 2C_2H_5Cl + POCl_3$$

or

$$C_2H_5OC_2H_5 + SOCl_2 \rightarrow 2C_2H_5Cl + SO_2$$

(b)



Anisole

(c) Ethanol is obtained from formaldehyde when treated with Grignard reagent.

$HCHO + CH_3MgBr \longrightarrow$

$CH_3CH_2OMgBr \longrightarrow CH_3CH_2OH$ + MgBr(OH)

Ethanol

Examiner's Comment

- Most of the candidates wrote unbalanced equations.
  - (i) For the conversion of C_2H_5–O–C_2H_5 to C_2H_5Cl, some candidates used Cl_2 instead of PCl_5 or $SOCl_2$. A few candidates did not write the by product.
  - (ii) For the conversion of phenol to anisole, many candidates converted phenol directly by reacting with CH_3Br. They did not convert phenol to phenoxide.
  - (iii) For the conversion of ethanol from formaldehyde, most of the candidates wrote incorrect structure of the product. Some candidates did not balance the equation

Answering Tip

- Understand organic reactions and conversions with proper reactants, catalysts and conditions. Practice for the conversion of organic compounds with balanced equations. Write the by product in all organic reactions.

OR

(ii) (a) Since, the alkyl halide is a 3° halide and C_2H_5ONa is a strong base, therefore elimination occurs preferably. The product obtained is 2-Methylprop-1-ene.

$CH_3—C(CH_3)=CH_2$.

(b) To prepare *t*-butyl ethyl ether, the alkyl halide should be 1°, i.e., chloroethane and the nucleophile should be sodium *t*-butoxide because the 3° nucleophile is able to attack 1° alkyl halide.

$(CH_3)_3C-ONa + CH_3CH_2-Cl \rightarrow$

$(CH_3)_3C-OCH_2CH_3 + NaCl$ 3

18. (i) Using formula: $K = \frac{2.303}{t}\log\frac{[R]_0}{[R]}$

$$K = \frac{2.303}{t}\log\frac{[R]_0}{[R]}$$

$$\therefore \quad 0.0051 = \frac{2.303}{180}\log\frac{0.10}{[R]}$$

$$\text{or} \quad \log\frac{0.10}{[R]} = \frac{0.0051 \times 180}{2.303}$$

$$\text{or} \quad \log\frac{0.10}{[R]} = \frac{0.918}{2.303} = 0.3986$$

$$\text{or} \quad \frac{0.10}{[R]} = \text{anti}\log(0.3986)$$

$$\text{or} \quad \frac{0.10}{[R]} = 2.503$$

$$\therefore \quad [R] = \frac{0.10}{2.503} = 0.0399$$

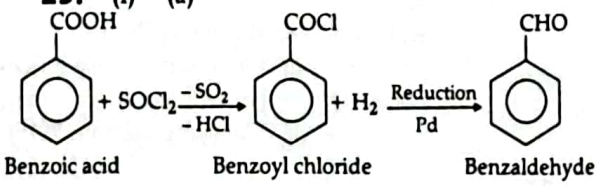
(ii) Rate = $k[N_2O_5]$

$[N_2O_5]$ = rate/k

$[N_2O_5] = 1.02 \times 10^{-4}/3.4 \times 10^{-5} = 3$ mol/L 3

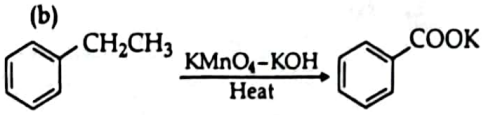
Section - D

19. (i) (a)

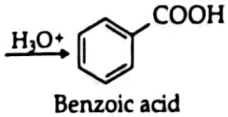


Benzoic acid Benzoyl chloride Benzaldehyde

(b)



Ethyl benzene Potassium benzoate



Benzoic acid

(c)

$$CH_3-\underset{\text{Propanone}}{\overset{\overset{O}{\|}}{C}}-CH_3 \xrightarrow[\text{(Reduction)}]{NaBH_4,\ CH_3OH} CH_3-\underset{\text{2-Propanol}}{\overset{\overset{OH}{|}}{CH}}-CH_3$$

$$\xrightarrow[443\ K-H_2O]{\text{Conc. } H_2SO_4} \underset{\text{Propene}}{CH_3-CH=CH_2}$$

(ii) The acidic order of the compounds are: 4-methoxybenzoic acid < benzoic acid < 4-nitrobenzoic acid < 3, 4-dinitrobenzoic acid.

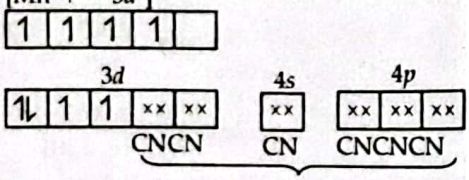
20. (i) $[Mn(CN)_6]^{3-}$

Type of hybridisation = d^2sp^3 hybridisation

Magnetic behaviour = Paramagnetic, as two unpaired electrons are present.

Spin only magnetic moment = Spin only magnetic moment (μ) = $\sqrt{2(2+2)} = \sqrt{8}$ = 2.82 BM.

$[Mn^{3+} = 3d^4]$



$[Co(NH_3)_6]^{3+}$

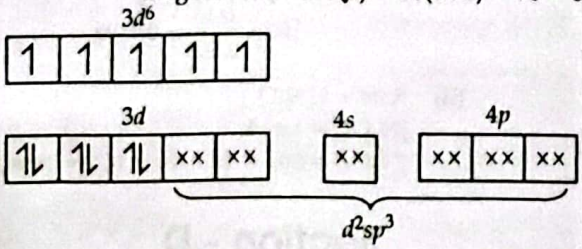
$[Co(NH_3)_6]^{3+}$

Type of hybridisation = d^2sp^3 hybridisation

Magnetic behaviour = Diamagnetic (as three paired electrons are present.)

Spin only magnetic moment = Spin only magnetic moment (μ) = $\sqrt{0(0+2)} = \sqrt{0} = 0$

$3d^6$



(ii) Aqueous solution of $K_4[Fe(CN)_6]$ ionises as:

$K_4[Fe(CN)_6] \rightleftharpoons 4K^+ + [Fe(CN)_6]^{4-}$

Fe^{2+} ion is not in free state, hence it does not give the test of Fe^{2+} ion.

[ISC Marking Scheme, 2016]

21. (a) $Al \rightarrow Al^{+3} + 3e] \times 2$

$Ni^{+2} + 2e \rightarrow Ni] \times 3$

$2Al + 3Ni^{+2} \rightarrow 2Al^{+3} + 3Ni \quad n = 6$

$E^0_{cell} = E^0_{Cathode} - E^0_{Anode}$

$\Rightarrow E^0_{cell} = 0.25 - (-1.66) = 1.41\ V$

$$E_{M^{n+}/M} = E^0_{cell} - \frac{0.0591}{6}\log\frac{[Al^{+3}]^2}{[Ni^{+2}]^3}$$

$$\therefore E^0_{M^{n+}/M} = 1.41 - \frac{0.0591}{6}\log\frac{(1\times10^{-3})^2}{(5\times10^{-1})^3}$$

$$= 1.41 - 0.00985\log\frac{10^{-6}}{125\times10^{-3}}$$

$= 1.41 - 0.00985 \quad (-\log 10^{-3} - \log 125)$

$= 1.41 + 0.0985 \times 5.0970$

$= 1.41 + 0.502 = 1.91$ volt.

(b) $2Fe^{3+}(aq) + 2I^-(aq) \rightarrow 2Fe^{2+}(aq) + I_2(s)$

For the given cell, n = 2

$\Delta_rG^\circ = -nFE^\circ cell$

$= -2 \times 96500 \times 0.236$

$= -45.55\ kJ\ mol^{-1}$

Also, $\Delta_rG^\circ = -2.303\ RT \log K_C$

$\log K_C = \Delta_rG^\circ / 2.303RT$

$= -45.55 / 2.303 \times 8.314 \times 10^{-3} \times 298$

$= 7.983$

K_C = antilog (7983)

$= 9.616 \times 10^7$

Examiner's Comments

- Some students do not mention the formula or missed out on units.
  Also practice how to calculate E^0_{cell}.
- Some students got confused. Some made mistake in calculations.

Answering Tip

- Students must practice enough problems and calculations to avoid mistakes.
  Learn formula. Students must write correct formula and correct units to get full marks.

OR

(a) (i) Electrolyte X is a strong electrolyte and Y is a weak electrolyte.

(ii) Molar conductivity, Λ_m of X (strong electrolyte) increase slowly with dilution. This is because interionic forces of attraction decrease on dilution, although the number of ions remain the same. As, a result ions move more freely and hence Λ_m increase with dilution.

(iii) On the other hand, for Y (weak electrolyte) Λ_m increases sharply with dilution. This is because, degree of dissociation increase on dilution resulting in greater number of ions on dilution. Hence Λ_m increase.

(b) $\Lambda^\circ m_{(HAc)} = \Lambda^\circ_{H^+} + \Lambda^\circ_{Ac^-}$

$= \Delta^\circ CH_3COOH = \Lambda^\circ H + + \Delta^\circ CH_3COO-$

$= 349.6\ S\ cm^2\ mol^{-1} + 40.9\ S\ cm^2\ mol^{-1}$

$= 390.5\ S\ cm^2\ mol^{-1}$

$$\alpha = \frac{\Lambda_m}{\Lambda^0_m} = \frac{39.05\ cm^2\ mol^{-1}}{390.05\ cm^2\ mol^{-1}} = 0.1$$

□□