Sample Question Paper-4

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) Ethyl isocyanide, on hydrolysis with dilute sulphuric acid gives ..... and ..... (formic acid/ acetic acid/ethylamine)

(ii) In coordination complexes, the central metal atom or ion behaves as ..... and the ligands behave as ..... (Coordination compounds/Lewis base/Lewis acid/double salts)

(iii) Haloalkanes undergoes_____ reaction

(iv) Aromatic ether is prepared by heating ..... with .....(Aliphatic halide/ alkyl halide/aromatic oxide/aryl halide)

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

(i) For a spontaneous reaction $\Delta G°$ and $\Delta E°$ cell will be respectively:
(A) −ve and +ve **(B)** +ve and −ve **(C)** +ve and +ve **(D)** −ve and −ve

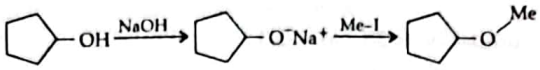
(ii) Which of the following pairs represents linkage isomers ?
(A) $[Pd(PPh_3)_2(NCS)_2]$ and $[Pd(PPh_3)_2(SCN)_2]$
(B) $[Co(NH_3)_5NO_3]SO_4$ and $[Co(NH_3)_5SO_4]NO_3$
(C) $[PtCl_2(NH_3)_4]Br_2$ and $[Pt\ Br_2(NH_3)_4]Cl_2$
(D) $[Cu(NH_3)_4[PtCl_4]$ and $[Pd(PPh_3)_2(SCN)_2]$

(iii) The actinoids show more oxidation states in general than the lanthanoids as:
(A) the 5*f* orbitals are more buried than 4*f* orbitals.
(B) there is similarity between 4*f* and 5*f* orbitals in their angular part of the wave function

(C) the actinoids are more reactive than the lanthanoids.

(D) the 5*f* orbitals extend further from the nucleus than the 4*f* orbitals

(iv) The reaction can be classified as:



(A) Williamson ether synthesis reaction (B) Alcohol formation reaction

(C) Dehydration reaction (D) Williamson alcohol synthesis reaction

(v) Which of the following will show negative deviation from Raoult's law?

(A) Water and ethanol (B) Water and hydrochloric acid

(C) Benzene and methanol (D) Acetic acid and toluene

(vi) **Assertion:** The negative sign in the expression $E_{Zn^{2+}/Zn} = -0.76$ V means Zn^{2+} cannot be oxidised to Zn. A I

Reason: Zn is more reactive than hydrogen and Zn will be oxidised and H^+ will get reduced.

(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 (A):** Solubility of amines in water decreases with increase in molar mass.

Reason (R): Intermolecular H bonds formed by the higher amines are weaker.

(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 aqueous solution of a non-volatile solute freezes at 272.4 K, while pure water freezes at 273.0 K. Determine the following :

(Given $K_f = 1.86$ K kg mol^{-1}, $K_b = 0.512$ K kg mol^{-1} and vapour pressure of water at 298 K = 23.756 mm of Hg)

(i) The molality of solution.

(ii) Boiling point of solution.

(iii) The lowering of vapour pressure of water at 298 K.

Section - B

(20 Marks)

Question 2 [2]

How are the following conversions carried out ?

(i) Benzyl chloride to Benzyl alcohol

(ii) Anisole to p-Bromoanisole

Question 3 [2]

Complete the following equations:

(i) $Cr_2O_7^{2-} + 2OH^- \rightarrow$

(ii) $MnO_4^{2-} + 4H^+ + 3e^- \rightarrow$ A I

Question 4 [2]

Rearrange the compounds of each of the following sets in order of reactivity towards S_N2 displacement:

(i) 2-Bromo-2-methyl butane, 1-Bromopentane, 2-Bromopentane

(ii) 1-Bromo-2-methyl butane, 2-Bromo-2-methyl butane, 3-Bromo-2-methyl butane

Question 5 [2]

Explain the following:

(i) Why do transition metal ions possess a great tendency to form complexes?

(ii) The paramagnetic character in 3*d*-transition series elements increases upto Mn and then decreases. A I

Question 6 [2]

Write IUPAC name and hybridisation of the following complexes:

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

(ii) $[NiCl_4]^{2-}$

(Atomic number Ni = 28, Co = 27)

Question 7 [2]

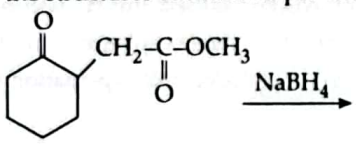
(i) (a) The E° values of MnO_4^-, Ce^{4+} and Cl_2 are 1.507, 1.61 and 1.358 V respectively. Arrange these in order of increasing strength as oxidising agent.

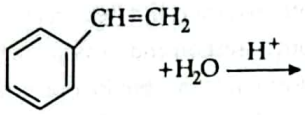
(b) E° values for Fe^{3+}/Fe^{2+} and Ag^+/Ag are respectively 0.771 V and 0.800 V. Is the reaction: $Fe^{3+} + Ag \rightarrow Fe^{2+} + Ag^+$ spontaneous or not?

(ii) How many coulombs are required to deposit 40.5 g of aluminium when the electrode reaction is : $Al^{3+} + 3e^- \rightarrow Al$

Question 8 [2]

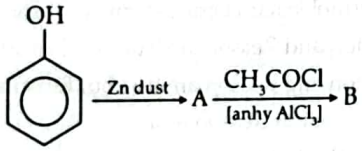
Write the structures of the main products in the following reactions:

(a) 

(b) 

OR

Identify the compounds A and B in the given reactions:



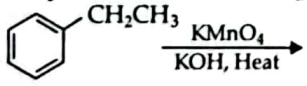
Question 9 [2]

3.9 g of benzoic acid dissolved in 49 g of benzene shows a depression in freezing point of 1.62 K. Calculate the van't Hoff factor and predict the nature of solute (associated or dissociated).

(**Given:** Molar mass of benzoic acid = 122 g mol^{-1}, K_f for benzene = 4.9 K kg mol^{-1})

Question 10 [2]

Write the product in the following reactions:

(i) 

(ii) $CH_3CH = CH - CN \xrightarrow[H_2O]{\text{(a) DIBAL-H}}$

Question 11 [2]

When MnO_2 fused with KOH in the presence of KNO_3 as an oxidising agent, it gives a dark green compound (A).

(i) Compound (A) disproportionated in an acidic solution to give a purple compound (B). Write the reaction.

(ii) Identify (A) and (B).

Section - C

(21 Marks)

Question 12 [3]

The concentration of a reactant R at different times are given below:

$t(s)$	[R] (mol L^{-1})	$t(c)$	[R] (mol L^{-1})
0	160×10^{-5}	5	80×10^{-5}
10	40×10^{-3}	20	10×10^{-3}
30	2.5×10^{-5}		

Calculate the average rate of reaction, R → P during different intervals of time.

Question 13 [3]

(i) Arrange the following compounds in a decreasing order of pK_b values with reason.
$C_2H_5NH_2$, $C_6H_5NHCH_3$, $(C_2H_5)_2NH$ and $C_6H_5NH_2$

(ii) Arrange the following compounds in an increasing order of basic strength with reason.
CH_3NH_2, $C_6H_5N(CH_3)_2$, $(C_2H_5)_2NH$ and $C_6H_5NH_2$

Question 14 [3]

(i) How will you bring about the conversion of Glucose to Saccharic acid ?

(ii) Write relevant equation to convert fructose to osazone.

(iii) What do you observe when glucose is treated with bromine water?

Question 15 [3]

(i) State Raoult's law for the solution containing volatile components. Write expression also.

(ii) What is the sign of Δ_{mix} H for positive deviation and negative deviation.

Question 16 [3]

Give balanced chemical equations for the following reactions:

(i) Wolf-Kishner reaction

(ii) Kolbe's electrolytic reaction

Question 17 [3]

(i) Explain the following observations:

(a) The boiling point of ethanol is higher than that of methoxymethane.

(b) Phenol is more acidic than ethanol

(c) *o*- and *p*-nitrophenols are more acidic than phenol.

OR

(ii) Write the reactions of Williamson synthesis of 2-ethoxy-3-methylpentane starting from ethanol and 3-methylpentanol.

Question 18 [3]

(i) A first order reaction takes 100 minutes for completion of 60% of the reaction. Find the time required when 90% of the reaction will be completed.

(ii) Mention any two factors that influence the rate of a chemical reaction.

Section - D

(15 Marks)

Question 19 [5]

(i) Give one chemical test for each to distinguish between the following pair of compounds:

(a) Formaldehyde and acetic acid

(b) Acetaldehyde and acetone

(c) Methanal and ethanal [3]

(ii) An organic compound A has the molecular formula C_7H_6O. When A is treated with NaOH followed by acid hydrolysis, it gives two products B and C. When B is oxidised, it gives A, when A is treated with PCl_5, it gives D. Identity A, B, C and D. [2]

Question 20 [5]

(i) Define crystal field splitting energy? State the energy level of t_{2g} and eg orbitals in tetrahedral complexes. Write the electronic configuration of d_4 in terms of eg and t_{2g} in an octahedral field, on the basis of crystal field theory, when $\Delta_0 < P$ and $\Delta_0 > P$. [3]

(ii) Name a chromium coordination compound which gives white ppt with barium chloride solution. Justify your answer with chemical equation? [2]

Question 21 [5]

(a) Resistance of a conductivity cell filled with 0.1 M KCl solution is 100 W. If the resistance of the same cell when filled with 0.02 M KCl solution is 520 W, calculate the conductivity and molar conductivity of 0.02 M KCl solution.
(The conductivity of 0.1 M KCl solution is 1.29 S m^{-1}.) [3]

(b) A 0.005 M NaOH solution offered a resistance of 31.6 Ω in a conductivity cell. If the cell constant of the conductivity cell is 0.378 cm^{-1}, determine the molar conductivity of sodium hydroxide solution at this temperature. [2]

OR

(a) Define Kohlrausch law and give its mathematical expression mentioning the terms involved in it.

(b) 0.3605 g of a metal is deposited on the electrode by passing 1.2 amperes of current for 15 minutes through its salt solution. The atomic weight of the metal is 96u. What is the valency of the metal?

ANSWERS

Sample Question Paper-4

CHEMISTRY (862)

Section - A

1. **(A)** **(i)** ethylamine, formic acid

(ii) Lewis acid, Lewis base

(iii) Nucleophilic reaction

(iv) aromatic oxide, alkyl halide

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

Explanation: For a spontaneous reaction, value of G is always negative and value of E is always positive.

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

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

Explanation: Actinides have almost similar energy and have more contraction due to poor shielding effect of 5f orbital.

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

Explanation: The given reaction is an example of Williamson ether synthesis reaction is which sodium alkoxide reacts with alkyl halide and gives ether.

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

Explanation: Negative deviation from Raoult's law is as pure components have greater forces of attraction than the solution. For example water and hydrochloric acid.

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

Explanation: It shows that the reduced form of (Zn) is not stable. It is difficult to reduce Zn^{2+} to Zn. Rather the reverse reaction, *i.e.*, Zn can get oxidised to Zn^{2+} and H^+ will get reduced as it is stabler among both the reduced species.

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

Explanation: Lower aliphatic amines are soluble in water because they can form hydrogen bonds with water molecules. However, solubility decreases with increase in molar mass of amines due to increase in size of the hydrophobic alkyl part.

(C) **(i)** The molality of solution:

$$\Delta T_f = K_f m$$

$$\Delta T_f = T_o - T_s$$

$$= 273.0 - 272.4 = 0.6 \text{ K}$$

$$\therefore \quad m = \frac{0.6}{1.86} = 0.3225 \text{ m} \quad 1$$

(ii) Boiling point of solution:

$$\Delta T_b = K_b m$$

$$= 0.512 \times 0.3225$$

$$\Delta Tb = 0.165 \text{ K}$$

$$T_s = T_o + \Delta T_b$$

$$= 373 + 0.165$$

$$= 373.165 \text{ K or } 100.165^\circ \text{ C} \quad 1$$

(iii) The lowering of vapour pressure of water at 298 K:

$$\frac{P_o - P_s}{P_o} = \frac{n}{N}$$

$$\text{or} \quad \frac{P_o - P_s}{P_o} = \frac{w}{m} \times \frac{M}{W}$$

$$\text{or} \quad \frac{P_o - P_s}{23.756} = \frac{0.3225}{1000} \times 18$$

$$\therefore \quad P_o - P_s = \frac{23.756 \times 0.3225 \times 18}{1000}$$

$(P_o - P_s)$ or $\Delta P = 0.1379$ mm of Hg 1

Examiner's Comment

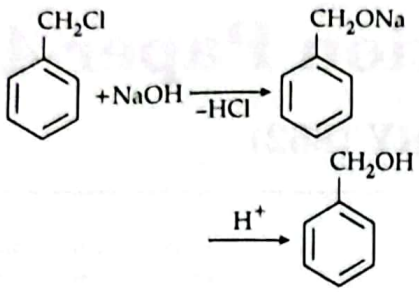
- Some students found it difficult to follow correct steps to calculate.
- Some did not use correct unit.

Answering Tip

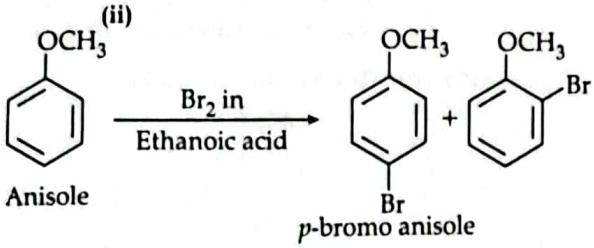
- Students must practice many numericals with different formulae.

Section - B

2. (i)



(ii)



Anisole

p-bromo anisole

3. (i) $Cr_2O_7^{2-} + 2OH^- \rightarrow 2CrO_4^{2-} + H_2O$

(ii) $MnO_4^{2-} + 4H^+ + 3e^- \rightarrow MnO_2 + 2H_2O$ 2

4. (i) 1-Bromopentane > 2-Bromopentane > 2-Bromo-2-methyl butane.

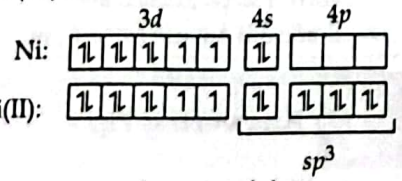
(ii) 1-Bromo-2-methyl butane > 3-Bromo-2-methyl butane > 2-Bromo-2-methyl butane. 2

5. (i) Due to small size, high nuclear charge, availability of vacant *d*-orbitals of suitable energy to accommodate lone pairs of electrons donated by the ligands.

(ii) On moving from Sc to Mn, the number of unpaired electrons increases and hence paramagnetic character increases. But after Mn, the pairing of electrons in the *d*-subshell starts and the number of unpaired electrons and hence paramagnetic character decreases. 2

6. (i) $[Co(NH_3)_6]^{3+}$: Hexaamminecobalt (III)
Hybridisation: d^2sp^3
Co: $(Ar)3d^74s^2$

(ii) $[NiCl_4]^{2-}$: Tetrachloronickelate (II)
Hybridisation: sp^3
Ni: $(Ar)3d^84s^2$



four pairs of electrons from four Cl^- ions 2

Examiner's Comment

- Some students did not write correct formula.
- Some students got confused in calculating hybridisation.

Answering Tips

- Students to learn the rules for nomenclature of coordination compounds and give adequate practice.
- Also focus on the method of determining the type of hybridisation, magnetic behaviour and oxidation state by using valence bond theory.

7. (i) (a) $Cl_2 < MnO_4^- < Ce^{4+}$.

(b) $E^\circ = 0.771 - 0.800$
$= -0.029$ V.
Therefore, the reaction is not spontaneous 2

(ii) 1 mole of Al requires 3 mol of electrons = 3×96500 C
1 mol of Al = 27g
27g of Al required = 3×96500 C
40.5 g of Al required = $\frac{3 \times 96500 \times 40.5}{27}$
$= 434250$C 2

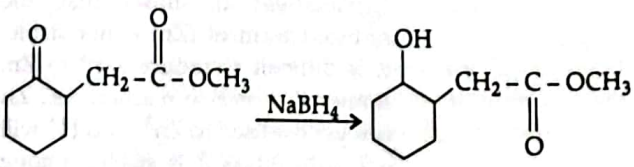
Examiner's Comment

- Students must focus on the formula of calculating E^0 of the cell as which one is anode and which one is cathode.

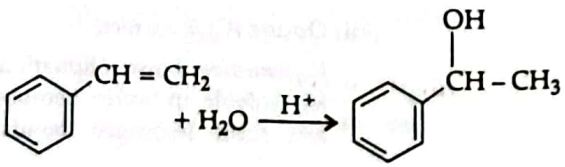
Answering Tip

- Learn chemical formula and the chemical equation.

8. (a)



(b)



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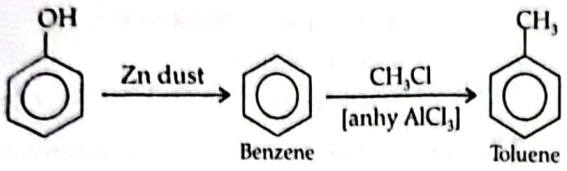


2

9. $$\Delta T_f = iK_f \times \frac{w_B \times 1000}{m_B \times w_A}$$

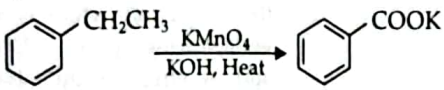
$$1.62 = i \times 4.9 \times \frac{3.9}{122} \times \frac{1000}{49}$$

$$i = \frac{1.62 \times 122 \times 49}{4.9 \times 3.9 \times 1000}$$

$$i = \frac{9684.36}{19110} = 0.506$$

As $i < 1$, therefore solute gets associated. 2

10. (i)



Potassium benzoate

(ii) $CH_3CH = CH - CN \xrightarrow[(b)\,H_2O]{(a)\,DIBAL-H}$

$CH_3CH - CH - CHO$

Examiner's Comment

- Students do not write reactions completely.

Answering Tip

- Students must practice writing reactions to get correct answers.

11. (i) $MnO_2 \xrightarrow[KNO_3]{KOH} K_2MnO_4 \xrightarrow{H^+}$

(A)
Green
$KMnO_4 + MnO_2$
(B)
purple

$3MnO_4^{2-} + 4H^+ \longrightarrow 2KMnO_4^- + MnO_2 + 2H_2O$

(B)
purple

(ii) A is potassium manganate
B is $KMnO_4$ /MnO_4^{2-} 2

Section - C

12. The average rate of reaction can be calculated as :

$$r_{av} = -\frac{[R]_2 - [R]_1}{\Delta t}$$

$[R_1]$	$[R_2]$	t_1	t_2	r_{av} (mol L^{-1} s^{-1})
160	80	0	5	$-\frac{(80-160)\times 10^{-3}}{5-0} = 16 \times 10^{-3}$
80	40	5	10	$-\frac{(40-80)\times 10^{-3}}{10-5} = 8 \times 10^{-3}$
40	10	10	20	$-\frac{(10-40)\times 10^{-3}}{10} = 3 \times 10^{-3}$
10	2.5	20	20	$-\frac{(2.5-10)\times 10^{-3}}{30-20} = 0.75 \times 10^{-3}$

It can be seen that the average rate decreases from 16×10^{-3} to 0.75×10^{-3} mol L^{-1} s^{-1} during the time interval 0 to 30 s. 3

13. (i) Alkyl groups has +I effect and aryl group has –R effect and also involves de localisation of lone pairs. $(C_2H_5)_2NH$ will be more basic than $C_2H_5NH_2$ as it contains two alkyl groups. So, order of increasing basic strength is as follows:

$C_6H_5NH_2 < C_6H_5NHCH_3 < C_2H_5NH_2 < (C_2H_5)_2NH$

Higher is the basic strength, lower is the pK_b value, i.e.,

$$pK_b \alpha \frac{1}{\text{Basic strength}}$$

So, decreasing order of pK_b is:

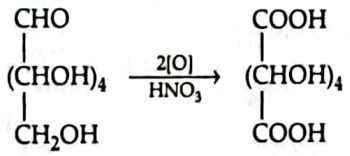
$C_6H_5NH_2 > C_6H_5NHCH_3 > C_2H_5NH_2 > (C_2H_5)_2NH$

(ii) $-C_6H_5$ group has –R effect and $-CH_3$ group has +I effect. Since $(C_2H_5)_2NH$ has alkyl groups, so $(C_2H_5)_2NH$ has maximum basicity. But as $C_6H_5N(CH_3)_2$ has two alkyl groups, so it will more basic than $C_6H_5NH_2$.

So, overall increasing order of basic strength is:

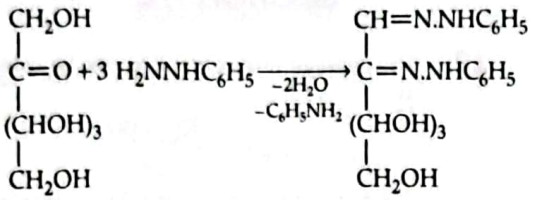
$C_6H_5NH_2 < C_6H_5N(CH_3)_2 < CH_3NH_2 < (C_2H_5)_2NH$ 3

14. (i)



Glucose Saccharic acid

(ii)



Fructose Fructosazone

(iii) Decolourises bromine water. (Red colour of bromine water disappears.)

$$CH_2OH(CHOH)_4CHO \xrightarrow[\Delta]{Br_2/H_2O} CH_2OH(CHOH)_4COOH$$

(glucose) (gluconic acid)

Examiner's Comment

- Some students made error in writing formulae.

Answering Tip

- Write formulae, remember how many carbon atoms are there.

15. (i) Raoult's law states that for a solution of volatile liquids, the partial vapour pressure of each component in solution is equal to the product of the vapour pressure of the pure component and its mole fraction. For a binary solution of two components A and B,

$P_A = P_A^\circ \times X_A$

$P_B = P_B^\circ \times X_B$

(ii) For positive deviation from Raoult's law.

$P_{total} > P^\circ_A X_A + P^\circ_B X_B$

$\Delta_{mix}H$ has positive sign.

For negative deviation from Raoult's law.

$P_{total} < P^\circ_A X_A + P^\circ_B X_B$

$\Delta_{mix}H$ has negative sign. 3

16. (i) Wolf-Kishner reaction:

$$CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{C}}=O \xrightarrow{(i)\ NH_2NH_2} \underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{C}}=N-NH_2 \xrightarrow[\text{Glycol}]{(i)\ KOH} \underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{CH}}-CH_3 + N_2$$

Propane

(ii) Kolbe's electrolytic reaction:

$2CH_3COOK \rightarrow 2CH_3COO^- + 2K^+$

at anode: $2CH_3 + 2CO_2$

at cathode: $H_2 + 2H_2O \rightarrow 2H^+ + 2OH^-$ 3

17. (i) (a) Due to presence of intermolecular H-bonding, associated molecules are formed. Thus, ethanol has high boiling point while methoxymethane does not have intermolecular H-bonding.

(b) Phenol on losing H^+ ion forms phenoxide ion, and ethanol on losing H^+ ion forms ethoxide ion. Therefore, Phenoxide ion is more stable than ethoxide ion as phenoxide ion exists in resonance structure.

Due to this phenol is more acidic than ethanol.

(c) Both *o*- and *p*-nitrophenols contain the NO_2 group which is an electron withdrawing group. Due to –R and –I effect of the $-NO_2$ group, electron density in the – OH bond of substituted phenol decreases and hence the loss of proton becomes easy and therefore more acidic.

OR

(ii) (a)

$$2CH_3-CH_2-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{CH}}-\underset{\displaystyle CH_3}{\overset{\displaystyle OH}{CH}}-OH + 2Na \rightarrow 2CH_3-CH_2-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{CH}}-\underset{\displaystyle CH_3}{\overset{\displaystyle O^-Na^+}{CH}}-O^-Na^+ + H_2$$

3-Methylpentan-2-ol

Sodium-3-methyl pentan-2-oxide

(b)

$$CH_3-CH_2-OH + HBr \xrightarrow{\Delta} CH_3-CH_2-Br + H_2O$$

Bromoethane

(c)

$$CH_3-CH_2-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{CH}}-\underset{\displaystyle CH_3}{\overset{\displaystyle ONa}{CH}}-ONa + CH_3-CH_2-Br \rightarrow$$

(A) (B)

$$CH_3-CH_2-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{CH}}-\underset{\displaystyle CH_3}{\overset{\displaystyle O-CH_2-CH_3}{CH}} + NaBr$$

2-ethoxy-3-methyl pentane

Examiner's Comment

- Some students wrote wrong reactions.

Answering Tip

There are few important reactions, like the one given here, students must thoroughly practice them.

18. (i) According to the first order reaction

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

$t = 100$ min

Initial concentration (a) = 100

If the reaction is 60% completed in 100 min

Final concentration $(a - x) = 100 - 60 = 40$

Putting the values in equation

$$k = \frac{2.303}{100}\log\frac{100}{40}$$

$k = 0.00916\ s^{-1}$

If the reaction is 90% completed in time t min

Final concentration $(a - x) = 100 - 90 = 10$

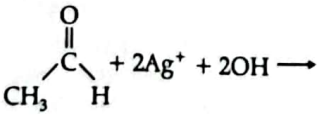
$$t = \frac{2.303}{0.00916}\log\frac{100}{10}\ t = 251.4 \text{ mins}$$

(ii) The two factors that affect the rate of a chemical reaction are:

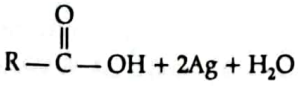
1. **Concentration of reactant:** Increase in the concentration of reactant increases the rate of reaction
2. **Temperature:** As the temperature increases, the rate of chemical reaction also increases.

Section - D

19. (i) (a) Formaldehyde gives silver mirror when heated with Tollen's reagent whereas acetic acid does not give this test.

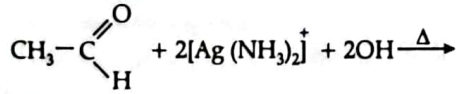


$$CH_3-\overset{\overset{O}{\|}}{C}-H + 2Ag^+ + 2OH \longrightarrow$$



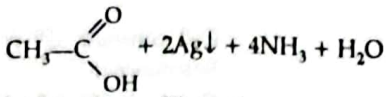
$$R-\overset{\overset{O}{\|}}{C}-OH + 2Ag + H_2O$$

(b) Acetaldehyde when reacts with Tollens reagent gives silver mirror test which acetone doesn't given silver mirror test.



$$CH_3-\overset{\overset{O}{\|}}{C}-H + 2[Ag(NH_3)_2]^+ + 2OH \xrightarrow{\Delta}$$

Acetaldehyde Tollen's reagent



$$CH_3-\overset{\overset{O}{\|}}{C}-OH + 2Ag\downarrow + 4NH_3 + H_2O$$

Acetic acid Silver mirror

(c) Ethanal when heated with I_2 and NaOH gives a yellow ppt. of iodoform whereas methanal shows no reaction due to absence of CH_3CO (Methyl ketone) group.

$$CH_3CHO + 3I_2 + 4NaOH \longrightarrow \underset{\text{Iodoform (yellow ppt.)}}{CHI_3\downarrow} + HCOONa + 3NaI + 3H_2O$$

$HCHO + 3I_2 + 4NaOH \longrightarrow$ No reaction

(ii) (a) $C_6H_5CHO + NaOH \longrightarrow$

$$\underset{A}{C_6H_5CHO} \longrightarrow \underset{B}{C_6H_5CH_2OH} + \underset{C}{C_6H_5COOH}$$

(b) $C_6H_5CHO + PCl_5 \longrightarrow C_6H_5COCl$

A D

(c) $C_6H_5CH_2OH + MnO_2 \longrightarrow$

B

C_6H_5CHO

A

(B on oxidation with MnO_2 gives A)

A : C_6H_5CHO — benzaldehyde

B : $C_6H_5CH_2OH$ — benzyl alcohol

C : C_6H_5COOH — Benzoic acid

D : C_6H_5COCl — Benzoyl chloride

20. (i) The energy difference between t_{2g} and e_g level is designated by triangle and is called crystal field splitting energy. (Δ_0) e_g orbitals have higher energy in octahedral and lower energy in tetrahedral complexes. While t_{2g} orbitals have high energy in tetrahedral complexes.

Electrons in t_{2g} orbitals are initially singly filled and then undergo pairing as per CFST and pairing energy. This pairing energy(p) can be greater or smaller than CFSE.

When $\Delta_0 < P$, the configuration will be t^3_{2g} e_g^1 and in this case high spin complex will be formed by weak field ligand.

When $\Delta_0 > P$, the configuration will be t_{2g}^4 e_g^0 and in this case strong field ligands with low spin complex will be formed.

(ii) $[Cr(H_2O)_5Br]SO_4$

It dissociates in aqueous solution to give sulphate ions. These sulphate ions react with barium chloride to give white ppt of barium sulphate.

$$[Cr(H_2O)_5Br]SO_4 \longrightarrow [Cr(H_2O)_5Br]^{2+} + SO_4^{2-}$$

$$SO_4^{2-} + BaCl_2 \longrightarrow BaSO_4 + 2Cl^-$$

21. (a) **Step I :** Let us first calculate the cell constant.

Cell constant, G^* = Conductivity (κ) × Resistance (R)

Conductivity of 0.1 M KCl solution = 1.29 S m^{-1}

$\therefore$ Cell constant = 1.29 S m^{-1} × 100 Ω

= 129 m^{-1}

or = 1.29 cm^{-1}

Step II : Calculation of conductivity of 0.02 M KCl solution.

Resistance of solution = 520 Ω

Cell constant (G^*) = 1.29 cm^{-1}

$$\text{Conductivity, } \kappa = \frac{\text{Cell constant}}{\text{Resistance}}$$

$$= \frac{1.29\ cm^{-1}}{520\ \Omega}$$

$$= 0.248 \times 10^{-2}\ cm^{-1}$$

Step III : Calculation of molar conductivity.

$$\Lambda_m = \frac{1000 \times \kappa}{C}$$

C = 0.02 M, $\kappa = 0.248 \times 10^{-2}$ S cm^{-1}

$$\therefore \quad \Lambda_m = \frac{1000 \times 0.248 \times 10^{-2}}{0.02}$$

$$= 124\ S\ cm^2\ mol^{-1}$$

(b) Concentration, C = 0.05 M, R = 31.6 Ω

G = 0.378 cm^{-1}

Molar conductance,

$$\Lambda_m = \frac{1000 \times \text{Cell constant}}{M \times R}$$

$$= \frac{1000 \times 0.378}{0.05 \times 31.6}$$

$$= 239.24\ ohm^{-1}\ cm^2\ mol^{-1}$$

OR

(a) According to Kohlrausch's law, limiting molar conductivity of an electrolyte, at infinite dilution, can be expressed as the sum of contributions from its individual ions. If the molar conductivity of the cations is denoted by λ_+^∞ and that of the anions by λ_-^∞ then the law of independent migration of ions is

$\Lambda_m^\infty = v_+\lambda_+^\infty + v_-\lambda_-^\infty$ or $\Lambda^\circ = v_+\lambda_+^\circ + v_-\lambda_-^\circ$

where, v_+ and v_- are the number of cations and anions per formula of electrolyte respectively.

(b)
$$W = \frac{E_{g\ wt}/i \times t}{96500}$$

$$\therefore \quad E_{g\ wt} = \frac{96500 \times 0.3605}{1.2 \times 15 \times 60} = 32.21$$

$$\therefore \quad \text{Valency} = \frac{96}{32.21} = 2.98 \approx 3$$

[ISC Marking Scheme, 2014]

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