Sample Question Paper-1

(Specimen Paper 2024 issued by CISCE in July 2023)

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]**
[Decreases, CN^- ion, activation energy, catalyst, two, Fe^{2+} ion, carbon, lattice energy, enzyme, five, double, halogen, triple, increases]

(i) In the Haber process, iron changes the _____ of reaction while molybdenum increases the efficiency of the _____.

(ii) The number of ions that will be produced when potassium Ferro cyanide, $K_4[Fe(CN)_6]$, dissolves in water is _____. This shows that _____ is the ligand in the coordination compound.

(iii) Haloalkenes undergo both nucleophilic and electrophilic reactions due to the presence of _____bond and the _____ atom.

(iv) In case of alcohols, as the carbon chain length increases, the boiling point _____ and the solubility in water_____.

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

(i) A potassium iodide (KI) solution containing starch turns blue on the addition of chlorine. Which one of the following statements explain this?
(P) The reduction potential of Cl_2 is more than that of I_2.
(Q) The oxidation potential of Cl_2 is more than that of I_2.
(R) The product formed when Cl_2 combines with starch is blue.
(S) The product formed when I_2 combines with starch is blue.
(a) Only P and R **(b)** Only Q and R **(c)** Only Q and S **(d)** Only P and S

(ii) Crystal field splitting energy (CFSE) for high spin d^4 octahedral complex is:
(a) $-1.6\ \Delta_o$ **(b)** $-1.2\ \Delta_o$ **(c)** $-0.8\ \Delta_o$ **(d)** $-0.6\ \Delta_o$

(iii) Acidified $K_2Cr_2O_7$ solution turns green when Na_2SO_3 is added to it. This is due to formation of:
(a) CrO_4^{2-} **(b)** $Cr_2(SO_3)_3$ **(c)** Cr_2O_3 **(d)** $Cr_2(SO_4)_3$

(iv) Which of the following product is formed when benzene diazonium chloride is reduced by hypo phosphorous acid (H_3PO_2) in the presence of cuprous ion as catalyst?
(a) Phenol (b) Aniline (c) Benzene (d) Benzene cyanide

(v) Which of the following aqueous solution has lowest vapour pressure?
(a) 1M NaCl (b) 1M K_2SO_4 (c) 1M Glucose (d) 1M Sucrose

(vi) **Assertion:** Adding water to two beakers 'A' and 'B' containing NaOH and CH_3COOH solutions respectively will increase the molar conductance (Λ_m) of the solutions sharply in beaker 'A' and slowly in beaker 'B'.
Reason: Molar conductance (Λ_m) increases with a decrease in concentration or upon dilution.
(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 is soluble in HCl while it is only slightly soluble in water.
Reason: Aniline cannot make hydrogen bonds with water but gets protonated easily by acids.
(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]
During the winter season in a particular year, Kashmir experienced heavy snowfall. It was an unexpected snowfall. Thousands of visitors were stranded because it was dangerous to travel on snowy roads and vehicles could not move as water froze in the car radiators. In such conditions officials decided to sprinkle rock salt or $CaCl_2$ on roads.
(i) Why was it decided to sprinkle rock salt or $CaCl_2$ on the roads?
(ii) A mixture of ethylene glycol and water is used as coolant in car radiators. Why?
(iii) How many grams of ethylene glycol (mol. wt. = 62 g mol^{-1}) should be added to 10 kg of water so that the solution freezes at –10°C?
(K_f for water = 1.86 K kg mol^{-1})

Section - B (20 Marks)

Question 2 [2]
(i) Arrange the following alcohols in order of decreasing activity towards Lucas' reagent.
2–butanol, 2–methyl–2–propanol and 1–butanol
(ii) Ethanol has a higher boiling point than methoxymethane. Justify the statement.

Question 3 [2]
Give a reason for each of the following:
(i) The size of the trivalent cations in Lanthanoid series decreases steadily as the atomic number increases.
(ii) The third ionization energy of manganese (Z = 25) is unexpectedly high.

Question 4 [2]
Give balanced chemical equations to convert the following:
(i) Benzene to biphenyl
(ii) Propene to propane –1–ol

Question 5 [2]
Account for the following:
(i) Salts of cuprous (Cu^+) ion are colourless whereas the salts of cupric (Cu^{2+}) ion are coloured.
(ii) Zinc is not regarded as a transition element. (at. no. of Zn = 30)

Question 6 [2]
Two compounds, D–2–chlorobutane and L–2–chlorobutane, are enantiomers of each other.
Name one physical property that is:
(i) Same for D–2–chlorobutane and L–2–chlorobutane.
(ii) Different for D–2–chlorobutane and L–2–chlorobutane.

Question 7 [2]
(i) A rusted piece of iron undergoes electrochemical reactions. Write the chemical reaction taking place at:
(a) The electrode that behaves as an anode.
(b) The electrode that behaves as a cathode.
(ii) Given that the standard reduction potential for Al^{3+}/Al = –1.66 V and $\frac{1}{2}\frac{I_2}{I^-}$ = 0.54V, what will be the standard potential of the cell made by using Al^{3+} and I^- ?

Question 8 [2]

(i) What happens when (write chemical reactions only)

(a) Diethyl ether is treated with phosphorous pentachloride.

(b) Ethyl alcohol is treated with methyl magnesium bromide.

OR

(ii) An organic compound [A] having molecular formula C_6H_6O gives a characteristic colour with aqueous $FeCl_3$ solution. [A] on treatment with CO_2 and NaOH at 400K under pressure gives [B] which on acidification gives compound [C]. [C] reacts with acetyl chloride to give [D] which is a popular pain killer.
Identify the compounds [A], [B], [C] and [D].

Question 9 [2]

John was making noodles in boiling water. When he added common salt (NaCl) to boiling water, the water stopped boiling for a short while. If John had added 15.0 g of NaCl to 250.0g of water, calculate the boiling point of solution assuming that NaCl dissociates completely in water.
(K_b for water = 0.512 K kg mol^{-1}, molecular mass of NaCl = 58.44 g mol^{-1}).

Question 10 [2]

(i) Aromatic aldehydes do not give a reddish–brown precipitate on heating with Fehling solution. Give a reason.

(ii) Why is benzaldehyde less reactive to electrophilic substitution reactions than benzene?

Question 11 [2]

(i) Give a reason to explain why transition metals can act as a good catalyst.

(ii) Scandium (Z = 21) does not exhibit variable oxidation states and yet it is regarded as transition element. Why?

Section - C

(21 Marks)

Question 12 [3]

The data in the table given below was obtained in a series of experiments on the rate of the reaction between compounds [A] and [B] at a constant temperature:

Experiment	The initial concentration of [A] mol dm^{-3}	The initial concentration of [B] mol dm^{-3}	Initial rate mol dm^{-3} s^{-1}
1	0.15	0.30	1.10×10^{-4}
2	0.30	0.30	4.40×10^{-4}
3	0.60	0.15	8.80×10^{-4}

Show how this data can be used to deduce the rate expression for the reaction between [A] and [B].

Question 13 [3]

Arrange the following compounds:
$C_6H_5NH_2$, $(C_2H_5)_2NH$, $(C_2H_5)_3N$, $C_2H_5NH_2$.

(i) In the increasing order of their basic strength in water.

(ii) In a decreasing order of their basic strength in gas phase.

Question 14 [3]

(i) What products are obtained when sucrose is subjected to acid hydrolysis?

(ii) Why are Vitamin B and Vitamin C essential for us?

(iii) On being heated, egg white becomes solid and opaque. Give a reason.

Question 15 [3]

Water vapour and liquid water are in equilibrium in a container. At room temperature, the vapour pressure of water is 25 mm of Hg. The volume of water is V ml.

(i) What will be the vapour pressure of water if the volume of water is reduced to V/4 ml without any change in temperature? Give a reason.

(ii) Will there be a change in vapour pressure if more water (at room temperature) is added to the container? Give a reason.

Question 16 [3]

Identify the compounds [A], [B] and [C].

(i) $C_6H_5COOH \xrightarrow{PCl_5} [A] \xrightarrow{+H_2,Pd/BaSO_4} [B] \xrightarrow{KCN(alc),distil} [C]$

(ii) $H\text{-}C \equiv C\text{-}H + H_2O \xrightarrow{Hg^{2+}/H_2SO_4} [A] \xrightarrow[K_2Cr_2O_7/H_2SO_4]{[Oxidation]} [B] \xrightarrow[(ii)dry\ distillation]{(i)Ca(OH)_2} [C]$

Question 17 [3]

(i) How will the following be obtained? (Give chemical equation)

(a) Picric acid from phenol (b) Ethyl acetate from ethanol

(c) Anisole from sodium phenoxide

OR

(ii) Explain the mechanism of acid catalysed dehydration of ethanol to yield the corresponding alkene.

Question 18 [3]

(i) The half-life period ($t_{1/2}$) for decay of radioactive ^{14}C is 5730 years. An ancient piece of wood has only 80% of the ^{14}C found in a living tree. Calculate the age of the piece of wood.

(ii) The rate of most of the reactions becomes double when the temperature is raised from 298K to 308K. Calculate the activation energy. ($R = 8.314\ J\ K^{-1}\ mol^{-1}$)

Section - D

(15 Marks)

Question 19 [5]

(i) Give a reason for each of the following:

(a) Formaldehyde does not undergo aldol condensation, but acetaldehyde does.

(b) Chloroacetic acid is stronger acid than acetic acid.

(c) Both aldehydes and ketones undergo a number of nucleophilic addition reactions.

(ii) An organic compound with the molecular formula C_7H_6O gets oxidised by Tollens' reagent. It does not respond to Fehling test but can undergo the Cannizzaro reaction.
Identify the compound. Show how you used the above information to identify the compound.

Question 20 [5]

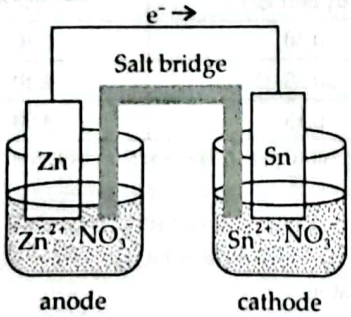
(i) When one mole of an isomer of the complex $[Cr(H_2O)_6]Cl_3$ is treated with $AgNO_3$, it produces 1 mole of a white precipitate of AgCl.
Write the formula of this isomer of the complex and show how the metal–ligand bonding differs in the isomers.

(ii) A coordination compound shows d^2sp^3 hybridisation. Identify the nature of ligand as weak or strong. What will be the geometry of the compound?

Question 21 [5]

(i)

(a) Calculate the value of E° cell and ΔG° that can be obtained from the following cell under the standard conditions at 25°C.



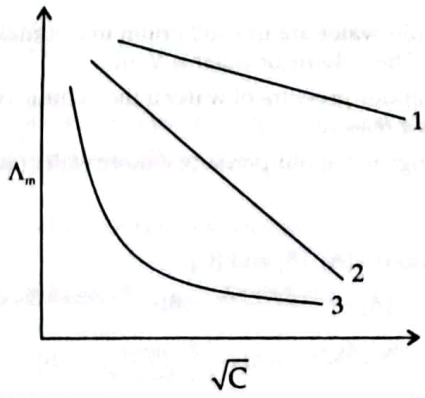
Given $E^0_{Zn^{2+}/Zn} = -0.76V$; $E^0_{Sn^{2+}/Sn} = -0.14V$

1 Faraday = 96500 C mol^{-1}

(b) How much electricity in Faraday is required for the complete reduction of MnO_4^- ions present in 500 ml of 0.5 M solution to Mn^{2+}?

OR

(ii) (a) The molar conductivity vs $\sqrt{C}$ curve for Na_2SO_4, H_2SO_4, and NH_4OH are shown below in random order.



Identify the curve that corresponds to Na_2SO_4, H_2SO_4, and NH_4OH. Justify your answer.

(b) The molar conductivity (Λ_m) of a dilute solution of methanoic acid is 34.1 S cm^2/mol. Calculate its degree of dissociation.
(Given $\lambda^0(H^+) = 349.6\ S\ cm^2/mol$ and $\lambda^0(HCOO^-) = 54.6\ S\ cm^2/mol$)

□□□

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ANSWERS

Sample Question Paper-1

CHEMISTRY (862)

Section - A

Answer 1.

(A) (i) Activation energy, catalyst

(ii) Five , CN^- ion

(iii) Carbon, halogen

(iv) Increases, decreases

(B) (i) Option (a) is correct.

(ii) Option (d) is correct.

Explanation:

$[-0.4 \times 3 + 0.6 \times 1]$

$[-1.2 + 0.6]$

$= -0.6\ \Delta_0$

(iii) Option (d) is correct.

$K_2Cr_2O_7 + 3Na_2SO_3 + 4\ H_2SO_4 \longrightarrow Cr_2(SO_4)_3 + K_2SO_4 + 3\ Na_2SO_4 + 4H_2O$

(iv) Option (c) is correct.

$C_6H_5\text{-}N_2^+\ Cl^- + H_3PO_2 + H_2O \rightarrow C_6H_6 + N_2 + H_3PO_3 + HCl$

(v) Option (d) is correct.

Explanation: The dissociation of the compound into ions is lowest in 1M sucrose. Hence, it has lowest vapour pressure.

(vi) Option (d) is correct.

Explanation: When solution is diluted, the total number of ions increases due to increase in the degree of dissociation.

On dilution of acetic acid molar conductivity increases sharply.

(vii) Option (a) is correct.

Explanation: Due to presence of hydrophobic group benzene, aniline does not undergo hydrogen bonding while in HCl the amine group easily gets protonated.

(C) (i) Rock salt helps in lowering the freezing point of water due to the colligative property freezing point depression. And thus, it makes difficult for water to freeze. 1

(ii) Ethylene glycol reduces the freezing point of water, thus the coolant in car radiators will not freeze. 1

(iii) $\Delta T_f = 0 - (-10) = 10^\circ C$

Mol.wt.of ethylene glycol (M_B) = 62 g/mol

Weight of water, $W_A = 10$ kg

K_f for water = 1.86 K kg/mol

$$W_B = 10 \times 62 \times \frac{10}{1.86}$$ 2

$$W_B = \frac{6200}{1.86} = 3333.3\ g$$

$= 3.33$ kg 1

Section - B

Answer 2.

(i) The order of reactivity towards Lucas reagent is:

Tertiary > secondary > primary

1– butanol is primary alcohol

2–butanol is secondary alcohol and 2–methyl, 2–propanol is tertiary alcohol.

Therefore, the decreasing order of reactivity for alcohols is: 1

2–methyl–2– propanol > 2–butanol > 1–butanol

(ii) Ethanol is alcohol while methoxymethane is an ether. Ethanol has –OH group (electronegative oxygen attached to hydrogen) that undergoes intermolecular hydrogen bonding. Methoxy methane being an ether does not contain –OH group. As intermolecular bonding is a strong bonding, it gives ethanol a higher boiling point. 1

Answer 3.

(i) The size of trivalent cations in lanthanide series like La^{3+}, Ce^{3+}, Pr^{3+} decreases due to:

- increasing nuclear charge and
- electrons enter into $(n-2)$ f orbitals.

As the atomic number increases there is poor shielding effect which results in higher effective nuclear charge. 1

(ii) Atomic number of Mn is 25 ($1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6 3d^5 4s^2$).

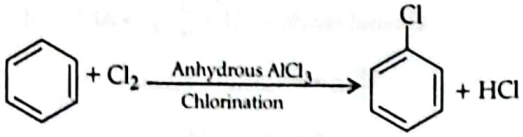
Loss of first two electrons from the manganese atom is easy as it leaves d–orbital half filled. ($[Ar]3d^5$, 5 unpaired electrons).

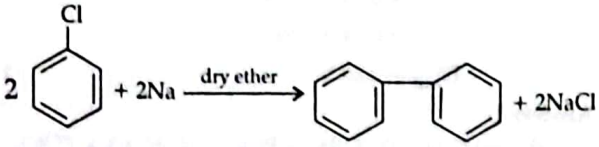
This makes Mn^{2+} ion stable.

Mn^{2+} is not ready to lose further electrons, which disturbs its stability, making third ionization energy very high. 1

Answer 4

(i) Benzene to biphenyl





(The reaction is Wurtz Fittig reaction.)

(ii) $CH_3-CH=CH_2 \xrightarrow{HBr/Peroxide}$ Propene

$CH_3-CH_2-CH_2-Br \xrightarrow{aq.\ KOH}$ 1-Bromopropane

$CH_3-CH_2-CH_2-OH \rightarrow$ Propane-1-ol

This is anti–Markownikoff's rule

Answer 5.

(i) Cu^+ ions have an electronic configuration $3d^{10}$. Thus making Cu^+ ion completely filled with no unpaired electrons. Hence, Cu^+ is colourless.

Cu^{2+} ions have an electronic configuration $3d^9$. There is presence of unpaired electrons, which impart colour to Cu^{2+} ions. 1

(ii) Transition elements have partly filled *d*– orbitals.

Zinc has an electronic configuration of $[Ar]3d^{10}4s^2$.

In excited state it loses two electrons, leaving the electronic configuration as $[Ar]3d^{10}$.

As its *d*–orbital is completely filled in ground state as well as in excited state zinc is not regarded as transition elements. 1

Answer 6.

(i) They have the same boiling point/melting point. 1

(ii) They have different optical rotation as they rotate the plane of polarized light in opposite direction equally. 1

Answer 7.

(i) (a) Pure iron acts as anode

At anode : $Fe \longrightarrow Fe^{2+}$

(b) Impure iron surface acts as cathode.

At cathode : $2H^+ + \frac{1}{2}O_2 + 2e^- \longrightarrow H_2O$ 1

(ii) $E^0_{\frac{Al^{3+}}{Al}} = -1.66V$

$E^0_{\frac{1}{2}\frac{I_2}{I^-}} = 0.54V$

At cathode : $\frac{1}{2}I_2 + e^- \rightarrow I^-$

At anode : $Al \rightarrow Al^{3+} + 3e^-$

Overall reaction: $Al + \frac{3}{2}I_2 \rightarrow Al^{3+} + 3I^-$

$E^o_{cell} = E^o_{cathode} - E^o_{anode}$

$= 0.54 - (-1.66)$

$= 0.54 + 1.66$

$E^0_{cell} = 2.20\ V$ 1

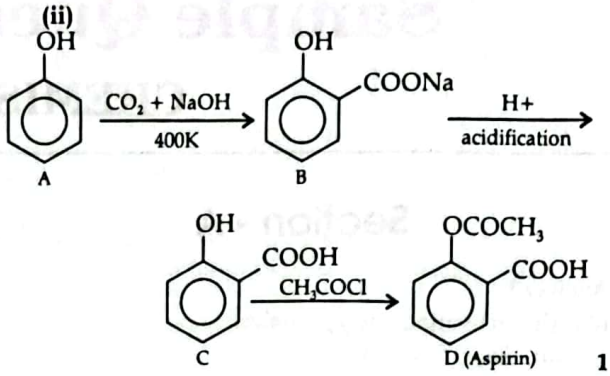
Answer 8.

(i) (a) $C_2H_5-O-C_2H_5 + PCl_5 \rightarrow 2C_2H_5Cl + POCl_3$ 1

(b) $CH_3MgBr + CH_3CH_2OH \rightarrow CH_4 + CH_3CH_2O^-Mg^+Br$ 1

OR

(ii)



1

Answer 9.

$NaCl \rightarrow Na^+ + Cl^-$

Given $i = 2$

$K_b = 0.512\ K\ kg\ mol^{-1}$

Molecular mass of NaCl = 58.44 g mol^{-1}

$\Delta T_b = iK_bm$

Molality(m) = moles of NaCl/kg water

$$= \frac{15}{58.44 \times 0.250}$$

$$\Delta T_b = \frac{2 \times 0.512 \times 1000 \times 15}{250 \times 58.44} = \frac{15360}{14610} = 1.05$$

Boiling point of solution = 100 + 1.05

= 101.05°C 2

Answer 10.

(i) Aldehydes that lack alpha hydrogen can not form enolate ion and thus do not give positive test with Fehling Solution.

In benzaldehyde the –CHO group is attached to benzene ring. Due to resonance C of carbonyl group acquires double bond and is difficult to break. 1

(ii) The C atom of carbonyl group of benzaldehyde is less electrophilic because due to resonance, the carbonyl carbon attached to benzene ring shows reduction in polarity, making it less reactive for electrophilic reactions. 1

Answer 11.

(i) Transition metals can take or give electrons easily from the reagent depending on the nature of the reaction.

- They have partially filled *d*–orbitals.
- They also form large number of oxidation states.
- They have the ability to form complexes with the reagents.

All this makes them good catalyst. 1

(ii) The electronic configuration of scandium is $([Ar]4s^2)3d^1$

- It loses 3 electrons to attain noble gas configuration and exhibit +3 oxidation state.
- It has partially filled *d*-orbital in the ground state. 1

Section - C

Answer 12

The conc. of reactant A is doubled and the reaction rate also increases by four times in experiment 1 and 2 So, it is second order reaction.

The concentration of reactant B is doubled and the reaction rate also is doubled, so it is first order reaction.

Knowing the reaction rate and concentration of reactant we can deduce the rate expression.

Rate = $[A]^2 [B]^1$ 3

Answer 13

(i) Increasing order of basic strength in water

$C_6H_5NH_2 < C_2H_5NH_2 < (C_2H_5)_3N < (C_2H_5)_2NH$

(ii) Decreasing order of their basic strength in gas phase.

$(C_2H_5)_3N > (C_2H_5)_2NH > C_2H_5NH_2 > C_6H_5NH_2$ 3

Answer 14.

(i) Glucose and fructose. 1

(ii) Vitamin B and C are water soluble.
They get excreted out of the body in the form of urine.
So, they need to be replenished on daily basis.
They are essential because they protect the body from different diseases.
Deficiency of Vitamin B causes Beri beri while deficiency of Vitamin C causes scurvy.(Bleeding of gums). 1

(iii) Due to denaturation of proteins. On being heated, egg white becomes solid and opaque.
As albumin gets denatured and coagulates. 1

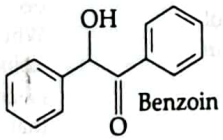
Answer 15.

(i) Vapour pressure will not change because it does not depend on volume. Vapour pressure depends on the nature of the liquid and the temperature. 1

(ii) When volume is increased the vapour pressure decreases. This is because on increasing the volume, there is no sudden increases in number of vapour substance. Therefore, the same number of particles get larger volume to occupy and thus decreases the vapour pressure. 1

Answer 16.

(i) $C_6H_5COOH \xrightarrow{PCl_5} C_6H_5COCl \xrightarrow{H_2\text{-}pd/BaSO_4} C_6H_5CHO$
(A) (B)

$2C_6H_5CHO \xrightarrow{KCN(Alc)/distil}$  Benzoin

$2H\text{-}C \equiv C\text{-}H + H_2O \xrightarrow{Hg^{2+}/H_2SO_4} 2CH_3CHO \xrightarrow[K_2Cr_2O_7/H_2SO_4]{Oxidation} 2CH_3COOH \xrightarrow[dry\ distillation]{Ca(OH)_2} CH_3COCH_3 + CaCO_3$ 3
(A) (B) (C)

Mechanism :

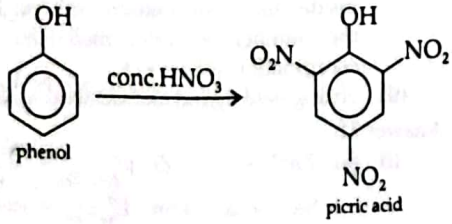
$CH \equiv CH + H_2O \xrightarrow[HgSO_4]{Hg^{2+}} CH_2 = CHOH \xrightarrow{rearrangement} CH_3\underset{H}{\overset{|}{C}} = O$ (A)

$\xrightarrow[H_2SO_4]{K_2Cr_2O_7} CH_3\text{-}\overset{O}{\overset{\|}{C}}\text{-}OH$ (B)

$2CH_3COOH \xrightarrow{Ca(OH)_2}$ acetic acid $\xrightarrow{dry\ distillation} CH_3CO\,CH_3 + CaCO_3$ acetone

CH_3COOH, CH_3COOH, Ca — calcium acetate (B) (C)

Answer 17.

(i) (a) 

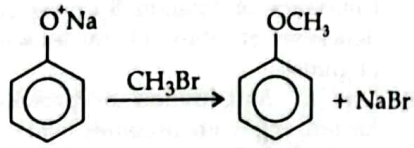
phenol — picric acid 1

(b) Ethyl acetate from ethanol

$$CH_3COOH + C_2H_5OH \xrightarrow{H^+} CH_3COOC_2H_5 + H_2O$$

Acetic acid Ethanol

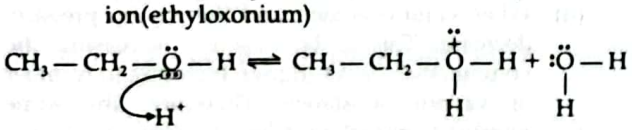
(An alcohol reacts with acetic acid to form ester. Thus, the reaction is known as esterification.) 1

(c) 

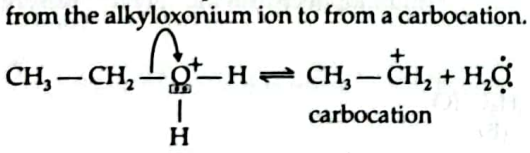
Sodium phenoxide Anisole 1

OR

(ii) In the first step the hydroxyl group in alcohol (ethanol) is protonated to form alkyloxonium ion(ethyloxonium)

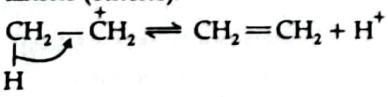


In the second step, a molecule of water is lost from the alkyloxonium ion to from a carbocation.



carbocation

In the third step water, a conjugate base of H_3O^+ removes β–hydrogen from cation to form alkene (ethene).



Answer 18

(i) $k = \frac{0.693}{t_{1/2}}$

$t_{1/2} = 5730$ yrs

$k = \frac{0.693}{5730}$

$k = 0.0001209$ /year

$k = 1.209 \times 10^{-4}$/years

$t = \frac{2.303}{k} \log \frac{N_0}{N}$

$t = \frac{2.303}{1.209 \times 10^{-4}} \log \frac{100}{80}$

$t = 1.9049 \times 10^4 \log \frac{100}{80}$,

$t = 0.184601 \times 10^4$

$t = 1846$ yrs (approx.) 1½

(ii) $k = Ae^{-E_a/RT}$

$$\log \frac{k_2}{k_1} = \frac{E_a}{2.303}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

Rate of reaction doubles.

$$\log 2 = \frac{E_a}{2.303}\left(\frac{1}{298} - \frac{1}{308}\right)$$

$$0.3010 = \frac{E_a}{2.303}\left(\frac{308 - 298}{298 \times 308}\right)$$

$$E_a = \frac{0.3010 \times 2.303 \times 298 \times 308 \times 8.314}{10}$$

$E_a = 52897.78$

$E_a = 52.89$ kJ/mol

Section - D

Answer 19.

(i) (a) Formaldehyde does not undergo aldol condensation, but acetaldehyde does because Aldehydes with one alpha hydrogen undergo aldol condensation in the presence of base.

As acetaldehyde contains alpha hydrogen it undergoes aldol condensation but formaldehyde has no alpha hydrogen.

(b) Chlorine is a strong electron withdrawing group, it uses inductive effect to pull the negative charge towards itself. Thus, giving slight positive charge to carbonyl group. And the conjugate base of chloroacetic acid becomes stable.

While conjugate base of acetic acid is less stable due to +I effect of $-CH_3$ group.

Hence, Chloroacetic acid is stronger acid than acetic acid.

(c) Oxygen is more electro negative than carbon. The C atom of carbonyl group thus acquires slight positive charge and hence undergo nucleophilic reactions by electron rich species. 3

(ii) $C_6H_5CHO + 2[Ag(NH_3)_2]^+ + 2OH^- \rightarrow C_6H_5COOH + 2Ag + 4NH_3 + H_2O$

Benzaldehyde, an aromatic aldehyde does not respond to Fehling's solution but undergoes Cannizaro reaction. This shows it is benzaldehyde. 2

Answer 20.

(i) $[Cr(H_2O)_5Cl]Cl_2.H_2O$

They have solvate isomerism.

In $[Cr(H_2O)_6]Cl_3$ the water molecules inside the coordination sphere are six and the number of water molecules outside the coordination sphere is 0.

In $[Cr(H_2O)_5Cl]Cl_2.H_2O$ the water molecules inside the coordination sphere is five and the number of water molecules outside the coordination sphere is 1. 3

(ii) Strong field ligand and octahedral geometry 2

Answer 21.

(i) (a) $Zn^{2+} + 2e^- \rightarrow Zn$ $E^0_{Zn^{2+}/Zn} = -0.76$ V

$Sn^{2+} + 2e^- \rightarrow Sn$ $E^0_{Sn^{2+}/Sn} = -0.14$ V

Cell reaction:

$Sn^{2+} + Zn \rightarrow Sn + Zn^{2+}$

Emf of the cell $E^0_{cell} = 0.76 - 0.14 = 0.62V$

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

$= -2 \times 96500 \times 0.62$

$= -119660$

$= -119.660$ kJ

(b) $(MnO_4)^- \rightarrow Mn^{2+}$

$Mn^{7+} + 5e^- \rightarrow Mn^{2+}$

Electricity required = n × number of moles × F (coulombs)

$= 5 \times 0.025 \times 96500$

$= 12062.5$

$= 1.20625 \times 10^4$ C

OR

(ii) **(a)** Graph 3 corresponds to NH_4OH

Graph 2 is Na_2SO_4

Graph 1 is H_2SO_4

H_2SO_4 is the strongest electrolyte as compared to Na_2SO_4.

NH_4OH is the weak electrolyte.

In a graph of molar conductivity against $\sqrt{C}$

A curved decreasing graph is shown by a weak electrolyte.

The strong electrolyte shows straight line in decreasing form.

As the strength is more, the line is placed above the weaker one.

(b) λ^0 for $H^+ = 349.6$ Scm²/mol

λ^0 for $HCOO^- = 54.6$ Scm²/mol

Λ^0_m for $HCOOH = \lambda^0 H^+ + \lambda^0 HCOO^-$

$= 349.6 + 54.6$

$= 404.2$ Scm²/mol

$\alpha = (\Lambda_m / \Lambda_0) \times 100$

Where:

Λ_m = Molar conductivity of the solution

Λ_0 = Molar conductivity of the fully dissociated ions

In this case, methanoic acid (HCOOH) can dissociate into H^+ and $HCOO^-$ ions.

Given that λ_0 (H^+) = 349.6 S cm²/mol and λ_0 ($HCOO^-$) = 54.6 S cm²/mol, and Λm = 34.1 S cm²/mol, we can calculate α as follows:

α = (34.1 S cm²/mol) / [(349.6 S cm²/mol) + (54.6 S cm²/mol)] x 100

α = (34.1 S cm²/mol) / (404.2 S cm²/mol) x 100

$\alpha \approx 8.44\%$.

❑❑❑