CBSE
Class XII Chemistry
Sample Paper 1
Term 2 – 2021 - 22

Time: 2 Hours Total marks: 35

General Instructions:

- *There are 12 questions in the question paper with the internal choice.*
- *Section A: Q. No. 1 to 3 are very short questions carrying 2 marks each.*
- *Section B: Q. No. 4 to 11 are short answer questions carrying 3 marks each.*
- *Section C: Q. No. 12 is case based question carrying 5 marks.*
- *All questions are compulsory*
- *Use of calculators and log tables is not permitted.*

Section A

1. What is Etard Reaction?

2. The rates of a reaction starting with initial concentrations 2.0×10^{-3} M and 1.0×10^{-3} M are equal to 2.40×10^{-4} M s^{-1} and 0.60×10^{-4} M s^{-1}, respectively. Calculate the order of the reaction with respect to the reactant and also the rate constant.

3. Arrange the following compounds in the increasing order of their reactivity in nucleophilic addition reactions.
(a) Ethanal, Propanal, Propanone, Butanone
(b) Benzaldehyde, p-Tolualdehyde, p-Nitrobenzaldehyde, Acetophenone

Section B

4. Account for the following:

(a) Electrophilic substitution in case of aromatic amines takes place more readily than benzene.
(b) CH_3CONH_2 is a weaker base than $CH_3CH_2NH_2$.
(c) Nitrocompounds have higher boiling points than hydrocarbons having almost same molecular mass.

5.

(a) Calculate number of unpaired electrons in complex $[Ni(H2O)_2(NH3)_4]^{2+}$.
(b) What type of isomerism is present in $[Pt(NH_3)_4Cl_2]Br_2$ and $[Pt(NH_3)_4Br_2]Cl_2$.
(c) What is the geometry of Ferrocyanide ion?

6.

(a) Name two transition elements which show +1 oxidation state.
(b) Name the transition element which does not exhibit variable oxidation state.
(c) Transition elements show catalytic properties. Why?

OR

(a) Write the steps involved in the preparation of Na_2CrO_4 from chromite ore.

(b) What is the effect of increasing pH on $K_2Cr_2O_7$ solution?

(c) Draw the structure of dichromate ion indicating the bond angles and bond lengths.

7.

(a) Ethanol reacts with acetic acid in the presence of conc. H_2SO_4 to give sweet-smelling substance. Give the equation involved in the reaction.

(b) Write a note on

(i) Rosenmund's reduction

(ii) Hell–Volhard–Zelinsky reaction

8. Explain the term with a suitable example:

(a) Alcosol

(b) Aerosol

(c) Hydrosol

9. An organic compound with the molecular formula $C_9H_{10}O$ forms 2, 4-DNP derivative, reduces Tollens' reagent and undergoes the Cannizzaro reaction. On vigorous oxidation, it gives 1, 2-benzene carboxylic acid. Identify the compound.

OR

(a) How will you convert acetaldehyde to the following compounds?

(i) But 2-enal (ii) But-2-enoic acid

(b) Write a chemical test to distinguish between propanal and propanone.

10. The rates of a reaction starting with initial concentrations 2.0×10^{-3} M and 1.0×10^{-3} M are equal to 2.40×10^{-4} M s^{-1} and 0.60×10^{-4} M s^{-1}, respectively. Calculate the order of the reaction with respect to the reactant and also the rate constant.

11. Give reasons:

(a) The radius of Fe^{2+} (Z = 26) is less than that of Mn^{2+} (Z = 25).

(b) Chemistry of actinoids is more complicated than that of lanthanoids.

(c) Cu^+ ion is not stable in aqueous solutions.

Section C

12. Leclanche cell is a primary cell. It consists of a cylindrical zinc container which acts as the anode. A graphite rod surrounded by a paste of manganese dioxide acts as the cathode. These are in contact with a thick paste of ammonium chloride and zinc chloride which acts as the electrolyte.

(a) What is the reaction taking place at the anode?

(b) How much electricity in terms of F is produced by the oxidation of one mole of Zn?

(c) Why Leclanche cell is considered as the primary cell ?

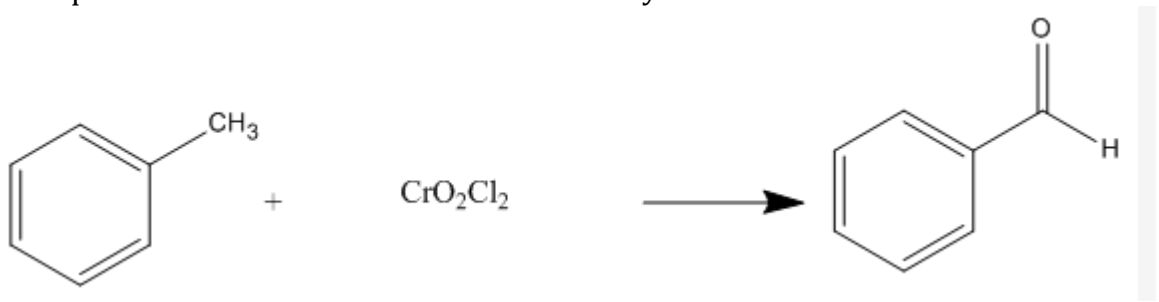
(d) What are the uses of Leclanche cell ?

(e) Write the other example of primary cell?

Solution

Section A

1. This reaction involves direct oxidation of heterolytic or an aromatic methyl group to an aldehyde using chromyl chloride.
Example- Toluene can be oxidized to benzaldehyde.



2.

Suppose $r = k[A]^x$ where x = order of the reaction.

Given is that

$2.40 \times 10^{-4} = k[2.0 \times 10^{-3}]^x$ (Eq.1)

and

$(0.60 \times 10^{-4}) = k[1.0 \times 10^{-3}]^x$ (Eq.2)

Dividing equation (1) by (2) gives

$(2.40 \times 10^{-4}) / (0.60 \times 10^{-4}) = [(2.0 \times 10^{-3}) / (1.0 \times 10^{-3})]^x$

Or

$2^x = 4 = 2^2$

Therefore,

$x = 2$

The rate law is

$R = k[A]^2$ and order of reaction = 2

The rate constant

$$k = \frac{r}{[A]^2}$$

$$= \frac{2.40 \times 10^{-4}}{(2.0 \times 10^{-3})^2}$$

$= 60 \text{ mol}^{-1} \text{ L s}^{-1}$

3.

(a) Butanone < Propanone < Propanal < Ethanal

(b) Acetophenone < p-Tolualdehyde < Benzaldehyde < p-nitrobenzaldehyde

Section B

4.

(a) Due to resonance, the electrons on the N-atom in aniline are delocalized over the benzene ring. As a result, the electron density on the benzene ring increases as compared to benzene itself. In other words, aniline gets activated and hence electrophilic substitution occurs more readily in aniline.

(b) The lone pair of electrons on nitrogen interacts with oxygen atom due to resonance. Hence, the lone pair of electrons on nitrogen is less available for donation, which makes it less basic. While such mechanisms are not present in $CH_3CH_2NH_2$.

(c) Nitro compounds are highly polar in nature, therefore, there is strong electrostatic, attraction between nitrogen and oxygen atoms of a nitro group. As a result, a large amount of energy is requried to break th nitrogen and oxygen nonds. Hence, nitro comupounds have high boiling points in comarison with other comopounds.

5.

(a) Electronic configuration of Ni^{+2}= $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^8$
So, Number of unpaired electrons =2

(b) $[Pt(NH_3)_4Cl_2]Br_2$ and $[Pt(NH_3)_4Br_2]Cl_2$ are types of ionisation isomers.

(c) Ferrocyanide ion, i.e. $[Fe(CN)_6]^{4-}$ is a type of octahedral complex.

6.

(a) Au and Hg can show +1 oxidation state.

(b) Scandium

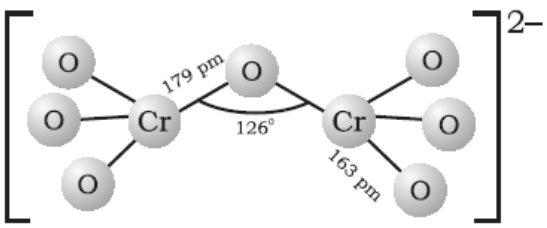
(c) Transition elements exhibit variable oxidation state and can form complexes.

OR

(a) $4FeCr_2O_4 + 8Na_2CO_3 + 7O_2 \rightarrow 8Na_2CrO_4 + 2Fe_2O_3 + 8CO_2$

(b) On increasing pH, the solution turns yellow due to the formation of chromate ion.

(c) $Cr_2O_7^{2-} + 2\ OH^- \rightarrow 2CrO_4^{2-} + H_2O$



Dichromate ion

7.

(a) $CH_3CH_2OH + CH_3COOH \xrightarrow{conc.\ H_2SO_4} CH_3COOCH_2CH_3 + H_2O$

(b)

(i) In Rosenmund's reaction, acid chlorides are subjected to catalytic hydrogenation in the presence of Pd supported over $BaSO_4$ to yield the corresponding aldehyde. The catalyst is poisoned by S or quinoline.

$$RCOCl + H_2 \xrightarrow{Pd, BaSO_4} RCHO + HCl$$

(ii) In the Hell–Volhard–Zelinsky reaction, carboxylic acids react with chlorine or bromine in the presence of a small amount of P to give α-halogenated carboxylic acids. The reaction requires the presence of α-hydrogen in the acid.

$$R\text{-}CH_2\text{-}COOH \xrightarrow[(ii)\,H_2O]{(i)\,X_2\,/\,Red\ phosphorous} R\text{-}\underset{\displaystyle X}{\underset{|}{CH}}\text{-}COOH$$

α-Halocarboxylic acid

(X = Cl, Br)

8.

(a) Alcosol: A colloidal sol in which the dispersion medium is alcohol. Example: Collodion

(b) Aerosol: When the dispersion medium is a gas and the dispersed phase is either solid or liquid, the colloidal system is called an aerosol. Examples: Fog, cloud, smoke

(c) Hydrosol: Colloids in water are called hydrosols. Examples: Milk, protein

9.

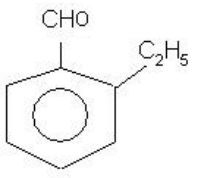
(i) The C:H ratio in the molecular formula suggests that the given compound is an aromatic compound.

(ii) Formation of 2, 4-DNP derivative indicates that the compound is an aldehyde or a ketone.

(iii) Since the compound reduces Tollens' reagent, it must be an aldehyde and not a ketone.

(iv) Only aldehydes which do not contain an α-hydrogen atom give the Cannizzaro reaction. Thus, the aldehyde group should be directly attached to the benzene ring. This implies that the ethyl group should be attached to benzaldehyde.

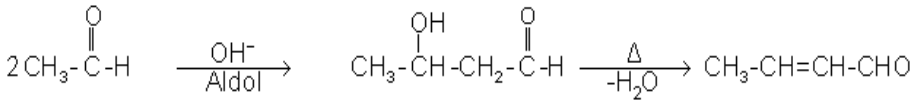
(v) As vigorous oxidation of the aromatic aldehyde yields 1, 2-dicarboxylic acid, the ethyl group must be present at the ortho position. Therefore, the compound is 2-ethyl benzaldehyde.



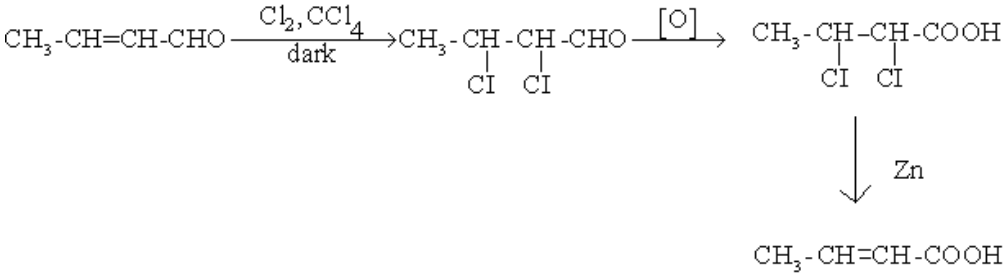
OR

(a)

(i)



(ii) But 2-enal obtained in the above steps is treated with chlorine in CCl_4 in the dark and the product obtained is oxidised to dihaloacid which is further dehalogenated to get but-2-enoic acid.



But-2-enoic acid

(b) Propanal reduces Tollens' reagent into silver mirror, while propanone does not give this test.

$$CH_3CH_2CHO + 2\left[Ag(NH_3)_2\right]^+ + 3OH^- \longrightarrow CH_3CH_2COO^- + 2Ag + 2H_2O + 4NH_3$$

Propanal Tollen's reagent

10.

Suppose $r = k[A]^x$ where x = order of the reaction.

Given is that

$2.40 \times 10^{-4} = k[2.0 \times 10^{-3}]^x$ (Eq.1)

and

$(0.60 \times 10^{-4}) = k[1.0 \times 10^{-3}]^x$ (Eq.2)

Dividing equation (1) by (2) gives

$(2.40 \times 10^{-4}) / (0.60 \times 10^{-4}) = [(2.0 \times 10^{-3}) / (1.0 \times 10^{-3})]^x$

Or

$2^x = 4 = 2^2$

Therefore,

$x = 2$

The rate law is

$R = k[A]^2$ and order of reaction = 2

The rate constant

$$k = \frac{r}{[A]^2}$$
$$= \frac{2.40 \times 10^{-4}}{(2.0 \times 10^{-3})^2}$$
$$= 60 \, mol^{-1} \, L \, s^{-1}$$

11.

(a) It is because the effective nuclear charge is more in Fe^{2+} than in Mn^{2+}.

(b) In actinoids, energy of 5f, 6d and 7s is comparable, and therefore, they show high oxidation states and their chemistry is more complicated. All of them are radioactive.

(c) Due to low charge density, Cu^{+} has low enthalpy of hydration. Cu^{+} in aqueous solution undergoes disproportionation.
$2Cu^{+}_{(aq)} \rightarrow Cu^{2+}_{(aq)} + Cu_{(s)}$
The E^{θ} value for this is positive and the reaction is favourable.

Section C

12.

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

(b) Two electrons are released by Zn. So, according to Faraday's law, 1 mole of Zn produces 2F electricity.

(c) In Leclanche cell, the reaction occurs only once, and after use over a period of time, the battery dies and cannot be used as the reaction is not reversed. So, it is considered a primary cell.

(d) Leclanche cells are used in a tape recorder, radio, flashlight, transistor etc.

(e) Other example of primary cell is Mercury cell.