CBSE
Class XII Chemistry
Sample Paper 5

Time: 3 Hrs **Total marks: 70**

General Instructions:

- There are 33 questions in this sample paper. All questions are compulsory.
- Section A: Q. Nos. 1 to 2 are case-based questions having four MCQs or Reason Assertion type based on given passage each carrying 1 mark.
- Section A: Question 3 to 16 are MCQs and Reason Assertion type questions carrying 1 mark each.
- Section B: Q. No. 17 to 25 are short answer questions and carry 2 marks each.
- Section C: Q. No. 26 to 30 are short answer questions and carry 3 marks each.
- Section D: Q. No. 31 to 33 are long answer questions carrying 5 marks each.
- Use of calculators and log tables is not permitted.

Section A

1. Read the passage given below and answer the following questions:

The number of reacting species (atoms, ions or molecules) taking part in an elementary reaction which must collide simultaneously to bring about a chemical reaction is called molecularity of a reaction.
Order of a reaction is an experimental quantity; it can be zero and even a fraction but molecularity cannot be zero or a non-integer. The sum of powers of the concentration of the reactants in the rate law expression is called the order of that chemical reaction. The overall rate of the reaction is controlled by the slowest step in a reaction called the rate-determining step. So, in a complex reaction, molecularity of the slowest step is the same as the order of the reaction step in a reaction called the rate-determining step. So, in a complex reaction, molecularity of the slowest step is the same as the order of the reaction.

Foragen eralreaction

$aA + bB \rightarrow cC + dD$

$Rate = k[A]^{x}[B]^{y}$

$x + y = Orderofreaction$

$k = rateconstan t$

(i) What is the molecularity of the reaction

$2NO + O_2 \rightarrow 2NO_2$

a) 1
b) 2
c) 0
d) 3

(ii) Find the order of the given reaction.

$H_2(g) + 2ICl(g) \rightarrow I_2(g) + 2HCl(g)$

Steps –

1. Slow reaction : $H_2 + ICl \rightarrow HI + HCl$

2. Fast reaction : $HI + ICl \rightarrow I_2 + HCl$

a) 1
b) 2
c) 3
d) 4

(iii) For the second-order reaction $A + B \rightarrow Product$, the rate law is given by Rate = $k[A]^2 [B]^x$. What is the value of x?

a) 0
b) 1
c) 2
d) 3

(iv) For the zero-order reaction $A + B \rightarrow Product$, if the concentration of A becomes double, then what will be the change in the rate of reaction?

a) increased
b) decreases
c) no change
d) can't say anything

2. Read the passage given below and answer the following questions:

The aggregation of $Fe(OH)_3$ sol can be done by adding ionic solution, especially if the solution contains multiple charged atoms (e.g., phosphate ions). Coagulation is the process by which the dispersed phase of colloid undergoes aggregation, and thus separates from the continuous phase.

In these questions (Q. No 5-8, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices).

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
c) Assertion is correct statement but reason is wrong statement.
d) Assertion is wrong statement but reason is correct statement.

(i) **Assertion:** $Fe(OH)_3$ is positively charged colloid.
Reason: $Fe(OH)_3$ can be coagulated by negatively charged ions.

(ii) **Assertion:** KCl is more effective than $MgCl_2$ in coagulating sulphur.
Reason: Greater the valence of the active ion or flocculating ion, greater will be its coagulating power.

(iii) **Assertion:** Arsenious sulphide is positively charged.

Reason: Aluminium hydroxide solution is negatively charged.

(iv) **Assertion:** Colloidal sulphur particles are negatively charged.

Reason: Colloidal sulphate particles are negatively charged.

Questions 3 to 11 are multiple choice questions carrying 1 mark each:

3. Then molal elevation constant depends on

a) Nature of solute
b) Nature of the solvent
c) Vapour pressure of the solution
d) Enthalpy change

4. The atmospheric pollution is generally measured in the units of

a) Mass percentage
b) Volume percentage
c) Volume fraction
d) Ppm

5. Tyndall effects confirms the

a) gravity effect on the sol particles
b) light scattering by the sol particles
c) heterogeneous nature of sols
d) Brownian motion

6. Degeneracy of the d-orbital is removed with the approach of the ligand due to

a) Ligand electron-metal electron repulsion
b) Ligand electron-metal nucleus attraction
c) Ligand nucleus-metal electron attraction
d) Ligand nucleus-metal nucleus repulsion

7. Nitrogen atom of amino group is…….hybridised.

a) sp
b) sp^2
c) sp^3
d) sp^3d

8. Picric acid is a yellow colored compound. Its chemical name is

a) m-nitro benzoic acid
b) 2,4,6-tribromophenol
c) 2,4,6-trinitrophenol
d) P-nitrophenol

9. Catenation property is maximum in
   a) Phosphorous
   b) Carbon
   c) Sulphur
   d) Zinc

10. Fused NaCl on electrolysis gives……. on cathode.
   a) Chlorine
   b) Sodium
   c) Sodium Amalgam
   d) Hydrogen

11. The oxidation of toluene to benzaldehyde by chromyl chloride is called
   a) Etard reaction
   b) Riemer-Tiemann reaction
   c) Wurtz reaction
   d) Cannizaro reaction

In the following questions questions (Question number 12 to 16) a statement of assertion is followed by a statement of reason is given. Choose the correct answer out of the following choices.

   a) Both assertion and reason are correct, and the reason is the correct explanation of the assertion.
   b) Both assertion and reason are correct, but the reason is not the correct explanation of the assertion.
   c) Assertion is correct, but reason is wrong.
   d) Assertion is wrong, but reason is correct.

12. **Assertion:** Bromobenzene upon reaction with Br_2/Fe gives 1, 4-dibromobenzene as the major product.
Reason: In bromobenzene, the inductive effect of the bromo group is more dominant than the mesomeric effect in directing the incoming electrophile.

13. **Assertion:** Iodine is sparingly soluble in water but fairly soluble in KI.
Reason: Iodine is non-polar.

14. **Assertion:** Aqueous gold colloidal solution is red.
Reason: The colour arises due to scattering of light by colloidal gold particles.

15. **Assertion:** Molecular mass of benzoic acid when determined by colligative properties is found to be high.
Reason: Dimerisation of benzoic acid.

16. **Assertion:** Speed of ions depends on the nature of ions only.
Reason: Mobility of ions depends on mass, charge and size of ions only.

Section B

The following questions Q. No. 17-25 are short answer type and carry 2 marks each.

17. Calculate the mass of ascorbic acid (Vitamin C, $C_6H_8O_6$) to be dissolved in 75 g of acetic acid to lower its melting point by 1.5°C. (K_f = 3.9 K kg mol^{-1})

18. Calculate the equilibrium constant for the following reaction at 298 K.

$Cu_{(s)} + Cl_{2(g)} \longrightarrow CuCl_{2(aq)}$ (R = 8.314 J/K mol)

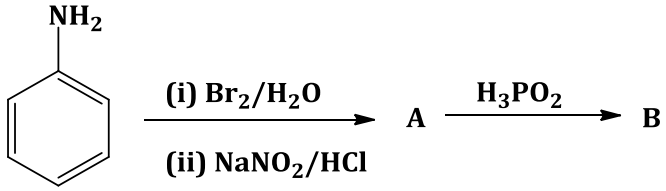
$E^0 Cu^{2+} / Cu = 0.34\ V$

$E^0_{\frac{1}{2}} Cl_2 / Cl^- = 1.36\ V$

$1F = 96500\ C\ mol^{1-}$

19. Give reason for the following:
(a) CN^- ion is known, but CP^- ion is not known.
(b) NO_2 dimerises to form N_2O_5.

20.
(a) Why do primary amines have higher boiling points than tertiary amines?
(b) Identify A and B.



21. 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

22. How is acetone obtained from ethanol?

23. Chromium crystallises in BCC structure. If its atomic diameter is 245 pm, find its density. (Atomic mass of Cr = 52 amu and $N_A = 6.02 \times 10^{23}\ mol^{-1}$)

24. Draw the structures of the following oxoacids of chlorine:
(a) Chlorous acid
(b) Chloric acid

25. Account for the following:

(a) Nitration of aniline gives a substantial amount of m-nitroaniline.

(b) pK_b of aniline is more than that of methylamine.

Section C

Q. No. 26-30 are short answer type II carrying 3 marks each.

26. Explain the term with a suitable example:

(a) Alcosol

(b) Aerosol

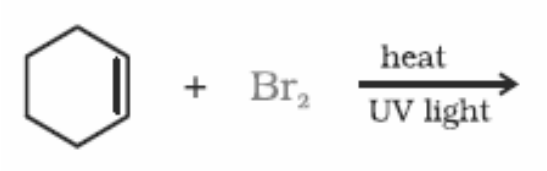
(c) Hydrosol

27. Write the structure of the major organic product in each of the following reactions:

(i) $(CH_3)_3CBr + KOH \xrightarrow[\text{heat}]{\text{ethanol}}$

(ii) $C_6H_5CH_2CI + C_2H_5ONa \rightarrow$

(iii)



OR

What happen when

(a) N-butyl chloride is treated with alcoholic KOH.

(b) Bromobenzene is treated with Mg in the presence of dry ether.

(c) Chlorobenzene is subjected to hydrolysis.

28. Give the equation of the following reactions:

(a) Oxidation of propan-1-ol with alkaline $KMnO_4$ solution

(b) Bromine in CS_2 with phenol

(c) Dilute nitric acid with phenol

29. Complete the equations:

(a) $NaCl + MnO_2 + H_2SO_4 \rightarrow$

(b) $Al + O_2 \rightarrow$

(c) $2Pb(NO_3)_2 \xrightarrow{673K}$

30. In the following cases, rearrange the compounds as directed:

(a) In the increasing order of basic strength:
$C_6H_5NH_2$, $C_6H_5N(CH_3)_2$, $(C_2H_5)_2NH$ and CH_3NH_2

(b) In the decreasing order of basic strength:
Aniline, p-nitroaniline and p-toluidine

(c) In the increasing order of pK_b value:
$C_2H_5NH_2$, $C_6H_5NHCH_3$, $(C_2H_5)_2NH$ and $C_6H_5NH_2$

Section D

Q. No. 31 to 33 are long answer type carrying 5 marks each.

(a) How will you convert acetaldehyde to the following compounds?
(i) Butan-2 one (ii) Butan-1,3-diol
(b) 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.

31.

(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?
(d) Explain why Cu^+ ion is not stable in aqueous solutions.

32. Explain:

(a) Perchloric acid is a stronger acid than sulphuric acid.
(b) Noble gases are bigger in size than halogens of the respective period.
(c) Solid PCl_5 exhibits some ionic character.
(d) Oxygen has lower electron gain enthalpy than S.
(e) Gaseous N_2 is used in food packaging.

CBSE
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Section A

1.

(i) (d)2 NO and 1 O_2 molecules are taking part in an elementary reaction.
So, molecularity = 2 + 1 = 3

(ii) (b)Molecularity of the slowest step: 1 + 1 = 2

(iii) (a)Order of reaction = 2
2 + x = 2
x = 0

(iv) (c) In the zero-order reaction, rate of reaction = k
So, there will be no change in the rate of reaction.

2.

(i) (a) $Fe(OH)_3$ is positively charged colloid so it can be coagulated by negatively charged ions.

(ii) (d) According to Hardy-schulze rule, Greater the valence of the active ion or flocculating ion, greater will be its coagulating power.

(iii) (b) Arsenious sulphide is positively charged and Aluminium hydroxide is negatively charged.

(iv) (b) Colloidal sulphur and colloidal sulphate particles are negatively charged.

3. (b) The molal elevation constant depends upon nature of the solvent.

4. (d) The atmospheric pollution is generally measured in the units of ppm.

5. (c) Tyndall effect confirms the heterogeneous nature of sols.

6. (a) Degeneracy of the d-orbital is removed with the approach of the ligand due to ligand electron-metal electron repulsion.

7. (c) Nitrogen atom of amino group is sp^2 hybridised.

8. (c) 2,4,6-trinitrophenol

9. (b) Catenation property is maximum in carbon.

10. (b) Fused NaCl on electrolysis gives sodium on cathode.

11. (a) The oxidation of toluene to benzaldehyde by chromyl chloride is called Etard reaction.

12. (c) Assertion is correct, but reason is wrong.

13. (a) Both assertion and reason are correct, and the reason is the correct explanation of the assertion.

14. (a) Both assertion and reason are correct, and the reason is the correct explanation of the assertion.

15. (a) Both assertion and reason are correct, and the reason is the correct explanation of the assertion.

16. (d) Assertion is wrong, but reason is correct.

Section B

17. The molecular mass of ascorbic acid ($C_6H_8O_6$) = 12 × 12 + 22 × 1 + 11 × 16 = 342 g mol^{-1}.

$$\Delta T_f = K_f \frac{1000 \times W_B}{M_B \times W_A}$$

$$W_B = \frac{\Delta T_f \times M_B \times W_A}{K_f \times 1000}$$

$$W_B = \frac{1.5\,K \times 176\,g\,mol^{-1} \times 75\,g}{3.9\,K\,kg\,mol^{-1} \times 1000} = 5.08\,g$$

18.

$$E^0_{cell} = E^0_{1/2}\,Cl_2 / Cl^- - E^0 Cu^{2+} / Cu$$

$$= +1.36\,V - 0.34\,V = 1.02\,V$$

$$\log k = \frac{nE^0}{0.0591} = \frac{2 \times 1.02}{0.0591}$$

$$= \frac{2.04}{0.0591} = 34.5177$$

$$k = antilog\,34.5177$$

$$k = 3.294 \times 10^{34}$$

19.

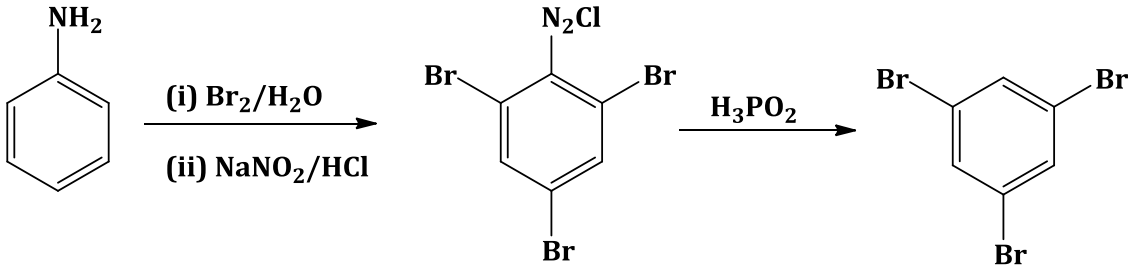
(a) Nitrogen being smaller in size forms $p\pi - p\pi$ multiple bonding with carbon, so CN^- ion is known, but phosphorus in CP^- ion does not form $p\pi - p\pi$ bond due to its larger size.

(b) NO_2 dimerises to form N_2O_5 because NO_2 is an odd electron molecule and therefore gets dimerised to the stable N_2O_4.

20.

(a) Primary amines (RNH_2) have two hydrogen atoms attached to the nitrogen atom and therefore show hydrogen bonding. Tertiary amines (R_3N) do not have hydrogen atoms attached to the nitrogen atom and therefore do not show hydrogen bonding. Thus, primary amines have a higher boiling point than tertiary amines as a result of their hydrogen bonding.

(b)



(A) **(B)**

21.

(a) Butanone < Propanone < Propanal < Ethanal

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

22. $\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[\text{Oxidation}]{K_2Cr_2O_7/H_2SO_4} \underset{\text{Ethanoic acid}}{CH_3COOH} \xrightarrow{CaCO_3} \underset{\text{Ca.Ethanoate}}{(CH_3COO)_2Ca} \longrightarrow \underset{\text{Acetone}}{CH_3COCH_3}$

23. Diameter = 245 pm

$$\therefore \text{Radius} = \frac{245}{2}\text{pm} = 122.5\text{ pm}$$

$$\text{In a bcc structure, } r = \frac{\sqrt{3}}{4}a$$

$$\therefore \quad 122.5 = \frac{\sqrt{3}}{4}a$$

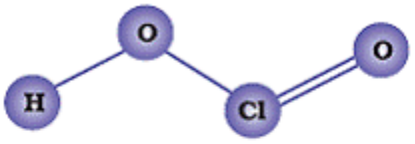
$$\therefore \ a = \frac{122.5 \times 4}{\sqrt{3}} = \frac{490}{1.732} = 282.91\text{ pm}$$

$$d = \frac{z \times M}{a^3 \times N_A} = \frac{2 \times 52}{(282.91 \times 10^{-10})^3 \times 6.02 \times 10^{23}}$$

$$= \frac{104}{2.264 \times 10^{-23} \times 6.02 \times 10^{23}} = \frac{104}{2.264 \times 6.02} = 7.63\text{ g cm}^{-3}$$

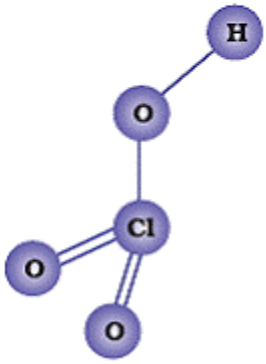
24.

(i)



Chlorous acid

(ii)



Chloric acid

25.

(a) In the presence of nitrating mixture $(HNO_3 + H_2SO_4)$, aniline gets protonated to form anilinium ion, which is a meta-directing group, thus giving a substantial amount of m-nitroaniline.

(b) In aniline, a lone pair of electrons on the N atom is delocalised over the benzene ring, resulting in lowering its basic strength. Hence, its K_b value will be lower and its pK_b value will be higher. On the other hand, the +I effect of the $-CH_3$ group increases the electron density on the N atom in CH_3NH_2 making it a stronger base. Hence, its K_b value will be higher and its pK_b value will be lower.

Section C

26.

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

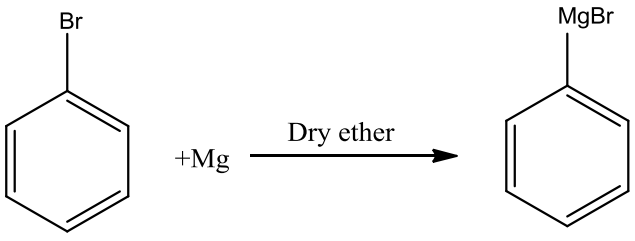
(b) Aerosol: When the dispersion medium is a gas and the dispersed phase is either solid or liquid, the colloidal system is called an aerosol. Examples: Fog, cloud, smoke

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

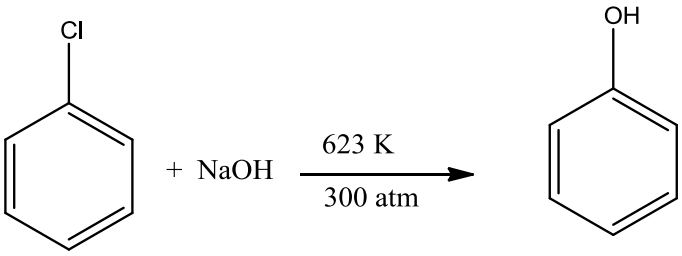
27.

(a) $CH_3CH_2CH_2CH_2Cl + KOH_{(alc)} \longrightarrow CH_3CH_2 - CH = CH_2 + KCl + H_2O$

(b)



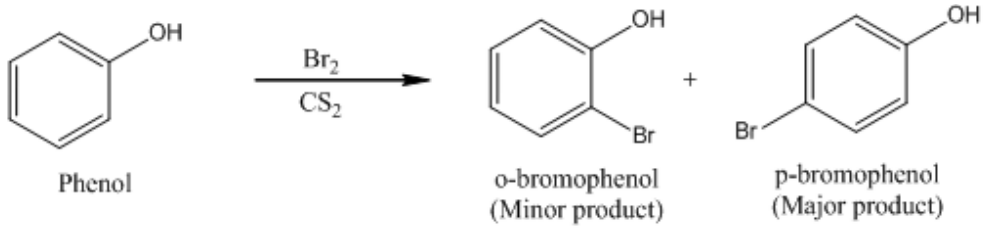
(c)



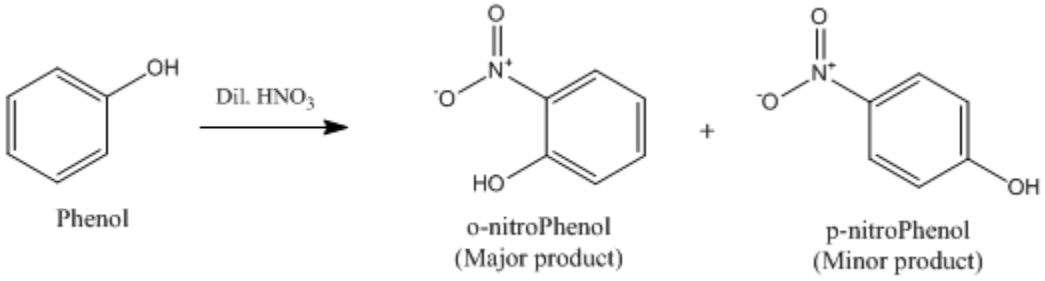
28.

(a) $\underset{\text{Propan-1-ol}}{CH_3CH_2CH_2OH} + 2[O] \xrightarrow[\text{Oxidation}]{\text{Alkaline } KMnO_4} \underset{\text{Propanoic acid}}{CH_3CH_2COOH} + H_2O$

(b)



(c)



29.

(a) $4NaCl + MnO_2 + 4H_2SO_4 \rightarrow MnCl_2 + 4NaHSO_4 + 2H_2O + Cl_2$

(b) $4Al + 3O_2 \rightarrow 2Al_2O_3$

(c) $2Pb(NO_3)_2 \xrightarrow{673\ K} 4NO_2 + 2PbO + O_2$

30.

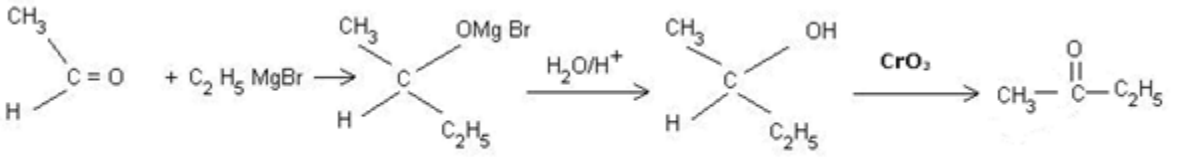
(a) In the increasing order of basic strength: $C_6H_5NH_2 < C_6H_5N(CH_3)_2 < CH_3NH_2 < (C_2H_5)_2NH$

(b) In the decreasing order of basic strength: p-toluidine > Aniline > p-nitroaniline

(c) In the increasing order of pK_b value: $(C_2H_5)_2NH < C_2H_5NH_2 < C_6H_5NHCH_3 < C_6H_5NH_2$

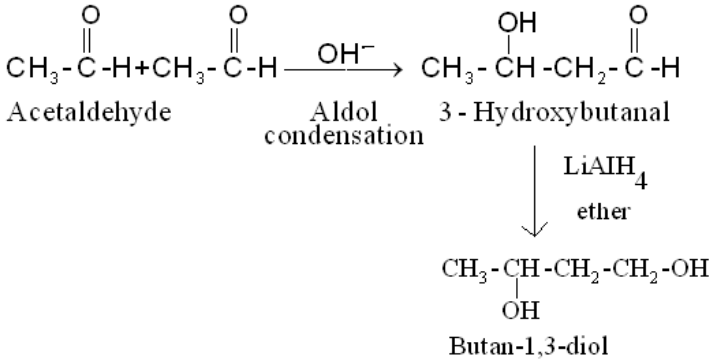
Section-D

31. (a) (i)



Acetaldehyde Butan – 2- one

(ii)



(b)

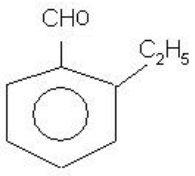
(i) The C:H ratio in the molecular formula suggests that the given compound is an aromatic compound.

(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.

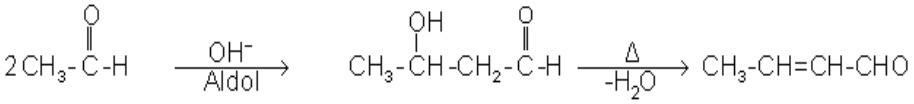
(v) As vigorous oxidation of the aromatic aldehyde yields 1, 2-dicarboxylic acid, the ethyl group must be present at the ortho position. Therefore, the compound is 2-ethyl benzaldehyde.



OR

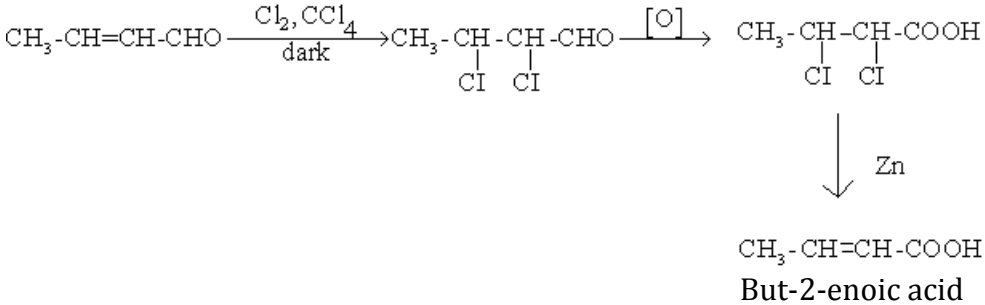
(a)

(i)



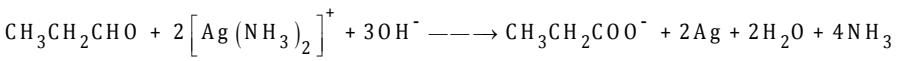
Acetaldehyde condensation 3-hydroxybutanal (dehydration) But -2 enal

(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.



Propanal Tollen's reagent

32.

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

(b) Scandium

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

(d) 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

33.

(a) $HClO_4$ is a stronger acid than H_2SO_4 due to the higher electronegativity of Cl than S making the O–H bond in $HClO_4$ more polar.

(b) Noble gases contain a fully filled p-subshell. This leads to interelectronic repulsions leading to an increase in size. Therefore, noble gases are larger in size than the corresponding halogens.

(c) In the solid state, PCl_5 exists as $[PCl_4]^+$ $[PCl_6]^-$, thus exhibiting ionic character.

(d) Due to very small size of O, addition of an electron leads to interelectronic repulsions, hence lowering the value of electron gain enthalpy.

(e) Due to the $N \equiv N$ triple bond, N2 is chemically inert. Flushing packaged foods with high purity nitrogen retards oxidative deterioration by typically reducing the oxygen level in packaged foods. Hence, it is used in food packaging.