

CBSE
Class XII Chemistry
Sample Paper 3

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.*
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Section A

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

The pressure exerted by the vapour when in equilibrium with a liquid or a solution at a particular temperature is known as vapour pressure. When two (or more) components of a liquid solution evaporate, the vapour contain molecules of each substance. All liquid solutions of non-volatile solutes (solute that have no tendency to evaporate) have lower vapour pressures than their pure solvents. The vapour pressure of such a solution is proportional to how much of the solution actually consists of the solvent. The proportionality is given by Raoult's law (also known as the vapour-pressure concentration law) which says that the vapour pressure of the solution equals the mole fraction of the solvent multiplied by its vapour pressure when pure. In a binary solution of components A and B, if the interactive force between A—A, B---B and A—B are same the solution is ideal. Practically, no solution is ideal. Practically, no solution is ideal. A non-ideal solution is that solution in which solute and solvent molecules interact with one another with a different force than the forces of interaction between the molecules of pure components. If for the two components A and B, the force of interaction between the A-A and B-B, the non-ideal solutions have positive deviations. On the other hand, if the forces of interaction between A and B molecules are more than those between A—A and B---B, the non-ideal solutions have negative deviation.

The following questions are multiple choice questions. Choose the most appropriate answer:

- (i) If two liquids A and B form an ideal solution, then
- a) The Gibbs energy of mixing is zero.
 - b) The entropy of mixing is zero.
 - c) The enthalpy of mixing is zero.
 - d) None of these.

- (ii) Vapour pressure of dilute aqueous solution of glucose is 750 mm of Hg at 373K. the mole fraction of the solute is:
- 1/75
 - 75/76
 - 1/76
 - 1/10
- (iii) Which of the following statements is correct for non-ideal solutions?
- For solutions showing positive deviation, ΔH_{mix} is positive.
 - For solutions, showing negative deviations, the interactions between the components are greater than pure components.
 - For solutions showing negative deviations, ΔV_{mix} is positive but ΔH_{mix} is negative.
 - For solutions showing negative deviations, ΔV_{mix} and ΔH_{mix} are positive.
- (iv) The vapour pressure of a pure liquid A is 30mm of Hg at 300 K. The vapour pressure of this liquid in solution with liquid B is 24 mm of Hg. The mole fraction of A in solution obeying Raoult's law is
- 0.4
 - 0.3
 - 0.5
 - 0.8

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

X-ray studies show that the packing of atoms in a crystal of a metal is found to be in layers such that starting from any layer, every fourth layer is exactly identical. The density of the metal is found to be 19.4 g cm^{-3} and its atomic mass is 197 u.

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 followings).

- Both assertion and reason are correct, and the reason is the correct explanation of the assertion.
- Both assertion and reason are correct, but the reason is not the correct explanation of the assertion.
- Assertion is correct, but reason is wrong.
- Assertion is wrong, but reason is correct.

(i) **Assertion:** The Coordination number of metal atom in the crystal is 12.

Reason: Metal has fcc arrangement.

(ii) **Assertion:** The fraction occupied by metal atoms in the crystal is 0.74.

Reason: Packing efficiency in fcc arrangement is 74%

(iii) **Assertion:** Assuming the metal atom to be spherical, its radius will be 103.5 pm.

Reason: For fcc, $r = \frac{a}{2\sqrt{2}}$

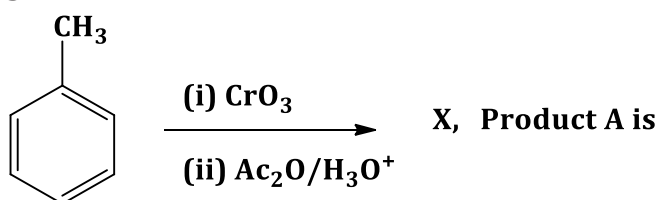
(iv) **Assertion:** The approximate number of unit cells present in 1 g of metal is 1.53×10^{21} .

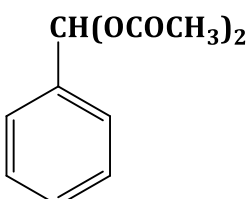
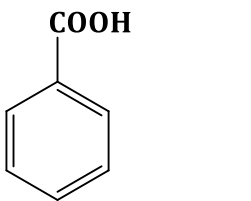
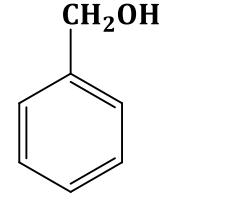
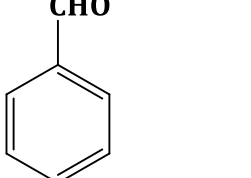
Reason: For fcc arrangement, there are 4 atoms per unit cell.

Questions 3 to 11 are multiple choice questions:

3. On heating ammonium dichromate, what is evolved?
- Oxygen
 - Ammonia
 - Nitrous oxide
 - Nitrogen
4. K_2MnO_4 can be converted to $KMnO_4$ using all of the following except
- Dil. H_2SO_4
 - Cl_2
 - O_3
 - HCl

5.



- a) 
- b) 
- c) 
- d) 

6. For the reaction $\text{H}_2 + \text{Cl}_2 \xrightarrow{\text{sunlight}} 2\text{HCl}$ taking place on water, the order of the reaction is
- 0
 - 1
 - 2
 - 3
7. Which of the following pairs is coloured in aqueous solution?
- Sc^{3+} , Co^{2+}
 - Ni^{2+} , Cu^{2+}
 - Ni^{2+} , Ti^{3+}
 - Sc^{3+} , Ti^{3+}
8. Ethylene oxide when treated with Grignard reagent yields
- Cyclopropyl alcohol
 - Primary alcohol
 - Secondary alcohol
 - Tertiary alcohol
9. Lyophillic colloids are stable due to
- Charge on particles
 - Large size of the particles
 - Small size of the particles
 - Layer of dispersion of medium on particles
10. Turnbull's blue is
- Ferricyanide
 - Ferrous Ferricyanide
 - Ferrous Cyanide
 - $\text{Fe}_3[\text{Fe}(\text{CN})_6]_4$
11. The boiling point of an azeotropic mixture of water and ethanol is less than that of water and ethanol. The mixture shows
- No deviation from Raoult's law
 - Positive deviation from Raoult's law
 - Negative deviation from Raoult's law
 - That the solution is unsaturated

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.

- Both assertion and reason are correct, and the reason is the correct explanation of the assertion.
- Both assertion and reason are correct, but the reason is not the correct explanation of the assertion.
- Assertion is correct, but reason is wrong.
- Assertion is wrong, but reason is correct.

12. Assertion: The two strands in the double strand helix structure of DNA are complementary to each other

Reason: Disulphide bonds are formed between specific pairs of bases.

13. Assertion: Between SiCl_4 and CCl_4 , only SiCl_4 reacts with water.

Reason: SiCl_4 is ionic and CCl_4 is covalent.

14. Assertion: Geometrical isomers of the complex $[\text{M}(\text{NH}_3)_4\text{Cl}_2]$ are optically inactive.

Reason: Both geometrical isomers of the complex $[\text{M}(\text{NH}_3)_4\text{Cl}_2]$ possess an axis of symmetry.

15. Assertion: Aldol condensation can be catalysed by both acids and bases.

Reason: β -hydroxy aldehydes or ketones readily undergo acid-catalysed dehydration.

16. Assertion: NF_3 is a weaker ligand than $\text{N}(\text{CH}_3)_3$.

Reason: NF_3 ionises to give F^- ions in aqueous solution.

Section B

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

17. In a cell reaction, the equilibrium constant K_c is less than one.

(a) Is E^θ for the cell positive or negative?

(b) What will be the value of K_c if $E^\theta_{\text{cell}} = 0$?

18. Calculate the half-life of a first-order reaction whose rate constant is 200 s^{-1} .

19. Find the oxidation states of halogens in the following:

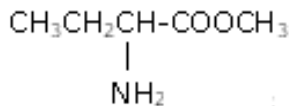
(a) Cl_2O

(b) KBrO_3

20. Give a chemical test to distinguish between methanol and ethanol.

21. Give the IUPAC names of the following:

(a)



(b) $\text{C}_6\text{H}_5\text{NHCH}_3$

Or

Illustrate the following with an example reaction:

(a) Ambident nucleophile

(b) Hoffmann bromamide degradation

22. Draw the structures of the following oxoacids of chlorine:

- (a) Chlorous acid
- (b) Chloric acid

23. How do size of particles of adsorbent, pressure of gas and prevailing temperature influence the extent of adsorption of a gas on a solid?

24. Write the structures of the following organic halogen compounds:

- (a) 2-chloro-3-methyl pentane
- (b) p-Bromochlorobenzene

25. Arrange the following:

- (a) In the decreasing order of pK_b values:
 $C_2H_5NH_2$, $C_6H_5NHCH_3$, $(C_2H_5)_2NH$ and $C_6H_5NH_2$
- (b) In the increasing order of basic strength:
 $C_6H_5NH_2$, $C_6H_5NHCH_3$, $(C_2H_5)_2NH$ and CH_3NH_2

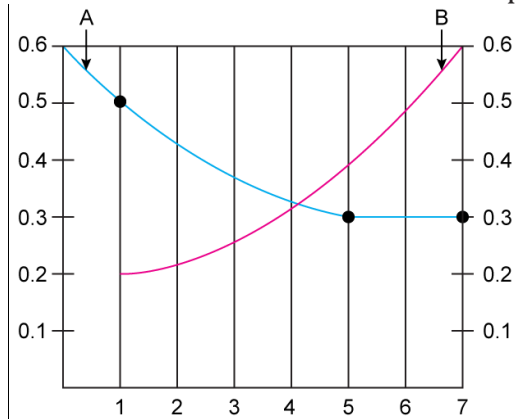
Section-C

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

26.

- (a) Amylose and cellulose are both straight chain polysaccharides containing only D-glucose units.
- (b) What is the structural difference between the two?
- (c) Why does milk coagulate when lemon juice is added to it?

27. The progress of the reaction $A \rightleftharpoons nB$ with time is presented in the figure below:



Determine:

- (a) Value of n
- (b) Equilibrium constant k
- (c) Initial rate of conversion of A

28.

The molar volume of liquid benzene (density = 0.877 g mL^{-1}) increases by a factor of 2750 as it vaporises at 20°C and that of liquid toluene (density = 0.867 g mL^{-1}) increases by a factor of 7720 at 20°C . A solution of benzene and toluene at 20°C has a vapour pressure of 46.0 torr. Find the mole fraction of benzene in the vapour above the solution.

29.

(a) What are ambidentate ligands? Give an example.

(b) Write the names of the following:



(c) Draw the structure of the cis isomer of $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$.

30. Account for the following:

(a) Alcohols act as weak acids.

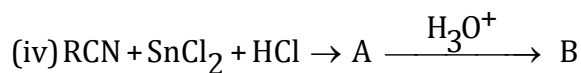
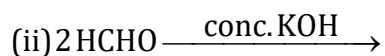
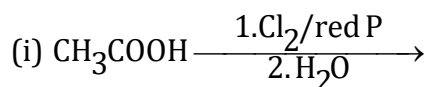
(b) Phenols have smaller dipole moment than alcohols.

(c) How can ethers be distinguished from alcohols? Give the equation involved.

Section-D

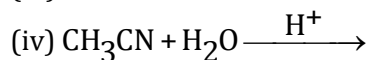
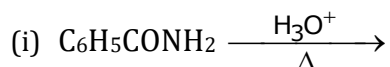
Q. No. 31 to 33 are long answer type carrying 5 marks each.

31. Complete the equations and name the reaction represented.



Or

Complete the equations:



32.

(a) Convert:

(i) Ethanal to crotonaldehyde

(ii) Propanoic acid to lactic acid

(b) Draw the structure of methyl hemiacetal of formaldehyde. How do carbonyl compounds react with sodium hydrogen sulphite? Explain giving a reaction.

33. 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.

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Sample Paper 3 - Solution

Time: 3 Hrs

Maximum Marks: 70

Section A

1.

(i) (c) This is because when an ideal solution is formed, no heat is evolved or absorbed.

(ii) (c) According to Raoult's law,

$$\frac{p^0 - p_s}{p^0} = x_B$$

$$\frac{760 - 750}{760} = \frac{10}{760} = \frac{1}{76}$$

(iii) (b) For solutions showing negative deviation the interaction between the components are greater than the pure components. For solutions having negative deviation, $\Delta v_{\text{mix}} < 0$ and $\Delta H_{\text{mix}} < 0$. In this case, the escaping tendency of the molecules is reduced and so it shows negative deviation.

(iv) (d)

$$p_s = \frac{p^0 - p_s}{p^0} = x_B$$

$$= \frac{760 - 750}{760} = \frac{10}{760} = \frac{1}{76}$$

2.

(i) (a) As the metal has fcc arrangement, so its coordination number is 12.

(ii) (a) In fcc arrangement, the packing efficiency is 74% so the fraction occupied by metal ions in crystal is 0.74.

(iii) (d)

$$\text{For fcc, } r = \frac{a}{2\sqrt{2}} = 0.3535 \times 407 = 143.9 \text{ pm}$$

(iv) (a)

The density is given by –

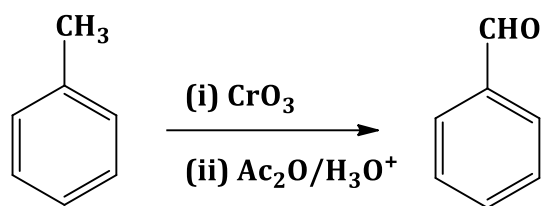
$$\rho = \frac{z \times M}{a^3 \times N_A}$$

$$a^3 = \frac{4 \times 197}{6.02 \times 10^{23} \times 10^{-30} \times 19.4} = 407 \text{ pm}$$

3. (d) On heating ammonium dichromate nitrogen gas is released.

4. (d) K_2MnO_4 cannot be converted to KMnO_4 using HCl .

5.



6. (a) The order of reaction is 3.

7. (c) Ni^{2+} , Ti^{3+}

8. (b) Ethylene oxide when treated with Grignard reagent yields a primary alcohol.

9. (d) Lyophilic colloids are stable due to layer of dispersion of medium on the particles.

10. (b) Turnbull's blue is Ferrous ferricyanide.

11. (b) The boiling point of azeotropic mixture of water and ethanol is less than that of water and ethanol. This mixture shows positive deviation from Raoult's law.

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

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

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

15. (b) Both assertion and reason are correct, but the reason is not the correct explanation of the assertion.

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

Section B

17. For a cell, $E_{\text{cell}}^{\theta} = \frac{0.059}{n} \log K_c$
 When $K_c < 1$, taking log, gives a negative value.
 For example:

$$E_{\text{cell}}^{\theta} = \frac{0.059}{n} \log 0.01$$

$$= -2 \times 0.059/n \text{ (negative value)}$$

Thus, E_{cell}^{θ} is negative if the equilibrium constant $K_c < 1$.

$$\text{If } E_{\text{cell}}^{\circ} = 0$$

$$\text{Then } 0 = \frac{0.059}{n} \log K_c$$

$$\log K_c = 0$$

$$K_c = \text{Antilog}(0)$$

$$\Rightarrow K_c = 1$$

18.

Given:

$$\text{Rate constant } K = 200 \text{ s}^{-1}$$

The half-life of the first-order reaction is

$$t_{1/2} = \frac{0.693}{K} = \frac{0.693}{200} = 3.46 \times 10^{-3} \text{ sec.}$$

19.

(a) Cl_2O :

$$2x - 2 = 0$$

$$2x = 2$$

$$x = +1$$

(b) KBrO_3 :

$$1 + x - 6 = 0$$

$$x = 6 + 1$$

$$x = 7$$

20. On adding I_2 and NaOH to both ethanol and methanol, ethanol will give a yellow ppt. of iodoform, while methanol will not.



Yellow



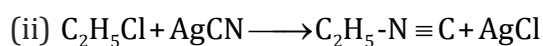
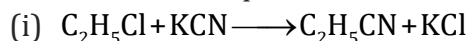
21.

(a) Methyl-2-aminobutanoate

(b) N-methylbenzenamine

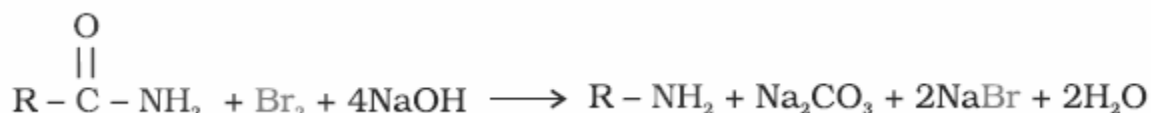
Or

(a) Ambident nucleophile



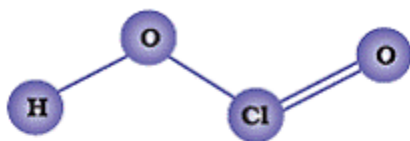
From the above reactions, it is clear that CN^- is an ambident nucleophile.

(b) Hoffmann bromamide degradation: Primary amines can be prepared from amides by treatment with Br_2 and KOH . Amine contains one carbon atom less than the parent amide.



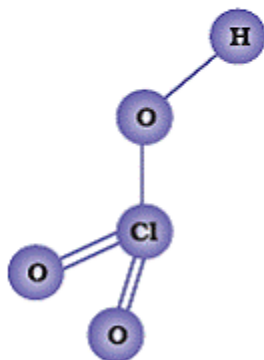
22.

(i)



Chlorous acid

(ii)



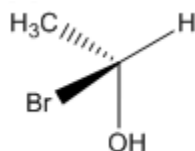
Chloric acid

23.

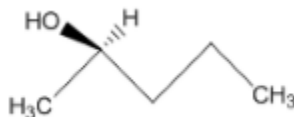
Smaller the size of particles of the adsorbent, larger will be the surface area and greater will be the extent of adsorption. At constant temperature, the extent of adsorption increases with increase in pressure—rapidly in the beginning, relatively slow at moderate pressure, attains equilibrium at high pressure and then ultimately becomes independent of pressure. In physical adsorption, it decreases with increase in temperature, but in chemisorption, it first increases and then decreases.

24.

(a)

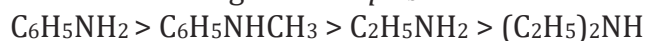


(b)

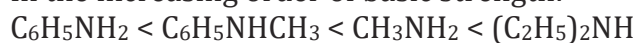


25.

(a) In the decreasing order of pK_b values:



(b) In the increasing order of basic strength:



Section-C

26.

- (a) Amylose is a straight chain polysaccharide having α -D-(+)-glucose units joined together by α -glycosidic linkages between C-1 of one glucose and C-4 of the next glucose. It has 200–1000 α -D-(+)-glucose units.
- (b) Cellulose is a straight chain polysaccharide composed of β -D-glucose units which are joined by glycosidic linkage between C1 of one glucose unit and C4 of the next glucose unit.
- (c) Milk is an emulsion which contains the protein casein as an emulsifier. On adding lemon juice, the pH changes, thus protein gets denatured, leading to the coagulation of milk.

27.

- (a) Observing the graph, there is a decrease in the concentration of A in the time period of four hours from 1 hr to 5 hr, i.e. $0.5 - 0.3 = 0.2$ M.
In this same period of time, an increase in the concentration of B is twice the decrease in concentration of A. Thus, $n = 2$.
- (b) $k = \frac{[B_{eq}]^2}{[A_{eq}]} = \frac{(0.6)^2}{(0.3)} = 1.2$
- (c) Initial rate of conversion of A = change in conc. of A during 1 hour

$$= \frac{0.6 - 0.5}{1} = 0.1 \text{ mol litre}^{-1} \text{ hour}^{-1}$$

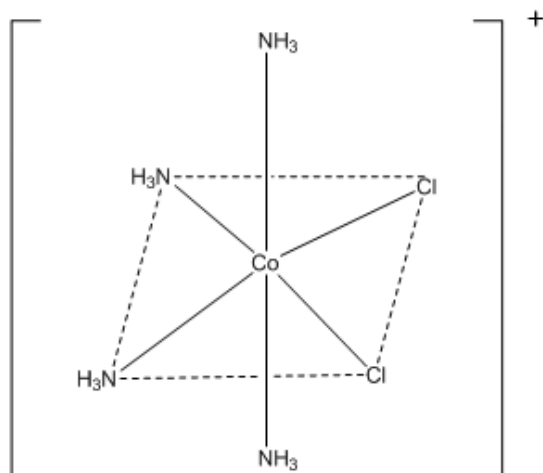
28.

- (a) Vapour pressure is the pressure of the vapour at the equilibrium state when the rate of evaporation becomes equal to the rate of condensation. Equilibrium constant does not change at a particular temperature, and therefore, the vapour pressure remains constant.
- (b) As the solution becomes cool, heat gets absorbed; hence, enthalpy change is positive. Thus, the solution shows positive deviation.
- (c) B will show greater lowering of vapour pressure because $\frac{P^0 - P^s}{P^0} = \frac{w_2 M_1}{w_1 M_2}$

29.

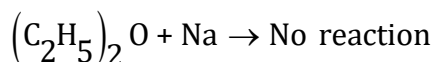
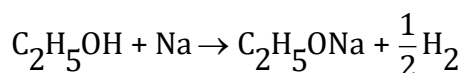
- (a) Ambidentate ligand: A unidentate ligand which can bind to the central metal atom through any of the two donor atoms present in it is called ambidentate ligand.
Example: NO_2^- , SCN^-

$$\begin{array}{cc} \text{M} \leftarrow \text{SCN} & \text{M} \leftarrow \text{NCS} \\ \text{Thiocynato} & \text{Isothiocynato} \end{array}$$
- (b)
 - (i) Potassium trioxalatochromate (III)
 - (ii) Diamminedichloridoplatinum (II)
- (c)



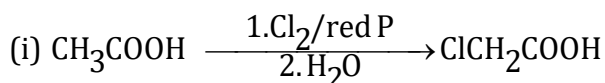
30.

- (a) The acidic character of alcohols is due to the polar nature of the O–H bond. An electron-releasing group increases electron density on oxygen tending to decrease the polarity of the O–H bond. This decreases the acid strength. Hence, alcohols act as weak acids.
- (b) Due to the electron-withdrawing inductive effect of the phenyl group, the C–O bond in phenol is less polar, whereas due to the electron-releasing inductive effect of the alkyl group, the C–O bond in alcohols is more polar. Hence, phenol has a smaller dipole moment than alcohols.
- (c) Alcohols react with sodium metal leading to the evolution of H_2 gas, while ethers do not react with sodium metal.



Section D

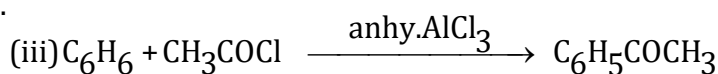
31.



Hell Volhard Zelinsky reaction



Cannizaro reaction

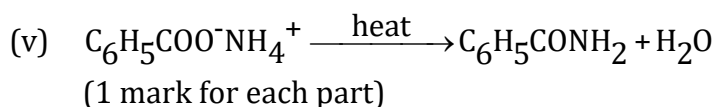
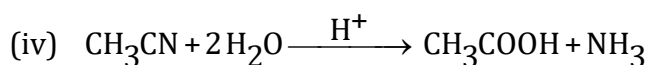
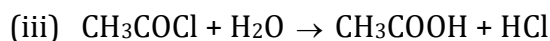
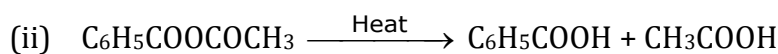
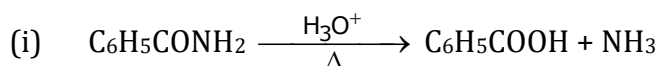


Friedel Crafts acylation



Stephen reduction

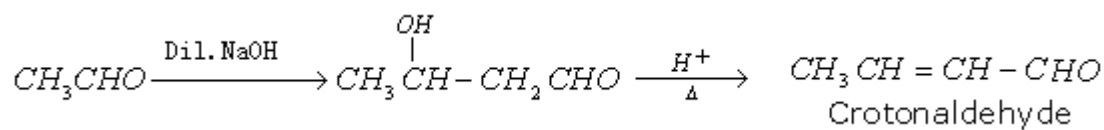
Or



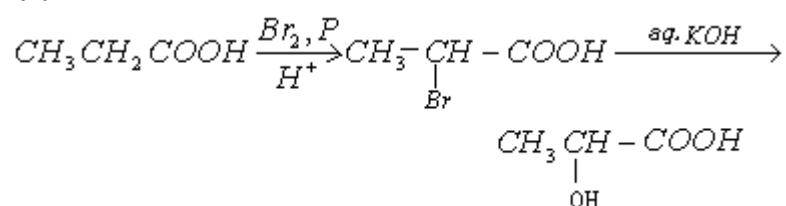
32.

(a)

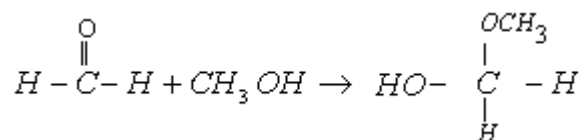
(i)



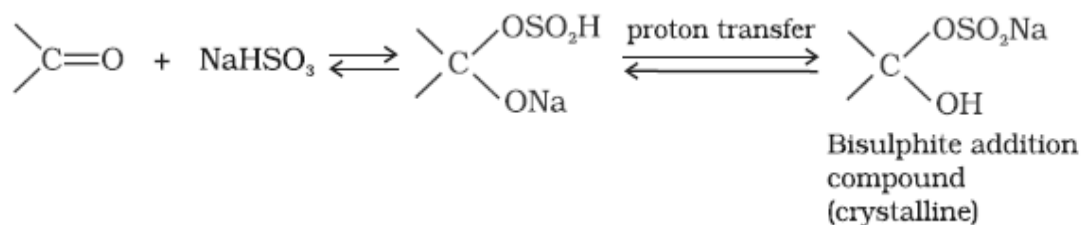
(ii)



(b)



(c) Carbonyl compounds react with $NaHSO_3$ to give a crystalline bisulphite addition product which on hydrolysis with dilute acid gives the original carbonyl compound.



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 $[\text{PCl}_4]^+ [\text{PCl}_6]^-$, 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.
Due to the $\text{N} \equiv \text{N}$ triple bond, N_2 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.