CBSE Sample Paper

Fully Solved

CHEMISTRY-XII

Issued by Central Board of Secondary Education

Time : 3 hrs **Max. Marks : 70**

General Instructions

1. All questions are compulsory.
2. Question numbers 1 to 8 are very short answer questions and carry 1 mark each.
3. Question numbers 9 to 18 are short answer questions and carry 2 marks each.
4. Question numbers 19 to 27 are also short answer questions and carry 3 marks each.
5. Question numbers 28 to 30 are long answer questions and carry 5 marks each.
6. Use log tables if necessary, use of calculator is not allowed.

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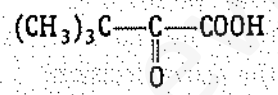
1. Bond enthalpy of fluorine is lower than that of chlorine, why?
2. Give the IUPAC name of the following compound



3. On adding catalyst, activation energy of a reaction decreases, why?
4. Which of the following is the most effective electrolyte in the coagulation of $(AgI/Ag)^+$ sol?

   K_2SO_4, $MgCl_2$, $K_4[Fe(CN)_6]$
5. Write the reaction when glucose is heated with excess of HI.
6. Which Xe compound has distorted octahedral shape?
7. What is the denticity of coordination compound used for the treatment of lead poisoning?
8. An alkoxide is a stronger base than hydroxide ion. Justify.
9. (i) State the law which helps to determine the limiting molar conductivity of weak electrolyte.
   (ii) Calculate limiting molar conductivity of $CaSO_4$ (limiting molar conductivity of calcium and sulphate ions are 119.0 and 106.0 S $cm^2 mol^{-1}$ respectively).
10. Rate constant k for the first order reaction has been found to be $2.54 \times 10^{-3}\ s^{-1}$. Calculate its three-fourth life.

OR

A first order gas reaction,

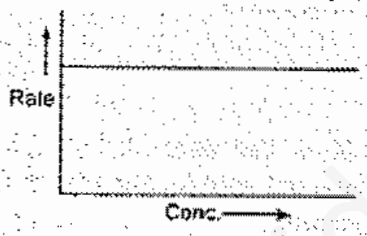
$$A_2B_2(g) \longrightarrow 2A(g) + 2B(g)$$

at the temperature 400°C has the rate constant $k = 2.0 \times 10^{-4}\ s^{-1}$. What percentage of A_2B_2 is decomposed on heating for 900 s?

11. Do the following conversions.
   (i) Methyl bromide to acetone.
   (ii) Benzyl chloride to 2-phenyl acetic acid.

12. How will you distinguish between the following pairs of compounds?
   (i) Chloroform and carbon tetrachloride.
   (ii) Benzyl chloride and chlorobenzene.

13. For a chemical reaction variation in rate with concentration is shown below.



   (i) What is the order of the reaction?
   (ii) What are the units of rate constant k for the reaction?

14. Give the electronic configuration of d-orbitals of $K_3[Fe(CN)_6]$ and $K_3[FeF_6]$ and explain why these complexes give different colour with same solution? (Atomic number of Fe = 26 u)

15. Give reason for the following.
   (i) o-toluidine is more basic than aniline.
   (ii) Tertiary amines do not undergo acetylation reaction.

16. Write the following name reactions.
   (i) Gabriel phthalimide reaction.
   (ii) Hofmann bromamide reaction.

17. Silver metal crystallises with a face centred cubic lattice. The length of unit cell is found to be 4.077×10^{-8} cm. Calculate atomic radius and density of silver.
   (Atomic mass of Ag = 108 u, $N_A = 6.022 \times 10^{23}\ mol^{-1}$)

18. Calculate packing efficiency in ccp structure.

19. Manu and his father went to a shop to purchase a battery for their inverter. Shopkeeper showed them two types of batteries, one with lead plates and the other with cadmium plates. The battery with cadmium plates was more expensive than the lead battery. Manu's father wanted to purchase lead battery as it was cheaper.
   After reading the above passage, answer the following questions.
   (i) As a student of chemistry, why would you suggest to Manu's father to buy the expensive cadmium plate battery. Give two reasons.
   (ii) What are the values associated with the above decision?

20. Give a reason for the following.
   (i) Rough surface of catalyst is more effective than smooth surface.
   (ii) Smoke passed through charged plates before allowing it to come out of chimneys in factories.
   (iii) Ne gets easily adsorbed over charcoal than He.

21. (i) Give one example of each of the following.
   (a) Acidic flux (b) Basic flux

(ii) What happens when
(a) Cu_2O undergoes self reduction in a silica lined converter?
(b) Haematite oxidises carbon to carbon monoxide?

OR

(i) What role does cryolite play in Hall Heroult process?

(ii) How can alumina be separated from silica in a bauxite ore associated with silica? Give equations also.

22. Write balanced chemical equations for the following reactions.
(i) Hypophosphorous acid is added to $AgNO_3$ solution.
(ii) Chlorine gas is passed through hot and concentrated solution of sodium hydroxide.
(iii) XeF_2 undergoes hydrolysis.

23. (i) Draw the structure of sulphuric acid.
(ii) A sparkless current is passed through oxygen to prepare ozone, why?
(iii) Bleaching action of sulphur dioxide is a temporary action. Comment.

24. (i) Give one structural difference between amylose and amylopectin.
(ii) Name the protein and its shape present in oxygen carrier in human body.
(iii) Name two fat storing tissues in human body.

25. Define the following by giving one example of each.
(i) Antiseptics
(ii) Antioxidants
(iii) Narcotic analgesics

26. (i) Write the names of the monomers of polymer used for making unbreakable crockery.
(ii) Write the reaction of preparation of neoprene.
(iii) Arrange the following polymers in decreasing order of intermolecular forces.
PVC, Nylon 66, Natural rubber

27. Write the mechanism for the preparation of ethanol from ethene.

28. (i) What is the freezing point of 0.4 molal solution of acetic acid in benzene in which it dimerises to the extent of 85%? Freezing point of benzene is 278.4 K and its molar heat of fusion is 10.042 kJ mol^{-1}.
(ii) Explain the following.
(a) Solution of chloroform and acetone is an example of maximum boiling azeotrope.
(b) A doctor advised a person suffering from high blood pressure to take less quantity of common salt.

OR

(i) Calculate the boiling point of a solution containing 0.061g of benzoic acid in 5 g of CS_2. Assuming 84% dimerisation of acid. The boiling point and K_b of CS_2 are 46.2°C and 2.3 K kg mol^{-1} respectively.
(ii) State Raoult's law for the solution containing non-volatile solute. Give its mathematical expression also.

29. Account for the following.
(i) Transition elements show highest oxidation state in their oxides than fluorides.

(ii) Cu has positive electrode potential in the first transition series.

(iii) Ionisation enthalpy of lanthanides is higher than actinides.

(iv) Potassium dichromate is a good oxidising agent in acidic medium.

(v) Actinides show more number of oxidation states than lanthanides.

OR

(i) Compare non-transition and transition elements on the basis of their
(a) variability of oxidation states.
(b) stability of oxidation states.

(ii) Give chemical reactions for the following observations.
(a) Potassium permanganate is a good oxidising agent in basic medium.
(b) Interconvertibility of chromate ion and dichromate ion in aqueous solution depends upon pH of the solution.
(c) Potassium permanganate is thermally unstable at 513 K.

30. (i) Give names of the reagents to bring about the following transformations.
(a) Ethanoic acid to ethanol
(b) Propan-1-ol to propanal
(c) Pent-3-en-2-ol to pent-3-en-2-one
(d) Sodium benzoate to benzene

(ii) Arrange the following in the increasing order.
(a) Methanal, propanal, butanone, ethanal, propanone (nucleophilic addition reaction)
(b) Formaldehyde, acetone, acetaldehyde (reactivity towards HCN)
(c) Acetophenone, *p*-tolualdehyde, *p*-nitrobenzaldehyde, benzaldehyde (nucleophilic addition reaction)

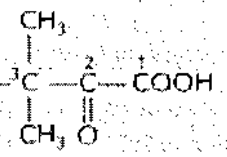
OR

(i) Bring out the following conversions.
(a) 4-nitrotoluene to 2-bromobenzoic acid.
(b) Ethylcyanide to 1-phenyl propanone.

(ii) Give a reason for the following.
(a) Chloroacetic acid is more acidic than acetic acid
(b) Carboxylic acids have higher boiling point than alcohols
(c) 4-nitrobenzoic acid is more acidic than 4-methoxy benzoic acid

Answers

1. Bond enthalpy of fluorine is lower than that of chlorine because there are relatively large electron-electron repulsion among the lone pairs of fluorine (F_2) molecule due to its smaller size, but they are much closer to each other in chlorine (Cl_2) molecule. (1)

2. 

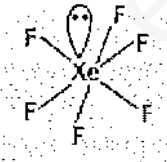
   IUPAC name = 3, 3-dimethyl-2-oxobutanoic acid. (1)

3. Catalyst reduces the activation energy by providing a new path way where intermediate compound is formed with less energy consumption than needed for the actual reaction. (1)

4. $K_4[Fe(CN)_6]$ as $[Fe(CN)_6]^{4-}$ the oppositely charge ion, charge ion, carry highest charge. (1)

5. $CHO—(CHOH)_4—CH_2OH + \underset{\text{(Excess)}}{HI} \xrightarrow{\Delta} CH_3—(CH_2)_4—CH_3$ (1)
   Glucose → n-hexane

6. XeF_6 has distorted octahedral shape. (1)

7. EDTA (Ethylene diamine tetra acetate) is used for the treatment of lead poisoning. $\left(\frac{1}{2}\right)$

   It is a hexadentate ligand, i.e., its denticity is 6. $\left(\frac{1}{2}\right)$

8. An alkoxide ion is a stronger base than hydroxide ion because there is higher electron density on an alkoxide ion due to the presence of an alkyl group as compared to hydroxide ion where electron density is lower. (1)

9. (i) **Kohlrausch law of independent migration of ions**
   The law states that limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of the anion and cation of the electrolyte towards molar conductance. (1)

   (ii) $\Lambda^\circ_{m,CaSO_4} = \lambda^\circ_{Ca^{2+}} + \lambda^\circ_{SO_4^{2-}}$

   $= 119.0\ S\ cm^2\ mol^{-1} + 106.0\ S\ cm^2\ mol^{-1}$

   $= 225.0\ S\ cm^2\ mol^{-1}$ (1)

10. Given, $k = 2.54 \times 10^{-3}\ s^{-1}; a = 1; x = \frac{3}{4}$

    For a first order reaction,

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

    $$t = \frac{2.303}{k} \log \frac{a}{(a-x)} \quad \left(\frac{1}{2}\right)$$

    $$t_{3/4} = \frac{2.303}{2.54 \times 10^{-3}} \log \frac{1}{\left(1-\frac{3}{4}\right)} \quad \left(\frac{1}{2}\right)$$

    $$= 0.9066 \times 10^3 \times 0.6021$$

    $$t_{3/4} = 5.46 \times 10^2\ s \quad (1)$$

    OR

    Given, $k = 2.0 \times 10^{-4}\ s^{-1}$

    $t = 900\ s$

    For first order reaction,

    $$k = \frac{2.303}{t} \log \frac{a}{(a-x)} \quad \left(\frac{1}{2}\right)$$

    $$2.0 \times 10^{-4}\ s^{-1} = \frac{2.303}{900} \log \frac{a}{(a-x)} \quad \left(\frac{1}{2}\right)$$

    $$\log \frac{a}{(a-x)} = \frac{2.0 \times 10^{-4} \times 900}{2.303}$$

    $$= 0.0781 \quad \left(\frac{1}{2}\right)$$

Taking antilog $\frac{a}{a-x}$, antilog 0.0781 = 1.197

$$a = 1.197\,a - 1.197\,x$$

$$x = \frac{0.197}{1.197}\,a = 0.1645\,a$$

where, a = 100, then $x = 0.1645 \times 100 = 16.45$

It means that 16.45% of initial concentration is decomposed to form products. $\left(\frac{1}{2}\right)$

11. (i) Methyl bromide to acetone

$$\underset{\text{Methyl bromide}}{CH_3Br} + Mg \xrightarrow{\text{Dry ether}} CH_3MgBr$$

$$\xrightarrow{CH_3CHO} \left[CH_3-\underset{CH_3}{\overset{OMgBr}{\underset{|}{\overset{|}{C}}}}-H\right] \xrightarrow{H_3O^+}$$

$$CH_3-\underset{CH_3}{\overset{OH}{\underset{|}{\overset{|}{C}}}}-H \xrightarrow[573\,K]{Cu} \underset{\text{Acetone}}{CH_3COCH_3} \quad (1)$$

(ii) Benzyl chloride to 2-phenyl acetic acid

$$\underset{\text{Benzyl chloride}}{C_6H_5CH_2Cl} \xrightarrow{KCN} C_6H_5CH_2CN$$

$$\xrightarrow{H_3O^+} \underset{\text{2-Phenyl acetic acid}}{C_6H_5CH_2COOH} \quad (1)$$

12. (i) Chloroform and carbon tetrachloride

When chloroform is heated with aniline and ethanolic potassium hydroxide, a pungent smelling isocyanide is formed.

Carbon tetrachloride does not respond to this test. (1)

$$CHCl_3 + C_6H_5NH_2 + 3KOH \longrightarrow C_6H_5NC + 3KCl + 3H_2O$$

$$CCl_4 + C_6H_5NH_2 + KOH \longrightarrow \text{No reaction}$$

(ii) Benzyl chloride and chlorobenzene

When benzyl chloride is treated with NaOH and $AgNO_3$, a white precipitate is formed.

Chlorobenzene does not form white ppt. with NaOH and $AgNO_3$. (1)

$$C_6H_5CH_2Cl + AgNO_3 \xrightarrow{NaOH} C_6H_5CH_2NO_3 + \underset{\text{white ppt.}}{AgCl\downarrow}$$

$$C_6H_5Cl + AgNO_3 \xrightarrow{NaOH} \text{No ppt.}$$

13. (i) Order of the reaction is zero. (1)

(ii) For zero order reaction,

$$\text{rate}\left(\frac{dx}{dt}\right) = k[A]^0 = k$$

$\therefore$ Unit of rate constant $k = \text{mol}\,L^{-1}s^{-1}$ (1)

14. (i) Oxidation state of Fe in $K_3[Fe(CN)_6]$ is +3.

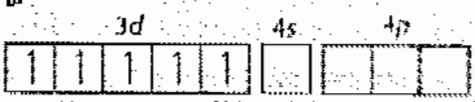
Configuration of Fe^{3+} is $[Ar]3d^5$,

$K_3[Fe(CN)_6]$

Pairing of *d*-electrons takes place and only one unpaired electron, is left. (1/2)

(ii) In $K_3[FeF_6]$, oxidation state of Fe is + 3 and there are 5 unpaired electrons in 3*d* orbital because F^- (a weak field ligand) cannot pair the unpaired electrons of Fe.

$K_3[FeF_6]$



(1/2)

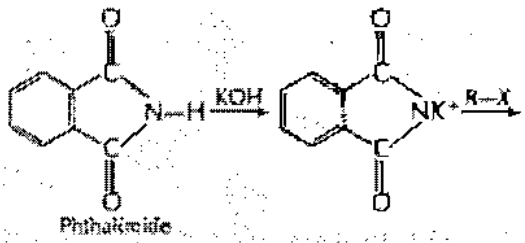
Because of the presence of different number of unpaired electrons, these impart different colour with same solution. (1)

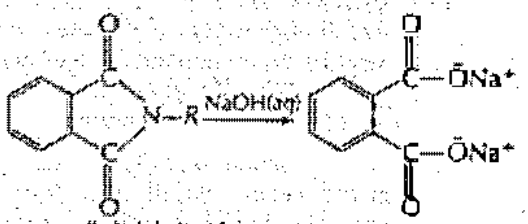
15. (i) Due to the presence of electron releasing methyl group (+*I* effect) at *ortho* position electron density at the nitrogen of NH_2 in o-toluidine increases. Therefore, o-toluidine is more basic than aniline. (1)

(ii) Due to the absence of replaceable hydrogen atom at nitrogen, tertiary amines do not undergo acetylation reaction. (1)

16. (i) **Gabriel phthalimide reaction** It is an important reaction for the preparation of primary amines. In this reaction, phthalimide

is first treated with KOH and then heated with alkyl halide. The obtained product on hydrolysis gives primary amine, e.g.,





$+ R—NH_2$ (1)

Primary amine

(ii) **Hofmann bromamide reaction** The reaction which involves conversion of amide into amine by treating it with Br_2 and NaOH is called Hofmann bromamide reaction e.g.,

$$R—\underset{\underset{O}{\|}}{C}—NH_2 + Br_2 + 4NaOH \longrightarrow RNH_2 + Na_2CO_3 + 2NaBr + 2H_2O \quad (1)$$

17. Given, $a = 4.077 \times 10^{-8}$ cm, $Z = 4$

(for fcc unit cell)

$M = 108$ g mol^{-1}, $N_A = 6.022 \times 10^{23}$

$$\text{Density, } d = \frac{Z \times M}{a^3 \times N_A} \quad \left(\frac{1}{2}\right)$$

$$= \frac{4 \times 108 \text{ g mol}^{-1}}{(4.077 \times 10^{-8} \text{ cm})^3 \times 6.022 \times 10^{23}}$$

$$d = 10.58 \text{ g cm}^{-3} \quad \left(\frac{1}{2}\right)$$

$$\text{Atomic radius, } r = \frac{a}{2\sqrt{2}} = \frac{4.077 \times 10^{-8} \text{ cm}}{2\sqrt{2}}$$

$$r = 1.441 \times 10^{-8} \text{ cm} \quad (1)$$

18. For ccp structures, $a = \frac{4r}{\sqrt{2}} = 2\sqrt{2}r$

or $$r = \frac{a}{2\sqrt{2}} \quad (1)$$

Packing efficiency

$$= \frac{\text{Volume occupied by four spheres in the unit cell}}{\text{Total volume of the unit cell}} \times 100\% \quad \left(\frac{1}{2}\right)$$

$$= \frac{4 \times \frac{4}{3}\pi r^3 \times 100}{(2\sqrt{2}\,r)^3}\% \quad \left(\frac{1}{2}\right)$$

$$= \frac{\left(\frac{16}{3}\right)\pi r^3 \times 100}{16\sqrt{2}r^3}\%$$

Packing efficiency = 74% $\left(\frac{1}{2}\right)$

19. (i) We would suggest Mana's father to buy expensive cadmium plate battery instead of the lead plate battery due to following reasons

(a) Lead causes harmful effect on human beings. (1/2)

(b) It also has adverse effects on environment. (1/2)

If health and environment can be saved by spending a little amount of more money, it is beneficial. (1)

(ii) Values associated with the above decision

(a) Knowledge of chemistry and its relation to our environment. (1/2)

(b) Knowledge is useful only when utilised, awareness of lead free petrol-legal aspect of pollution free environment. Less usage of lead batteries to keep ourselves and the environment healthy. (1/2)

20. (i) Rough surface of a catalyst provides more surface area for adsorption so more effective than smooth surface. (1)

(ii) By doing so, the unburnt charged carbon particles settle down between the charged plates leaving behind air free from pollutants. (1)

(iii) Neon has higher critical temperature than helium so, liquefied readily and form stronger van der Waals' bond with adsorbent. Therefore, it is easily adsorbed. (1)

21. (i) (a) **Acidic flux** e.g., SiO_2 (as it forms slag with basic impurities like FeO) (1/2)

(b) Basic flux e.g., CaO (as it forms slag with acidic impurities like SiO_2) $\left(\frac{1}{2}\right)$

(ii) (a) When Cu_2O undergoes self reduction in a silica lined converter, blister copper is formed:

$$2Cu_2O + Cu_2S \longrightarrow 6Cu + SO_2 \quad (1)$$

(b) Haematite oxidises carbon to carbon monoxide and itself gets reduced to molten iron.

$$Fe_2O_3 + 3C \longrightarrow 3CO + 2Fe \quad (1)$$

OR

(i) Cryolite is added to alumina during the electrolytic reduction (Hall Heroult's process)

(a) to reduce the melting point of the electrolytic mixture and $\left(\frac{1}{2}\right)$

(b) to increase its conductivity. $\left(\frac{1}{2}\right)$

(ii) If bauxite is associated with silica, Serpeck's process is used, in which the ore is mixed with coke and heated at 1800°C in a current of nitrogen. By this, alumina gets converted into AlN and SiO_2 into Si. Si being volatile, passes off as vapours. (1/2)

$$Al_2O_3 + 3C + N_2 \longrightarrow 2AlN + 3CO$$

$$SiO_2 + 2C \longrightarrow Si + 2CO \quad (1/2)$$

AlN on dilution induces the precipitation of aluminium hydroxide.

$$AlN + 3H_2O \longrightarrow Al(OH)_3 + NH_3 \quad (1/2)$$

The precipitate is filtered, washed and ignited to obtain alumina.

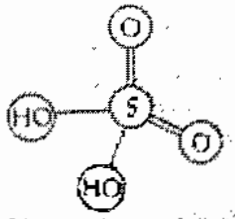
$$2Al(OH)_3 \xrightarrow{\Delta} Al_2O_3 + 3H_2O \quad (1/2)$$

22. (i) $H_3PO_2 + 4AgNO_3 + 2H_2O \longrightarrow 4Ag + 4HNO_3 + H_3PO_4$ (1)

(ii) $3Cl_2 + 6NaOH \xrightarrow[\text{(Hot and conc.)}]{} 5NaCl + NaClO_3 + 3H_2O$ (1)

(iii) $2XeF_2(s) + 2H_2O(l) \longrightarrow 2Xe(g) + 4HF(aq) + O_2(g)$ (1)

23. (i) Structure of sulphuric acid (H_2SO_4) (1)



(ii) A sparkless (silent) electric discharge is passed through oxygen to prepare ozone to prevent its decomposition, as the reaction $[3O_2 \longrightarrow 2O_3; \Delta H° \text{ at } 298\ K = +142\ kJ\ mol^{-1}]$ is endothermic. (1)

(iii) Bleaching action of SO_2 is due to its reducing nature. So, it is a temporary action. The bleached article regains its original colour, when exposed to air. (1)

$$SO_2 + 2H_2O \longrightarrow H_2SO_4 + 2[H]$$

Coloured matter + [H] $\longrightarrow$ Colourless (Bleached) matter

Bleached matter + O_2 $\longrightarrow$ Colour is regained.

24. (i) Amylose is a long unbranched chain polymer of α-D(+) glucose. $\left(\frac{1}{2}\right)$

Amylopectin is a branched chain polymer of α-D glucose. $\left(\frac{1}{2}\right)$

(ii) Haemoglobin is the oxygen carrier in human body and globin is a globular protein and have spherical shape. $\left(\frac{1}{2} + \frac{1}{2}\right)$

(iii) Liver and adipose tissue. $\left(\frac{1}{2} + \frac{1}{2}\right)$

25. (i) **Antiseptics** The chemicals applied to the living tissues either to kill or prevent the growth of microorganisms are called antiseptics, e.g., dettol. $\left(\frac{1}{2} + \frac{1}{2}\right)$

(ii) **Antioxidants** These are the compounds that retard the action of oxygen on food and reduces its rate of decomposition or spoilage due to oxidation.

e.g., butylated hydroxyanisole (BHA). $\left(\frac{1}{2}+\frac{1}{2}\right)$

(iii) Narcotic analgesics These are the chemicals used for the relief of post operative pain. Actually these produce sleep and unconsciousness, e.g., morphine. $\left(\frac{1}{2}+\frac{1}{2}\right)$

26. (i) Melamine and formaldehyde are the monomers of melmac, a polymer used for making unbreakable crockery. $\left(\frac{1}{2}+\frac{1}{2}\right)$

(ii) $n CH_2=\underset{\underset{Cl}{|}}{C}-CH=CH_2 \xrightarrow{\text{Polymerisation}}$

Chloroprene (2-chlorobuta-1, 3-diene

$$\left[-CH_2-\underset{\underset{Cl}{|}}{C}=CH-CH_2-\right]_n$$

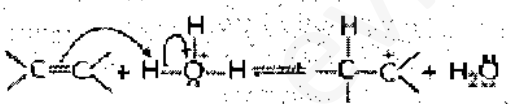
Neoprene (1)

(iii) Nylon 66 > PVC > Natural rubber. (1)

27. **Mechanism for preparation of ethanol from ethene** It involves the following three steps.

Step I Protonation of alkene to form carbocation by electrophilic attack of H_3O^+.

$$H_2O + H^+ \longrightarrow H_3O^+$$

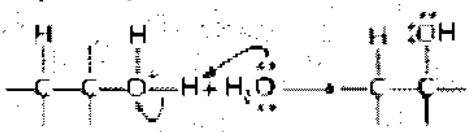


(1)

Step II Nucleophilic attack of water on carbocation

(1)

Step III Deprotonation to form an alcohol



(1)

28. (i) Given, $m = 0.4$; $T_f^\circ = 270.4$ K

$\Delta_{fus}H = 10.042$ kJ mol^{-1}

$$K_f = \frac{RT_f^2M}{1000 \times \Delta_{fus}H}$$

$$= \frac{8.314 \times 10^{-3} \times (270.4)^2 \times 78}{1000 \times 10.042} \quad \left(\frac{1}{2}\right)$$

$$= 5.0 \text{ K kg mol}^{-1} \quad \left(\frac{1}{2}\right)$$

$2CH_3COOH \xrightarrow{\text{Dimerisation}} (CH_3COOH)_2$

$$\alpha = \frac{i-1}{\frac{1}{n}-1} = \frac{i-1}{\frac{1}{2}-1} = \frac{i-1}{-0.5} = 0.85 \quad \left(\frac{1}{2}\right)$$

$$i - 1 = -0.425$$

$$i = 0.575 \quad \left(\frac{1}{2}\right)$$

$$\Delta T_f = i K_f m = 0.575 \times 5 \times 0.4 = 1.15 \quad \left(\frac{1}{2}\right)$$

$$T_f = T_f^\circ - \Delta T_f = 270.4 - 1.15$$

$$= 277.25 \text{ K} \quad \left(\frac{1}{2}\right)$$

(ii) (a) This solution has lesser vapour pressure due to stronger interactions between chloroform and acetone molecules. (1)

(b) Because higher quantity of NaCl will increase number of sodium and chloride ions in the body fluid which can increase the osmotic pressure of the body fluid, i.e., the blood pressure of a person. (1)

OR

(i) Molality, $m = \frac{0.061 \times 10^3}{122 \times 5}$ $\left(\frac{1}{2}\right)$

$$= 0.1 \quad \left(\frac{1}{2}\right)$$

$2C_6H_5COOH \xrightarrow{\text{Dimerisation}} (C_6H_5COOH)_2$

$$\alpha = \frac{i-1}{\frac{1}{n}-1} = 0.84; \quad \frac{i-1}{\frac{1}{2}-1} = 0.84 \quad \left(\frac{1}{2}\right)$$

$$i = 1 - \frac{0.84}{2} = 1 - 0.42 = 0.58$$

Normal molar mass of benzoic acid
$= 122\text{ g mol}^{-1}$ $\left(\frac{1}{2}\right)$

$$\Delta T_b = i \cdot K_b \cdot m = 0.58 \times 2.3 \times 0.1$$
$$= 0.1334°C \quad \left(\frac{1}{2}\right)$$

$$T_b = T_b^\circ + \Delta T_b = 46.2 + 0.1334$$
$$= 46.334°C \quad \left(\frac{1}{2}\right)$$

(ii) **Raoult's law** : According to the law, the relative lowering of vapour pressure of the solvent over a solution is equal to the mole fraction of the non-volatile solute present in the solution. (1)

Mathematical expression $x_B = \frac{p_1^\circ - p_1}{p_1^\circ}$

or $\frac{n}{n+N} = \frac{p_1^\circ - p_1}{p_1^\circ}$

where n = moles of solute and
N = moles of solvent (1)

29. (i) Because oxygen forms multiple bonds with transition metals but fluorine does not form multiple bonds.

(ii) Because copper has lower hydration enthalpy which is unable to compensate the sum of first and second ionisation enthalpy.

(iii) 4*f* electrons of lanthanides held effectively by nuclear charge than 5*f*-electrons of actinides.

(iv) Because dichromate ions get reduced to chromium ions in acidic medium.

(v) The actinides show more number of oxidation states than lanthanides because in actinides 5*f*, 6*d* and 7*s* levels have comparable energies. $(1 \times 5 = 5)$

OR

(i) (a) Oxidation states of transition elements differ from each other by unity (due to comparable energy of $(n-1)d$ and ns orbitals). In non-transition elements, oxidation states normally differ by a unit or two (due to inert pair effect). $\left(\frac{1}{2} + \frac{1}{2}\right)$

(b) In transition elements, higher oxidation states are favoured by heavier elements whereas in non-transition elements, lower oxidation state is favoured. $\left(\frac{1}{2} + \frac{1}{2}\right)$

(ii) (a) $2MnO_4^- + H_2O + I^- \longrightarrow 2MnO_2 + 2OH^- + IO_3^-$ (1)

(b) $2CrO_4^- + 2H^+ \underset{\text{Alkali (pH > 7)}}{\overset{\text{Acid (pH < 7)}}{\rightleftharpoons}} Cr_2O_7^{2-} + H_2O$ (1)

(c) $2KMnO_4 \xrightarrow{513\text{ K}} K_2MnO_4 + MnO_2 + O_2$ (1)

30. (i) (a) $LiAlH_4 / H_3O^+$

(b) PCC (Pyridine chlorochromate)

(c) PCC

(d) Sodalime (NaOH + CaO) $\left(\frac{1}{2} \times 4\right)$

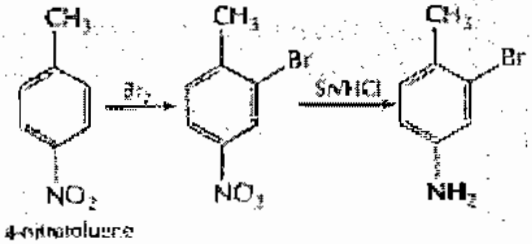
(ii) (a) Butanone < propanone < propanal < ethanal < methanal

(b) Acetone < acetaldehyde < formaldehyde

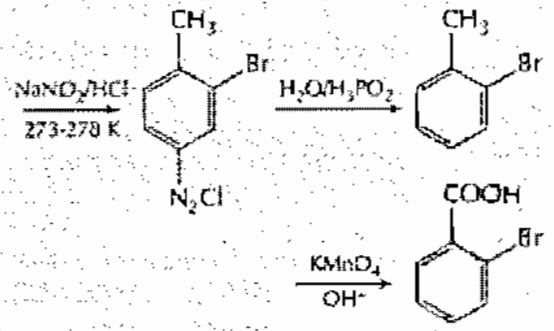
(c) Acetophenone < *p*-tolualdehyde < benzaldehyde < *p*-nitrobenzaldehyde (1×3)

OR

(i)(a) 4-nitrotoluene to 2-bromobenzoic acid



4-nitrotoluene



2-bromobenzoic acid

(1)

(b) Ethyl cyanide to 1-phenyl propanone

$$CH_3—CH_2CN + C_6H_5MgBr \xrightarrow{\text{Ether}}$$

Ethyl cyanide

$$CH_3CH_2—\overset{NMgBr}{\overset{\|}{C}}—C_6H_5 \xrightarrow{H_3O^+}$$

$$CH_3CH_2—\overset{O}{\overset{\|}{C}}—C_6H_5$$

1-phenylpropanone or (Propiophenone) (1)

(ii) (a) Because chloroacetate ion is more resonance stabilised than acetate ion due to the presence of electron withdrawing chlorine atom (–*I* effect).

(b) This is because of the presence of extensive intermolecular hydrogen bonding in carboxylic acids than in alcohol molecules.

(c) Because of –*I* effect of nitro group, stability of benzoate ion increases in 4-nitrobenzoic acid. But methoxy group decreases the stability of benzoate ion due to +*I* effect. (1 × 3)