Question Paper 2008 Delhi Set-2

Class-12 Chemistry

Time Allowed: 3 Hours, Maximum Marks: 70

General Instructions

1. All questions are compulsory.
2. Marks for each question are indicated against it.
3. Question numbers 1 to 8 are very short-answer questions, carrying 1 mark each. Answer these in one word or about one sentence each.
4. Question numbers 9 to 18 are short-answer questions, carrying 2 marks each. Answer these in about 30 words each.
5. Question numbers 19 to 27 are short-answer questions of 3 marks each. Answer these in about 40 words each.
6. Question numbers 28 to 30 are long-answer questions of 5 marks each. Answer these in about 70 words each.
7. Use Log Tables, if necessary Use of calculators is not permitted.

1. What is the total number of atoms per unit cell in a face-centred cubic (fcc) structure? [1]

Ans. 4.

2. What is a primary cell? Give an example. [1]

Ans. In primary battery the reaction occurs only once and after use over a period of time becomes dead. Leclanche cell or Dry cell is an example.

3. What causes Brownian movement in a colloidal solution? [1]

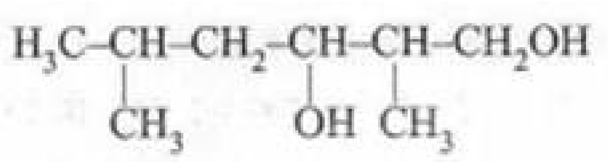
Ans. Due to unbalanced bombardment of the colloidal particles by the molecules of the dispersion medium.

4. In which one of the two structures, NO_2^+ and NO_2^-, the bond angle has a higher value. [1]

Ans. NO_2^+

---

5. Write the IUPAC name of the following compound: [1]



$H_3C-CH(CH_3)-CH_2-CH(OH)-CH(CH_3)-CH_2OH$

Ans. 2,5-Dimethylhexane -1,3-diol.

---

6. Write the IUPAC name of the following compound: [1]

$CH_3COCH_2COCH_3$

Ans. Pentane -2, 4 –dione

---

7. Write a chemical reaction in which the iodide ion replaces the diazonium group in a diazonium salt. [1]

Ans. $C_6H_5N_2^+Cl^- + KI \rightarrow C_6H_5I + KCl + N_2$

---

8. Name a substance that can be used as an antiseptic as well as a disinfectant. [1]

Ans. Phenol .

---

9. State Raoult's law for solutions of volatile liquids. Taking suitable examples explain the meaning of positive and negative deviations from Raoult's law. [2]

OR

Define the term osmotic pressure. Describe how the molecular mass of a substance can be determined by a method based on measurement of osmotic pressure?

Ans. Raoult’s law states that for a solution of volatile liquids, the partial vapour pressure of each component in the solution is directly proportional to its mole fraction.

When the solute-solvent interaction is weaker than those between the solute-solute and solvent-solvent molecules than solution shows positive deviation from Raoults law because the partial pressure of each component is greater.
ex. mixture of ethanol and acetone or carbon-disulphide and acetone behave in this manner.

When the solute-solvent interaction is stronger than those between the solute-solute and solvent-solvent molecules than solution shows negative deviation from Raoults law and the partial vapour pressure of each component is lower.
ex. mixture of chloroform and acetone behave in this manner.

OR

The extra pressure applied on the solution side that just stops the flow of solvent to solution through semi-permeable membrane is called osmotic pressure of the solution.
Here π is the osmotic pressure and R is the gas constant.

$$\pi = (n_2 / V)RT$$

$$\pi V = \frac{w_2 RT}{M_2}$$

$$or\ M_2 = \frac{w_2 RT}{\pi V}$$

Thus, knowing the quantities $w_2,\ T,\ \pi\ and\ V$ we can calculate the molar mass of the solute

10. The conductivity of a $0.20\ M$ solution of $KCl\ at\ 298\ K\ is\ 0.0248\ S\ cm^{-1}$. Calculate its molar conductivity. [2]

Ans. $\Lambda_m = \dfrac{\kappa \times 1000 cm^3 L^{-1}}{c}$

$$= \frac{0.0248\, S\, cm^{-1} \times 1000\, cm^3\, L^{-1}}{0.20\, mol\, L^{-1}} = \frac{24.8\, S\, cm^2}{0.20\, mol}$$

$\Lambda_m = 124\, S\, cm^2\, mol^{-1}$

---

11. Formulate the galvanic cell in which the following reaction takes place: [2]

$$Zn(s) + 2Ag^+(aq) \rightarrow Zn^{2+}(aq) + 2Ag(s)$$

State:

(i) Which one of its electrodes is negatively charged.

(ii) The reaction taking place at each of its electrode.

(iii) The carriers of current within this cell.

Ans. The galvanic cell is depicted as:

$$Zn(s)|Zn^{2+}(aq)||Ag^+(aq)|Ag(s)$$

(i) Zinc electrode is negatively charged

(ii) The ions formed i.e Zn^{2+} and Ag^+ in the solution are the carriers of the current within the cell.

(iii) At anode: $Zn(s) \rightarrow Zn^{2+}(aq) + 2e^-$

At cathode: $2Ag^+(aq) + 2e^- \rightarrow 2Ag(s)$

---

12. Define the following terms in relation to proteins: [2]

(i) Peptide linkage

(ii) Denaturation

Ans. (i) Peptide linkage: Peptide linkage is an amide $(-CO-NH-)$ bond formed between $-COOH$ and $-NH_2$ group in protein formation.

(ii) Denaturation: When a protein in its native form, is subjected to physical change like change in temperature or chemical change like change in pH, protein loses its biological activity. This is called denaturation of protein.

13. List the reactions of glucose which cannot be explained by its open chain Structure. [2]

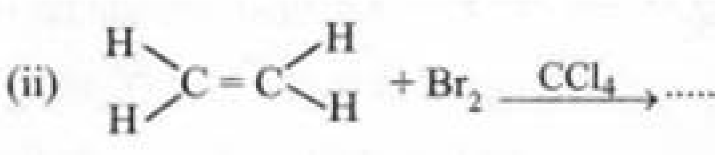
Ans. (i) Despite having the aldehyde group, glucose does not give 2,4-DNP test or Schiff's test.

(ii) It does not form the hydrogen sulphite addition product with $NaHSO_3$.

(iii) The pentaacetate of glucose does not react with hydroxylamine indicating the absence of free $-CHO$ group. (any two)

14. Complete the following reaction equations: [2]

$(i) C_6H_5N_2Cl + KI \rightarrow ...$

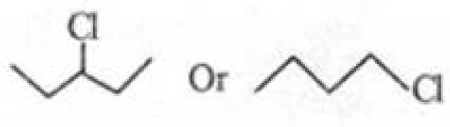


Ans. $(i) C_6H_5I + KCl + N_2$

$(ii) BrCH_2\text{-}CH_2Br$

15. (i) Why is it that haloalkanes are more reactive than haloarenes towards nucleophiles. [2]

(ii) Which one of the following reacts faster in an SN reaction and why?



Ans. (i) Aryl halides are less reactive towards nucleophilic substitution because of any of the following reasons

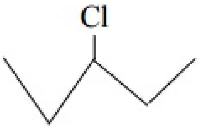
(a) Resonance effect stabilization

(b) sp^2 hybridization in haloarenes and sp^3 in haloalkanes.

(c) Instability of phenyl cation

(d) possible repulsion

(ii)



Undergoes S_N1 reaction faster because of the stability of secondary carbocation.

16. What are biodegradable and non-biodegradable detergents 2 Give one example of each class. [2]

Ans. Biodegradable detergents are those detergents which are easily degraded by the microorganisms and hence are pollution free.
ex. Soap / Sodium laurylsulphate / any other unbranched chain detergent. (any one)

Non-Biodegradable Detergents are those detergents which cannot be degraded by the bacteria easily and hence create pollution. [example not essential]

17. Assign a reason for each of the following statements: [2]

(i) Ammonia is a stronger base than phosphine.

(ii) Sulphur in Vapour State exhibits a paramagnetic behaviour.

Ans. (i)The lone pair of electrons on N atom in NH_3 is directed and not diffused / delocalized as it is in PH_3 due to larger size of P/ or due to availability of d-orbitals in P.

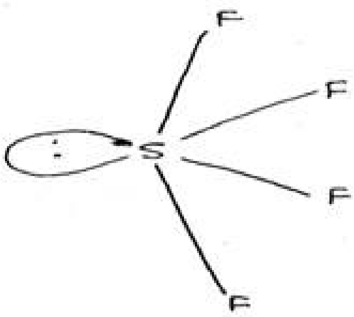
(ii) S_2 molecule like O_2, has two unpaired electrons in antibonding π^* orbitals.

18. Draw the structures of the following molecules: [2]

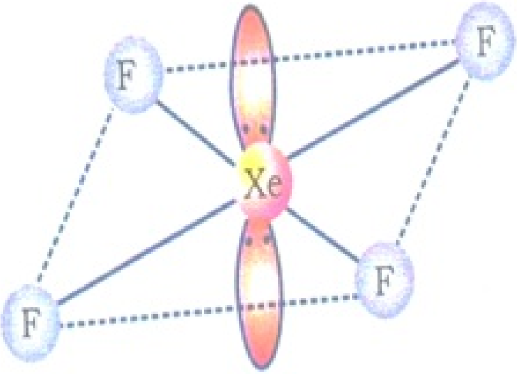
(i) SF_4

(ii) XeF_4

Ans. (i) SF_4



(ii) XeF_4



---

19. What are lyophilic and lyophobic sols 2 Give one example of each type. Which one of these two types of sols is easily coagulated and why? [3]

Ans. Lyophilic sols are solvent attracting sols
ex. Gum, gelatine, starch, rubber (any one)

Lyophobic sols are solvent repelling sols
ex. Metal sols, metal sulphides (any one)

Lyophobic sols are readily coagulated because they are not stable.

---

20. Calculate the temperature at which a solution containing 54 g of glucose, $(C_6H_{12}O_6)$, **in** $250\ g$ **of water will freeze.** $(K_f\ for\ water = 1.86\ K\ mol^{-1}\ kg)$ **[3]**

Ans. $\Delta T_f = K_f m$

No. of moles of glucose $= \dfrac{54\ g}{180\ g\ mol^{-1}}$

Molality of Glucose solution $= \frac{54\,mol}{180} \times \frac{1000}{250\,kg} = 1.20\,mol\,kg^{-1}$

$$\Delta T_f = K_f m$$
$$= 1.86\,K\,kg\,mol^{-1} \times 1.20\,mol\,kg^{-1}$$
$$= 2.23\,K$$

Temperature at which solution freezes

$$= (273.15 - 2.23)\,K = 270.77\,K\ or\ -2.23°\,C$$
$$Or\ (273.000 - 2.23)K = 2270.7\,K$$

---

21. What is a semiconductor? Describe the two main types of semiconductors and explain mechanisms for their conduction. [3]

Ans. The solids with intermediate conductivities between insulators and conductors are termed semiconductors.

(i) n- type semiconductor: It is obtained by doping Si or Ge with a group 15 element like P. Out of 5 valence electrons, only 4 are involved in bond formation and the fifth electron is delocalized and can be easily provided to the conduction band. The conduction is thus mainly caused by the movement of electron.

(ii) p – type semi-conductor: It is obtained by doping Si or Ge with a group 13 element like Gallium which contains only 3 valence electrons. Due to missing of 4th valence electron, electron hole or electron vacancy is created. The movement of these positively charged hole is responsible for the conduction.

---

22. Write chemical equations for the following processes: [3]

(i) Chlorine reacts with a hot concentrated solution of sodium hydroxide
(ii) Orthophosphorous acid is heated
(iii) $PtF_{6;}$ **and xenon are mixed together**

OR

Complete the following chemical equations:

$$(i)\ Ca_3P_2(s)+H_2O(l)\rightarrow \dots$$

$$(ii)\ Cu^{2+}(aq)+\underset{(excess)}{NH_3(aq)}\rightarrow \dots$$

$$(iii)\ F_2(g)+H_2O(l)\rightarrow \dots$$

Ans.

(i)$3Cl_2+6NaOH \rightarrow 5NaCl+NaClO_3+3H_2O$

(ii)$4H_3PO_3 \rightarrow 3H_3PO_4+PH_3$

(iii)$Xe^+[PtF_6]^-$

OR

(i)$Ca_3P_2(s)+ 6H_2O(l)\rightarrow 3Ca(OH)_2(aq) + 2PH_3(g)$

(ii)$Cu^{2+}(aq)+ 4NH_3(aq)\rightarrow [Cu(NH_3)_4]^{2+}(aq)$

(iii)$2F_2(g)+ 2H_2O(l) \rightarrow 4H^+(aq) + 4F^-(aq) + O_2(g)$

---

23. State briefly the principles which serve as basis for the following operations in metallurgy:

(i) Froth floatation process
(ii) Zone refining
(iii) Refining by liquation

Ans. (i) Froth floatation process: This method is based on the difference in the wettability of the mineral particles (sulphide ores) and the gangue particles. The mineral particles become wet by oils while the gangue particles by water and hence gets separated.

(ii) Zone refining: This method is based on the principle that the impurities are more soluble in the melt than in the solid state of metal.

(iii) Refining by Liquation: The method is based on the lower melting point of the metal than the impurities and tendency of the molten metal to flow on the sloping surface.

24. Account for the following observations: [3]

(i) pK_b for aniline is more than that for methylamine.
(ii) Methylamine solution in water reacts with ferric chloride solution to give a precipitate of ferric hydroxide.
(iii) Aniline does not undergo Friedel-Crafts reaction

Ans. (i) It is because in aniline the $-NH_2$ group is attached directly to the benzene ring. It results in the unshared electron pair on nitrogen atom to be in conjugation with the benzene ring and thus making it less available for protonation. (or any other suitable reason)

(ii) Methyl amine in water gives OH^- ions which react with $FeCl_3$ to give precipitate of ferric hydroxide/ or

$$CH_3NH_2 + H_2O \rightarrow CH_3\overset{+}{N}H_3OH^- \rightarrow CH_3NH_3^+ + OH^-$$
$$Fe^{3+} + 3OH^- \rightarrow Fe(OH)_3$$

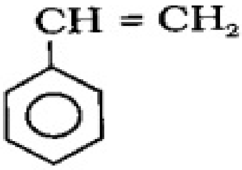
(iii) Aniline does not undergo Friedel-Crafts reaction due to salt formation with aluminium chloride, the Lewis acid.

25. Write the names and structures of the monomers of the following polymers: [3]

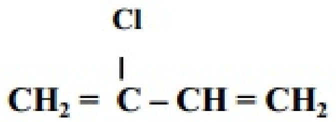
(i) Buna-S
(ii) Neoprene
(iii) Nylon-6

Ans. (i) Buna-S: 1,3- Butadiene and Styrene

$CH_2 = CH - CH = CH_2$ and

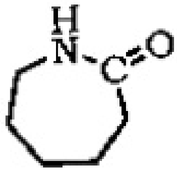


(ii) Neoprene: Chloroprene



$CH_2=\overset{\overset{\displaystyle Cl}{|}}{C}-CH=CH_2$

(iii) Nylon-6: Caprolactum



---

26. Name the reagents which are used in the following conversions: [3]

(i) A primary alcohol to an aldehyde
(ii) Butan-2-one to butan-2-ol
(iii) Phenol to 2, 4, 6-tribromophenol

Ans. $(i) PCC, KMnO_4, CrO_3\ (any\ one)$

$(ii) LiAlH_4, NaBH_4\ (any\ one)$

$(iii)\ aqueous\ Br_2$

---

27. (a) What is a ligand? Give an example of a bidentate ligand.

(b) Explain as to how the two complexes of nickel, $[Ni(CN)_4]^{2-}$ $and\ Ni(CO)_4$, **have different structures but do not differ in their magnetic behaviour.** $(Ni = 28)$ **[3]**

Ans. (a) Ligand: The ions or molecules bound to the central atom/ion in the coordination entity are called ligands.

ex. of bidentate ligand- ethane-1,2-diamine or oxalate ion (or any other)

(b) * $In\ [Ni(CN)_4]^{2-}$, nickel is $Ni^{2+}, (3d^8)$, with strong Ligand like CN^-, all the electrons are paired up in four d-orbitals resulting into dsp^2 hybridization giving square planar structure and diamagnetic character.

In $Ni(CO)_4$:, nickel is in zero valence state, $(3d^8 4s^2)$, with strong Ligand like $CO, 4s^2$,

electrons are pushed to the d-orbitals resulting into sp^3 hybridization giving tetrahedral shape and diamagnetic in nature.
(or this can be explained by drawing orbital configurations too.)

28. (a) Derive the general form of the expression for the half-life of a first order reaction.

(b) The decomposition of NH, on platinum surface is a zero-order reaction. What are the rates of production of N_2 and H_2, if $k = 2.5\times10^{-4} mol^{-1} Ls^{-1}$? [2, 3]

OR

(a) List the factors on which the rate of a chemical reaction depends.

(b) The half-life for decay of radioactive ^{14}C is 5730 years. An archaeological artefact containing wood has only 80% of the ^{14}C activity as found in living trees. Calculate the age of the artefact. [2, 3]

Ans. (a) Half-life of a First order reaction:

$$k = \frac{2.303}{t}\log\frac{[R]_0}{[R]}$$

at $t_{1/2}$ $\quad [R] = \frac{[R]_0}{2}$

So, the above equation becomes

$$k = \frac{2.303}{t_{1/2}}\log\frac{[R]_0}{[R]_0/2}$$

or $\quad t_{1/2} = \frac{2.303}{k}\log 2$

$$t_{1/2} = \frac{2.303}{k}\times 0.301$$

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

(b) $2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$

$$Rate = \frac{-d[NH_3]}{dt} = k[NH_3]^\circ = 2.5\times10^{-4}\ Ms^{-1}$$

$$-\frac{1}{2}\frac{d[NH_3]}{dt} = +\frac{d[N_2]}{dt} = +\frac{1}{3}\frac{d[H_2]}{dt}$$

Rate of production of $N_2 = +\frac{d[N_2]}{dt} = -\frac{1}{2}\frac{[NH_3]}{dt}$

$$= \frac{1}{2} \times \left(2.5 \times 10^{-4} Ms^{-1}\right) = 1.25 \times 10^{-4} Ms^{-1}$$

Rate of production of hydrogen $= \frac{d[H_2]}{dt} = -\frac{3}{2}\frac{[NH_3]}{dt}$

$$= \frac{3}{2} \times \left(2.5 \times 10^{-4} Ms^{-1}\right)$$

$$= 3.75 \times 10^{-4} Ms^{-1}$$

OR

$$\text{Rate} = -d[NH_3] = k[NH_3]^o = 2.5 \times 10^{-4} Ms^{-1}$$

$$\text{Rate} = \frac{-1}{2}\frac{d[NH_3]}{dt} = +\frac{d[N_2]}{dt} = +\frac{1}{3}\frac{d[H_2]}{dt}$$

Rate of production of $N_2 = +\frac{d[N_2]}{dt} = Rate = 2.5 \times 10^{-4} Ms^{-1}$

Rate of production of hydrogen $= \frac{d[H_2]}{dt} = 3 \times Rate$

$$= 3 \times (2.5 \times 10^{-4} Ms^{-1})$$

$$= 7.5 \times 10^{-4} Ms^{-1}$$

OR

(a) Factors affecting rate of chemical reaction are:

(i) Concentration of reactants
(ii) Temperature
(iii) Presence of catalyst
(iv) Surface Area
(v) Activation energy

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

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

$$K=1.21\times10^{-4}\ y^{-1}$$

$$t=\frac{2.303}{k}\frac{\log[A_0]}{[A]}$$

$$k=\frac{2.303}{1.21\times10^{-4}y^{-1}}\frac{\log 100}{80}$$

$$k=\frac{2.303}{1.21\times10^{-4}y^{-1}}\log 1.25$$

$$k=\frac{2.303}{1.21\times10^{-4}y^{-1}}\times0.0969$$

$$=1845\ \text{years}$$

---

29. (a) How will you bring about the following conversions?

(i) Ethanol to acetone

(ii) Benzene to acetophenone

(iii) Benzoic acid to benzaldehyde

(b) Describe the following giving a suitable example in each case:

(i) Decarboxylation

(ii) Cannizzaro's reaction

OR

(a) An organic compound contains $69.77\%\ carbon,\ 11.63\%\ hydrogen$ **and the rest is oxygen. The molecular mass of the compound is 86. It does not reduce Tollens' reagent but forms an addition compound with sodium hydrogen sulphite and gives a positive iodoform test. On vigorous oxidation, it gives ethanoic and propanoic acids. Deduce the possible structure of the organic compound.**

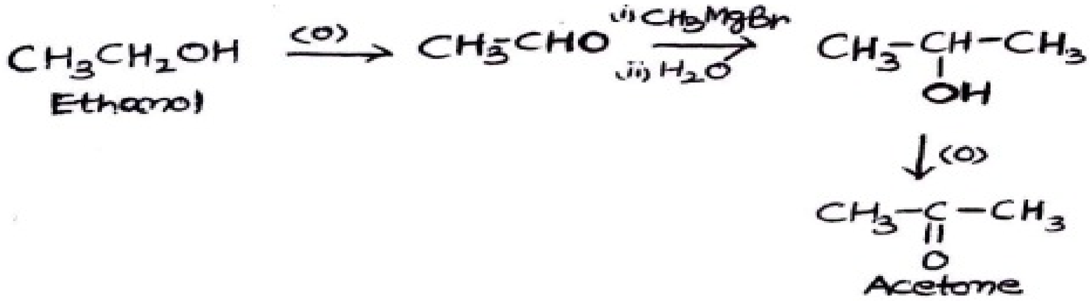
(b) State reasons for the following:

(i) Monochloroethanoic acid has a higher pK_a **value than dichloroethanoic acid**

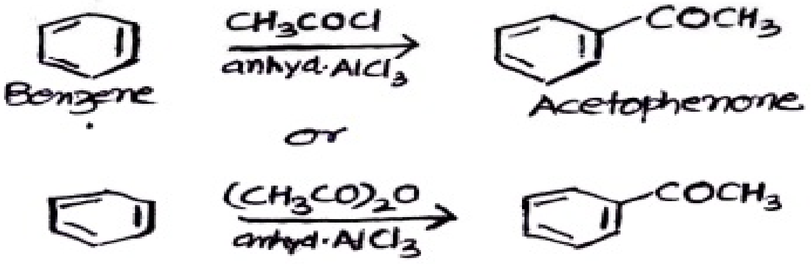
(ii) Ethanoic acid is a weaker acid than benzoic acid. [3, 2]

Ans.

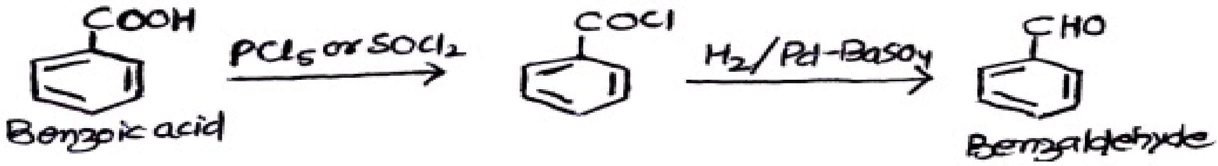
(i)



(ii)



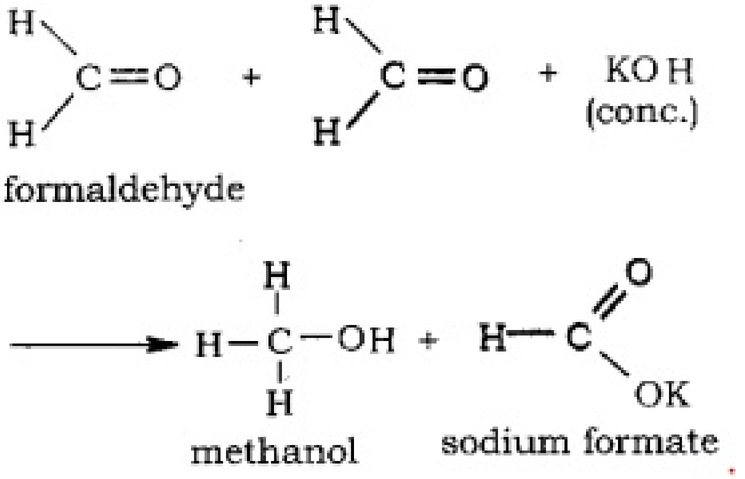
(iii)



(a) (i)Decarboxylation: Carboxylic acids lose carbon dioxide to form hydrocarbons when their sodium salts are heated with sodalime. The reaction is known as decarboxylation.

$$\text{R-COONa} \xrightarrow[\text{Heat}]{\text{NaOH \& CaO}} \text{R-H} + \text{Na}_2\text{CO}_3$$

(ii) Cannizzaro reaction: Aldehydes which do not have an $\alpha-hydrogen$ atom, uhdergo self-oxidation and reduction reaction on treament with concentrated alkali.



OR

(i)

C	69.77/12	5.81	5.81/1.16	5
H	11.63/1	11.63	11.63/1.16	10
O	18.60/16	1.16	1.16/1.16	1

Empirical formula $C_5H_{10}O$, empirical formula mass $60+10+16=86$ Hence, Mol formula $C_5H_{10}O$.

It is a ketone as it appears from its reactions which on oxidation gives ethanoic and propanoic acids, hence the compound is $CH_3COCH_2CH_2CH_3$

(b) (i) Because the stability of conjuguate base of monochloroethanoic acid is less due to presence of one electron withdrawing $-Cl\ group$ than in dichloroethanoic acid.

(ii) This is because of greater electronegativity of sp^2 hybridised carbon to which carboxyl carbon is attached.

30. Assign reasons for the following: [5]

(i) The enthalpies of atomisation of transition elements are high.

(ii) The transition metals and many of their compounds act as good catalyst.

(iii) From element to element the actinoid contraction is greater than the lanthanoid contraction.

(iv) The E^o value for the Mn^{3+}/Mn^{2+} couple is much more positive than that for Cr^{3+}/Cr^{2+}.

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

OR

(a) What may be the possible oxidation states of the transition metals with the following d electronic configurations in the ground State of their atoms: $3d^3 4s^2, 3d^5 4s^2\ and\ 3d^6 4s^2$. Indicate relative stability of oxidation states in each case.

(b) Write steps involved in the preparation of

(i) Na_2CrO_4 from chromite ore and

(ii) K_2MnO_4, from pyrolusite ore. [3, 2]

Ans. (i) Because of larger number of unpaired electrons in their atoms they have stronger interatomic interaction and hence stronger bonding between atoms resulting in higher enthalpies of atomisation.

(ii) Because of their ability to adopt multiple oxidation states and to form complexes.

(iii) Because of poorer shielding by $5f$ electrons than that by $4f$, actinoid contraction is greater than the lanthanoid contraction.

(iv) Much larger third ionization energy of Mn (where the required change is d^5 to d^4) is mainly responsible for this.

(v) Because of the presence of incomplete $d-orbital\left(3d^1 4s^2\right)$ in its ground state.

OR

$3d^3 4s^2$ (Vanadium): Oxidation states $+2, +3, +4, +5$

Stable oxidation state: $+4$ as VO^{2+}, $+5$ as VO_4^{3-}

$3d^5 4s^2$ (Manganese): Oxidation states $+2, +3, +4, +5, +6, +7$

Stable oxidation states: $+2$ as Mn^{2+}, $+7$ as MnO_4^-

$3d^6 4s^2$ (Iron): Oxidation states $+2, +3$

Stable oxidation state: +2 in acidic medium, +3 in neutral or in alkaline medium.

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

(ii) $2MnO_2 + 4KOH + O_2 \rightarrow 2K_2MnO_4 + 2H_2O$