CBSE
SAMPLE QUESTION PAPER

CHEMISTRY *(Theory)*
(With Solutions)
CLASS XII

Time Allowed : 3 Hours] *[Max. Marks : 70*

General Instructions :

(i) All questions are compulsory.
(ii) Question numbers 1 to 8 are very short answer questions and carry 1 mark each.
(iii) Question numbers 9 to 18 are short answer questions and carry 2 marks each.
(iv) Question numbers 19 to 27 are also short answer questions and carry 3 marks each.
(v) Question numbers 28 to 30 are long answer questions and carry 5 marks each.
(vi) Use log tables if necessary, use of calculators is not allowed.

Q.1. Bond enthalpy of fluorine is lower than that of chlorine, why ? 1

Ans. Fluorine atom being smaller in size, electron-electron repulsions among the lone pairs of F_2 molecule are larger compared to that in Cl_2 molecule.

Q.2. Give the IUPAC name of the following compound : 1

$$(CH_3)_3 - C - \underset{\underset{O}{\|}}{C} - COOH$$

Ans. 3, 3-Dimethyl-2-oxobutanoic acid.

Q.3. On increasing the temperature, activation energy of a reaction decreases, why ? 1

Ans. Energy of the molecules increases with the rise of temperature. The molecules require smaller energy to form the activated complex. Therefore, activation energy shows a decrease.

Q.4. Which of the following is most effective electrolyte in the coagulation of AgI/Ag$^+$ sol ?

K_2SO_4, $MgCl_2$, $K_4[Fe(CN)_6]$ 1

Ans. $K_4[Fe(CN)_6]$. This is because it ionises to give $[Fe(CN)_6]^{4-}$ ions which carry the maximum negative charge of -4.

Q.5. Write the reaction when glucose is heated with excess of HI. 1

Ans. The reaction is given as under :

$$CH_2OH(CHOH)_4CHO + HI \text{ (excess)} \xrightarrow{\Delta} \underset{\text{n-hexane}}{CH_3CH_2CH_2CH_2CH_2CH_3}$$

Q.6. Which Xe compound has distorted octahedral shape ? 1

Ans. XeF_6 has distorted octahedral shape because of repulsion from lone pair of electrons.

Q.7. What is the denticity of co-ordination compound used for the treatment of lead poisoning ? 1

Ans. Ethylene diammine tetraacetate is used for the treatment of lead poisoning. Its denticity is 6.

Q.8. An alkoxide is a stronger base than hydroxide ion. Justify. 1

Ans. Due to the presence of an alkyl group, higher electron density is found on alkoxide ion than on hydroxide ion.

$$R \rightarrow O^- \quad H - O^-$$

Q.9. (a) State the law which helps to determine the limiting [illegible]tivity of weak electrolyte.

(b) 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). 2

Ans. (*a*) The law which helps to determine the limiting molar conductivity of weak electrolyte is called Kohlarsch law.

It states : The limiting molar conductivity of an electrolyte can be represented as the sum of the individual contribution of the anion and the cation of the electrolyte.

(*b*) Limiting molar conductivity of $CaSO_4$ can be determined as under :

$$\overset{o}{\Lambda}_m CaSO_4 = \overset{o}{\lambda}_{Ca^{2+}} + \overset{o}{\lambda}_{SO_4^{2-}}$$

Substituting the values, we have

$$\overset{o}{\Lambda}_m CaSO_4 = 119.0 \text{ S cm}^2 \text{ mol}^{-1} + 106.0 \text{ S cm}^2 \text{ mol}^{-1}$$
$$= 225.0 \text{ S cm}^2 \text{ mol}^{-1}$$

Q.10. Rate constant *K* for first order reaction has been found to be 2.54×10^{-3} s^{-1}. Calculate its three-fourth life. 2

Ans. For first order reaction, use the relation

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

where a = Initial concentration
x = Amount that has undergone change
$a - x$ = Concentration after the time t
k = Rate constant

For three-fourth of the reaction to take place, $x = 0.75a$

Substituting the values in the rate equation, we have

$$2.54 \times 10^{-3} = \frac{2.303}{t} \log \frac{a}{a-0.75a}$$

$$= \frac{2.303}{t} \log 4$$

or $$t = \frac{2.303}{2.54} \times 10^3 \times 0.6021$$
$$= 5.46 \times 10^2 \text{ s}$$

Or

A first order gas reaction A_2B_2 (*g*) $\longrightarrow$ 2A (*g*) + 2B (*g*) at the temperature 400 °C has the rate constant $k = 2.0 \times 10^{-1}$ s^{-1}. What percentage of A_2B_2 is decomposed on heating for 900 seconds ?

Ans. For the first order reaction, use the relation

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

Given that $k = 2.0 \times 10^{-1}$ s^{-1} and $t = 900$ s

Substituting the values in the first order equation, we have

$$2.0 \times 10^{-1} = \frac{2.303}{900} \log \frac{a}{a-x}$$

or $$\log \frac{a}{a-x} = \frac{2.0 \times 10^{-1} \times 900}{2.303}$$

or $$\log \frac{a}{a-x} = 0.0761$$

Taking antilogarithm of the above

$$\frac{a}{a-x} = 1.197 \text{ or } \frac{a-x}{a} = \frac{1}{1.197} = 0.8354$$

or $$1 - \frac{x}{a} = 0.8354 \text{ or } \frac{x}{a} = 1 - 0.8354 = 0.1646$$

x/a represents the fraction of A_2B_2 decomposed.

Percentage of A_2B_2 decomposed = $0.1646 \times 100 = 16.46$.

Q.11. Do the following conversions :

(*i*) Methyl bromide to acetone.

(*ii*) Benzyl chloride to 2-phenylacetic acid. 2

Ans. (*i*) Methyl bromide to acetone

$$CH_3Br + Mg \xrightarrow[\text{ether}]{\text{Dry}} CH_3MgBr + CH_3CHO \xrightarrow{H_3O^+} CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle |}{CH}}-OH \xrightarrow[573\ K]{Cu} CH_3COCH_3$$

(*ii*) Benzyl chloride to 2-phenyl acetic acid

$$C_6H_5CH_2Cl + KCN \longrightarrow C_6H_5CH_2CN \xrightarrow{H_3O^+} C_6H_5CH_2COOH$$

Q.12. How will you distinguish between the following pairs of compounds :

(*i*) Chloroform and carbon tetrachloride.

(*ii*) Benzyl chloride and chlorobenzene. 2

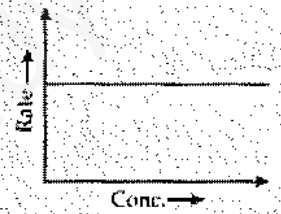
Ans. (*i*) Chloroform and carbon tetrachloride :

Chloroform gives an offensive smell of phenyl isocyanide on heating with aniline. Carbon tetrachloride does not give this test.

(*ii*) Benzyl chloride and chlorobenzene :

Benzyl chloride on treatment with aqueous sodium hydroxide and silver nitrate gives a white precipitate of silver chloride. Chlorobenzene does not.

Q.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 ? 2

Ans. (*i*) As the rate remains constant, it is a zero order reaction.

(*ii*) Units of rate constant for a zero order reaction are mol L^{-1} s^{-1}.

Q.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 colours with same solution. (At. No. of Fe = 26 u) 2

Ans. $K_3[Fe(CN)_6]$: Oxidation state of Fe in the compound is +3. Configuration of Fe^{3+} is $[Ar]3d^5$

In the presence of CN^- ions, pairing of electrons takes place as under :

These electrons will remain in t_{2g} orbitals and e_g orbitals will remain empty.

$K_3[FeF_6]$: Here also the oxidation number of Fe is +3. The configuration of Fe^{3+} in the presence of F^- ions will be

Here due to weak ligand, coupling will not take place. There are 5 unpaired electrons in this case.

The colour shown by a coordination compound is due to excitation of electrons within *d*-orbitals (from t_{2g} to e_g). As the distribution of electrons in the two coordination compounds is different, they will show different colours.

Q.15. Give reasons for the following :

(*i*) *o*-Toluidine is more basic than aniline.

(*ii*) Tertiary amines do not undergo acetylation reaction. **2**

Ans. (*i*)

o-Toluidine Aniline

Methyl group is electron releasing. If it is present in ortho position, it increases electron density on nitrogen in $-NH_2$ group. Hence, it is more basic than aniline.

(*ii*) $R_3N + (CH_3CO)_2O \longrightarrow$ No reaction

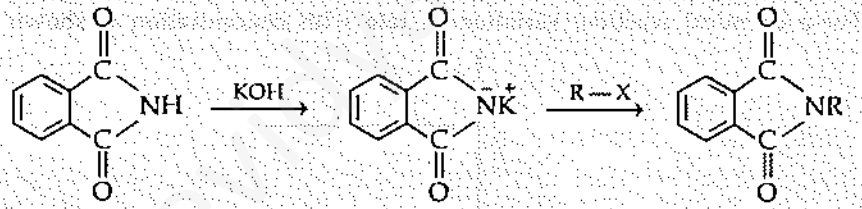
As there is no replaceable hydrogen atom in tertiary amine, reaction with acetic anhydride or acetyl chloride does not take place.

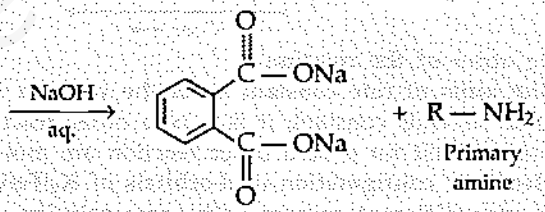
Q.16. Write the following name reactions :

(*i*) Gabriel phthalimide reaction.

(*ii*) Hoffman bromamide reaction. **2**

Ans. (*i*) Gabriel phthalimide reaction :





(*ii*) Hoffman bromamide reaction :

Q.17. Silver metal crystallises with a face-centred cubic lattice. The length of the unit cell is found to be 4.077×10^{-8} cm. Calculate atomic radius and density of silver.

(Atomic mass of Ag = 108 u, $N_A = 6.02 \times 10^{23}$ mol^{-1}) **2**

Ans. The following data is provided :

$$a = 4.077 \times 10^{-8} \text{ cm}, Z = 4, M = 108 \text{ g mol}^{-1}, N_A = 6.022 \times 10^{23}$$

Apply the relation

$$d = \frac{Z \times M}{a^3 \times N_A}$$

Substituting the values, we have

$$d = \frac{4 \times 108}{(4.077 \times 10^{-8})^3 \times 6.022 \times 10^{23}}$$

$$= 6.22 \text{ g/cm}^3$$

To calculate atomic radius, use the relation

$$R = \frac{a}{2\sqrt{2}} \text{ (for face centred cubic)}$$

Substituting the value of a, we have

$$R = \frac{4.077 \times 10^{-8}}{2 \times \sqrt{2}}$$

$$= 1.44 \times 10^{-8} \text{ cm}.$$

Q.18. Calculate packing efficiency in ccp structure. **2**

Ans. For ccp structure

$$a = \frac{4r}{\sqrt{2}} = 2\sqrt{2}r$$

or

$$r = \frac{a}{2\sqrt{2}}$$

$$\text{Packing efficiency} = \frac{\text{Volume occupied by four spheres in unit cell} \times 100}{\text{Total volume of the unit cell}} \%$$

$$= \frac{4 \times \frac{4}{3}\pi r^3 \times 100}{(2\sqrt{2}r)^3} \%$$

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

$$= 74\%.$$

Q.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 :

(a) As a student of chemistry, why would you suggest to Manu's father to buy the expensive cadmium plate battery. Give two reasons.

(b) What are the values associated with the above decision ? [Value Based Question] 3

Ans. (a) I would suggest Manu's father to buy cadmium plate battery. I would explain to him the adverse effects of lead to humans which are as under :

(i) Lead interferes with a variety of body processes and it is toxic to many organs and tissues like heart, bones, intestines, kidneys and reproductive and nervous system.

(ii) It can cause permanent learning and other disorders like confusion, headache, anemia, irritability, etc.

(*b*) Money is a resource but not at the cost of health. Knowledge is useful when it is put to practice. We should be aware of the harmful effects of lead and the damage it causes to environment.

Q.20. Give a reason for the following :

(*i*) Rough surface of a catalyst is more effective than smooth surface.

(*ii*) Smoke is passed through charged plates before allowing it to come out of chimneys in factories.

(*iii*) Ne gets easily absorbed over charcoal than He. **3**

Ans. (*i*) Effectiveness of a catalyst depends upon its surface area. Greater the surface area, greater will be the adsorption and hence more effective will be the catalyst. A rough surface possesses greater surface area than smooth surface. Hence, rough surface of a catalyst is more effective.

(*ii*) This is done so that unburnt charged carbon particles get settled on coming into contact with oppositely charged plate and only air free from pollutants escapes.

(*iii*) Ne being bigger in size than He exerts greater van der Waals forces with charcoal and is therefore easily adsorbed.

Q.21. (*a*) **Give one example of each of the following :**

(*i*) Acidic flux (*ii*) Basic flux.

(*b*) **What happens when :**

(*i*) Cu_2O undergoes self reduction in a silica line converter.

(*ii*) Haematite oxidises carbon to carbon monoxide. **3**

Ans. (*a*) (*i*) Acidic flux is SiO_2.

(*ii*) Basic flux is CaO.

(*b*) (*i*) Cu_2O undergoes self reduction to form blister copper according to the equation.

$$2Cu_2O + Cu_2S \longrightarrow 6Cu + SO_2$$

(*ii*)
$$Fe_2O_3 + C \longrightarrow 3CO + 2Fe$$

Or

(*a*) What role does cryolite play in Hall Haroult process ?

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

Ans. (*a*) Cryolite lowers the melting point of alumina and thus facilitates electrolysis of molten alumina.

(*b*) Concentration of the alumina ore is carried out by digesting the powdered ore with a concentrated solution of NaOH at 473–523 K and 35–36 bar pressure. Al_2O_3 gets dissolved in NaOH solution as sodium metaaluminate. SiO_2 is left behind as impurity.

$$Al_2O_3\,(s) + 2NaOH\,(aq) + 3H_2O \longrightarrow 2Na[Al(OH)_4]\,(aq)$$

The resulting solution is filtered, cooled and neutralised by passing CO_2 gas through it. Hydrated Al_2O_3 gets precipitated.

$$2Na[Al(OH)_4]\,(aq) + CO_2\,(g) \longrightarrow \underset{\text{Hydrated alumina}}{Al_2O_3.xH_2O\,(s)} + 2NaHCO_3\,(aq)$$

Hydrated alumina is filtered, washed, dried and heated to get pure Al_2O_3.

$$Al_2O_3.xH_2O\,(s) \xrightarrow{1470\ K} Al_2O_3\,(s) + xH_2O\,(g)$$

Q.22. Write balanced chemical equations for the following reactions :

(*a*) Hypophosphorous acid is added to $AgNO_3$ solution.

(*b*) Chlorine gas is passed through hot and concentrated solution of sodium hydroxide.

(*c*) XeF_2 undergoes hydrolysis. **3**

Ans. Balanced equations for the reactions are given as under :

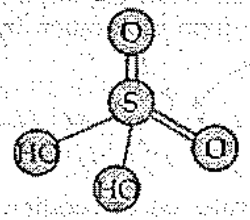
(*a*)
$$H_3PO_3 + 2AgNO_3 + H_2O \longrightarrow 2Ag + HNO_3 + 2H_3PO_4$$

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

(*c*)
$$2XeF_2 + 2H_2O \longrightarrow 2Xe + O_2 + 4H^+ + 4F^-$$

Q.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.** 3

Ans. (*i*) The structure of sulphuric acid is given as under :



Sulphuric acid
(H_2SO_4)

(*ii*) Formation of ozone from oxygen is an endothermic process. There is every possibility that ozone formed may revert back to oxygen. To prevent this, a sparkless current is passed through oxygen to obtain ozone.

$$3O_2 \xrightarrow[\text{current}]{\text{Sparkless}} 2O_3$$

(*iii*) Bleaching action of sulphur dioxide is a temporary action because of its reducing action.

Q.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.** 3

Ans. (*a*) Amylose and amylopectin are the constituents of starch.
Amylose is a long unbranched chain polymer of α-D(+) glucose.
Amylopectin is a branched chain polymer of α-D glucose.

(*b*) The protein present in oxygen carrier in human body is globular protein. Its shape is spherical.

(*c*) Two fat storing tissues in human body are liver and adipose tissue.

Q.25. **Define the following by giving one example of each :**
(*i*) **Antiseptics**
(*ii*) **Antioxidants**
(*iii*) **Narcotic analgesics.** 3

Ans. (*i*) Antiseptics are the chemicals applied to living tissues either to kill or prevent the growth of microorganisms. For example, dettol.

(*ii*) Antioxidants are the compounds which retard the action of oxygen on food and reduces its rate of decomposition. For example, BHA.

(*iii*) Narcotic analgesics are the chemicals used for the relief of post operative pain. For example, morphine.

Q.26. (*a*) **Write the names of the monomers of polymers used for making unbreakable crockery.**
(*b*) **Write the equation for the preparation of neoprene.**
(*c*) **Arrange the following polymers in decreasing order of intermolecular forces :**
PVC, Nylon 66, Natural rubber. 3

Ans. (*a*) Monomers of the polymer used in unbreakable crockery are melamine and formaldehyde.

(*b*) The equation for the preparation of neoprene is

$$n\underset{\text{2-Chloro-1,3-butadiene}}{CH_2=\underset{Cl}{\underset{|}{C}}-CH=CH_2} \xrightarrow{\text{Polymerisation}} \underset{\text{Chloroprene}}{+CH_2-\underset{Cl}{\underset{|}{C}}=CH-CH_2+_n}$$

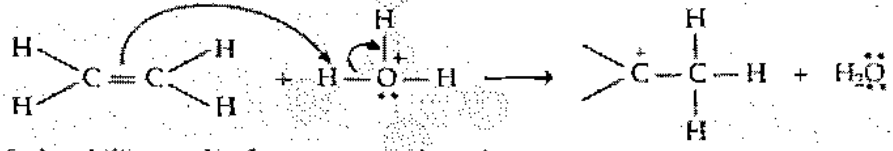
(c) Decreasing order of intermolecular forces is

Nylon 66 > Natural rubber > PVC

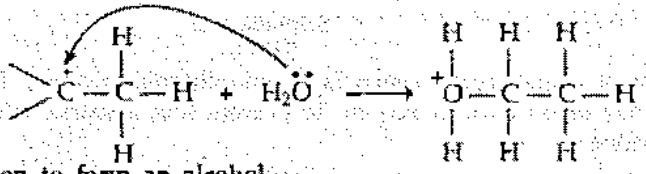
Q.27. Write the mechanism for preparation of ethanol from ethene. 3

Ans. The reaction proceeds in the following steps :

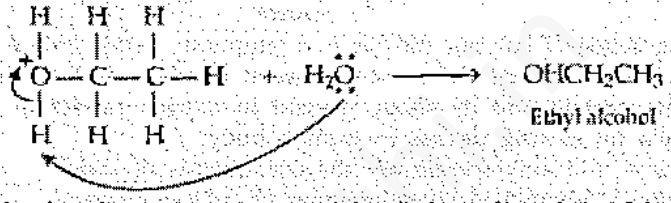
Step 1. Protonation of alkene to form carbocation by electrophilic attack of H_3O^+.



Step 2. Nucleophilic attack of water on carbocation.



Step 3. Deprotonation to form an alcohol.



Q.28. (a) 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}.

(b) Explain the following :

(i) Solution of chloroform and acetone is an example of maximum boiling azeotrope.

(ii) A doctor advised a person suffering from high blood pressure to take less quantity of common salt. 5

Ans. (a) The data provided is as under :

$m = 0.4$, $T_f^0 = 278.4$ K, $\Delta H_{fus} = 10.042$ kJ $mol^{-1} = 10.042 \times 10^3$ J mol^{-1}, $M = 78$ g $mol^{-1} = 78 \times 10^{-3}$ kg mol^{-1}

Apply the relation

$$K_f = \frac{R T_f^2 M}{\Delta H_{fus}}$$

Substituting the values, we have

$$K_f = \frac{8.34 \times (278.4)^2 \times 78 \times 10^{-3}}{10.042 \times 10^3} = 5 \text{ K kg mol}^{-1}$$

$$2CH_3COOH \longrightarrow (CH_3COOH)_2$$

$$\alpha = \frac{i-1}{1/n-1}$$

$$= \frac{i-1}{\frac{1}{2}-1}$$

$$= 0.85$$

or $i - 1 = -0.425$

or $i = 0.575$

$\Delta T_f = iK_f m$

$= 0.575 \times 5 \times 0.4$

$= 1.15$

$T_f = T_f^0 - \Delta T_f$

$= 278.4 - 1.15$

$= 277.25$ K

(*b*) (*i*) The solution of chloroform and acetone has smaller vapour pressure due to stronger interaction between chloroform and acetone molecules. Therefore, it is an example of maximum boiling azeotrope.

(*ii*) Higher quantity of NaCl will increase the number of sodium and chloride ions in the body fluid which can increase the osmotic pressure of the body fluid resulting in higher blood pressure.

Or

(*a*) Calculate the boiling point of a solution containing 0.61 g of benzoic acid in 50 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.

(*b*) State Raoult's law for the solution containing non-volatile solute. Give its mathematical expression also.

Ans. (*a*) The dimerisation of benzoic acid may be represented as under :

$$2C_6H_5COOH \longrightarrow (C_6H_5COOH)_2$$

Degree of dissociation may be written as

$$\alpha = \frac{i-1}{1/n-1} = 0.84$$

or $\dfrac{i-1}{0.5-1} = 0.84$ or $i - 1 = -0.42$

or $i = 0.58$

Molality of the solution $= \dfrac{0.61}{50} \times \dfrac{1000}{122} = 0.1$

$\Delta T_b = iK_b m$

$= 0.58 \times 2.3 \times 0.1$

$= 0.1334$ °C

$T_b = T_b^0 + \Delta T_b$

$= 46.2 + 0.1334$

$= 46.334$ °C

(*b*) Statement of Raoult's law : Relative lowering of vapour pressure is equal to the mole fraction of the solute.

Mathematically,

$$\frac{p_1^0 - p_1}{p_1^0} = \frac{n_2}{n_1 + n_2} \quad \left[\text{Since } x_2 = \frac{n_2}{n_1 + n_2}\right]$$

n_1 and n_2 are the number of moles of the solvent and solute respectively present in the solution. For dilute solutions, n_2 can be neglected compared to n_1 in the denominator.

Thus, we have

$$\frac{p_1^0 - p_1}{p_1^0} = \frac{n_2}{n_1}$$

Q.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. **5**

Ans. (*i*) This can be explained on the basis of the electronic configuration of O and F. Oxygen can form multiple bonds with transition metals but fluorine cannot.

(*ii*) Copper exhibits lower hydration enthalpy which is unable to compensate first and second ionisation enthalpies.

(*iii*) 4*f* electrons of lanthanides are less effectively shielded by nuclear charge than 5*f* electrons of actinides. Therefore, ionisation enthalpy of lanthanides is higher than that of actinides.

(*iv*) This is because dichromate ion gets reduced to chromium ion in acidic medium.

(*v*) 5*f*, 6*d* and 7*s* levels have comparable energies. Electrons from any one of them can participate. Therefore actinides show greater number of oxidation states than lanthanides.

Or

(*a*) Compare non-transition and transition elements on the basis of their :

(*i*) variability of oxidation states (*ii*) stability of oxidation states.

(*b*) Give chemical reactions for the following observations :

(*i*) Potassium permanganate is a good oxidising agent in basic medium.

(*ii*) Interconvertibility of chromate ion and dichromate ion in aqueous solution depends upon pH of the solution.

(*iii*) Potassium permanganate is thermally unstable at 513 K.

Ans. (*a*) (*i*) Oxidation states of transition elements differ from each other by unity. In non-transition elements, oxidation states normally differ by two, if the *s*-orbitals also participate in bond formation, the oxidation state increases by 2. In the case of transition elements, it is the *d*-orbitals which are generally involved. With the participation of every extra electron, the oxidation number increases by 1.

(*ii*) In transition elements, higher oxidation states are favoured by heavier elements whereas in non-transition elements, lower oxidation state is favoured by heavier elements due to inert pair effect of *s*-electrons.

(*b*) Reactions for the observation are given as under :

(*i*) $$2MnO_4^- + H_2O + I^- \longrightarrow 2MnO_2 + 2OH^- + IO_3^-$$

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

(*iii*) $$2KMnO_4 \xrightarrow{\Delta,\ 513\ K} K_2MnO_4 + MnO_2 + O_2$$

Q.30. (*a*) Give names of the reagents to bring about the following transformations :

(*i*) Ethanoic acid to ethanol

(*ii*) Propan-1-ol to propanal

(*iii*) Pent-3-en-2-ol to pent-3-en-2-one

(*iv*) Sodium benzoate to benzene.

(*b*) Arrange the following in increasing order of :

(*i*) Methanal, Propanal, Butanone, Ethanal, Propanone
(Nucleophilic addition reaction)

(ii) Formaldehyde, Acetone, Acetaldehyde (reactivity towards HCN)

(iii) Acetophenone, *p*-tolualdehyde, *p*-nitrobenzaldehyde, Benzaldehyde (Nucleophilic addition reaction).

Ans. (a) (i) $CH_3COOH \longrightarrow CH_3CH_2OH$ Reagent : $LiAlH_4/H_3O^+$

(ii) $CH_3CH_2CH_2OH \longrightarrow CH_3CH_2CHO$ Reagent : Pyridinium chloro chromate (PCC)

(iii) $CH_3-\underset{\displaystyle OH}{\underset{|}{CH}}-CH=CH-CH_3 \longrightarrow CH_3-\overset{\displaystyle O}{\overset{\|}{C}}-CH=CH-CH_3$ Reagent : PCC

(iv) $C_6H_5COONa \longrightarrow C_6H_6$ Reagent : Soda lime

(b) (i) For nucleophilic addition reaction, the increasing order of reactivity is

Butanone < Propanone < Propanal < Ethanal < Methanal

(ii) For reactivity towards HCN, the order is

Acetone < Acetaldehyde < Formaldehyde

(iii) For reactivity towards nucleophilic addition, the order is

Acetophenone < *p*-Tolualdehyde < Benzaldehyde < *p*-Nitrobenzaldehyde

Or

(a) Bring out the following conversions :

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

(ii) Ethylcyanide to 1-phenyl propanone.

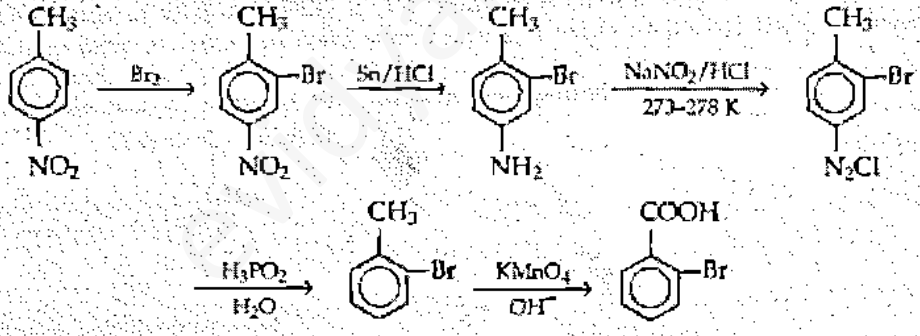
(b) Give a reason for the following :

(i) Chloroacetic acid is more acidic than acetic acid.

(ii) Carboxylic acids have higher boiling point than alcohols.

(iii) 4-Nitrobenzoic acid is more acidic than 4-methoxybenzoic acid.

Ans. (a) (i) 4-Nitrotoluene to 2-bromobenzoic acid



(ii) Ethyl cyanide to 1-phenyl propanone

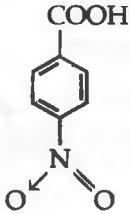
$$CH_3CH_2CN + C_6H_5MgBr \xrightarrow{\text{Ether}} CH_3CH_2\overset{\displaystyle C_6H_5}{\overset{|}{C}}=NMgBr \xrightarrow{H_3O^+} CH_3CH_2COC_6H_5 + Mg(NH_2)Br$$

(b) (i) $\underset{\text{Chloroacetic acid}}{Cl-CH_2COOH} \longrightarrow \underset{\text{Acetic acid}}{CH_3COOH}$

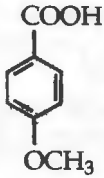
Due to the +I effect of Cl, removal of proton is facilitated in chloroacetic acid. Also, the anion after the removal of H^+ is more stabilised in the case of chloroacetic acid than acetic acid.

(ii) There is intensive intermolecular bonding in carboxylic acids compared to alcohols. Therefore, carboxylic acids boil at a higher temperature.

(*iii*)



4-Nitrobenzoic acid



4-methoxybenzoic acid

Nitro group is electron withdrawing group while methoxy (OCH_3) group electron donating. Therefore, stability of benzoate ion increases in the case of 4-nitrobenzoic acid and decreases in the case of 4-methoxybenzoic acid.