CHEMISTRY
SCIENCE Paper – 2

Question 1

(a) (i) A solution M turns blue litmus red, so it must contain (i) **hydronium** ions, another solution O turns red litmus blue and hence must contain (ii) **hydroxide** ions.

(ii) When solution M and O are mixed together, the products will be (iii) **Salt** and (iv) **water.**

(iii) If a piece of magnesium was put into a solution M, (v) $\mathbf{H_2}$ gas would be evolved.

(b) (i) A mixture of sodium propionate and soda lime taken in a hard glass tube, on strong heating of this mixture ethane gas is evolved.

$$\underset{\text{sodium propionate}}{CH_3 - CH_2 - COONa} + NaOH \xrightarrow{CaO} \underset{\text{ethane}}{CH_3 - CH_3} + Na_2CO_3$$

(ii) Potassium sulphate is heated with dilute hydrochloric acid.

$$K_2SO_3 + 2HCl \rightarrow 2KCl + H_2O + \underset{(g)}{SO_2}$$

The gas evolved is SO_2

(iii) Sulphur is heated with concentrated nitric acid

$$S + 6HNO_3 \rightarrow H_2SO_4 + 6\underset{(g)}{NO_2} + 4H_2O$$

The gas evolved is NO_2

(iv) Potassium nitrate on heating, it loses oxygen. The reaction can be written a,

$$2KNO_3 \rightarrow 2KNO_2 + O_2$$

(v) Concentrated hydrochloric acid is made to react with MnO_2

$$MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + 2H_2O$$
(g)

Cl_2 gas is evolved

(c)

(i)

$$CuSo_4\ 5H_2O \xrightarrow{Con.\ H_2SO_4} CuSO_4 + 5H_2O$$

Blue crystal Dehydration white powder.

The Blue crystal $CuSO_4\ 5H_2O$ treated with concentrated H_2SO_4 gives a white powder of $CuSO_4$

(ii) Copper sulphide treated with dilute HCl gives CuCl and H_2S.

$$\begin{matrix} Cu \\ Cu \end{matrix}\!\!>\!S + \begin{matrix} HCl \\ HCl \end{matrix} \longrightarrow H_2S + 2CuCl$$

(iii) Excess of chlorine gas reacted with ammonia gas gives NCl_3 and HCl

$$NH_3 + 3Cl_2 \rightarrow NCl_3 + 3HCl$$
excess

(iv) When a few drops of dilute hydrochloric acid are added to silver nitrate solution, followed by addition of ammonium hydroxide solution gives a soluble complex $[Ag(NH_3)_2]Cl^-$

$$HCl + AgNO_3 \rightarrow AgCl + HNO_3$$

$$AgCl + 2NH_4OH \rightarrow [Ag(NH_3)_2]Cl^-$$
Soluble complex

(v) When electricity is passed through molten lead bromide, the following reaction takes place.

$$PbBr_2 \rightarrow Pb^{2+} + 2Br^-$$

$$Pb^{2+} + 2e^- \rightarrow Pb$$

$$2Br^- \rightarrow 2e^- + Br_2$$

$$Pb^{2+} + 2Br^- \rightarrow Pb + Br_2$$

(d)

(i) Co-ordinate bond (→)

(ii) normal salt

(iii) Substitution

(iv) Hydration (water of crystallisation)

(v) Deliquescent

(e) (i) Sodium Chloride solution and sodium nitrate solution :-

$$NaCl + \underset{Conc}{H_2SO_4} \xrightarrow{<200^oC} NaHSO_4 + HCl$$

1. During this reaction, Hydrogen chloride evolved gives white precipitate with $AgNO_3$ [soluble in NH_4OH]

$$NaNO_3 + \underset{Conc}{H_2SO_4} \xrightarrow{<200^oC} NaHSO_4 + HNO_3$$

In this reaction, Nitric acid vapours evolved and it gives brown fumes on heating with copper turnings.

(ii) Hydrogen chloride gas :- Gives dense white fumes with glass red dipped in ammonia solution. Hydrogen sulphide gas (i) Turns moist lead acetate paper silvery black

(iii) Ethane gas: On adding a few drops of alkaline potassium permanganate (purple colour) to ethane gas no change is observed and to ethane the purple colour turns green and then brown.

(iv) Calcium nitrate and zinc nitrate:- When sodium hydroxide solution is added to zinc nitrate a white precipitate is formed which is soluble in excess of sodium hydroxide. When sodium hydroxide solution is added to calcium nitrate a white precipitate is formed which is insoluble in excess of sodium hydroxide.

(v) CO_2 turns lime water milky, SO_2 turns acidified $K_2Cr_2O_7$ green

(f)

(i) Chlorine

(ii) Ammonium chloride

(iii) They can undergo both substitution as well as addition reactions

(iv) Liquid carbon tetrachloride

(v) Carbon monoxide

(vi) Barium oxide

(vii) Oxidising agent

(viii) Magnesium nitride

(ix) They are insoluble in water.

(x) Solder

(g) (i) $2Vol + 13\ Vol \rightarrow 8\ vol$

$2ml + 13ml \rightarrow 8ml$

2ml of C_4H_{10} at NTP requires 13 ml of O_2

Therefore 1ml of C_4H_{10} at NTP requires O_2 = 13/2 = 6.5

Therefore $90dm^3$ of butane requires O_2 = 13/2 x 90

= 585 ml

(ii)

Vapour density	=	8		
Mass of gas	=	24g		
Temperature	=	273K		
Pressure	=	1atm		
Molecular mass	=	2 x vapour density		
R	=	0.0821 lit atm/ K/ mol		
PV	=	nRT	=	wRT/M
V	=	wRT/MP	=	24 x 0.0821 x 273/ 16 x 1
			=	33.62 litres

(iii) According to Avogadro's law, at same temperature and pressure, equal

volume of gas contain equal number of molecules. 80 'X' molecules of nitrogen gas would be present in the same vessel under same conditions of temperature and pressure.

Section II

Question 2

(a) (i) F

(ii) R(K)

(iii) M

(iv) 3

(v) T(Ca)

(vi) Y

(vii) NaH → Ionic bond

(b) NaCl is soluble and electrically conductive CCl_4 is insoluble and non conductive.

Question 3

(a)

(i) $Na_2CO_3 + H_2SO_4 \rightarrow Na_2SO_4 + CO_2 + H_2O$

(ii) $Zn\ (NO_3)_2 + Na_2CO_3 \rightarrow 2NaNO_3 + ZnCO_3$

(iii) $H_2SO_3 + CuCO_3 \rightarrow CuSO_4 + CO_2 + H_2O$

(iv) $Fe + H_2SO_4 \rightarrow Fe\ (II)\ SO_4 + H_2$

(b) (i) Copper nitrate reacts with ammonium hydroxide gives copper hydroxide and ammonium nitrate.

(ii) $2NH_4OH + Zn(NO_3)_2 \rightarrow 2NH_4NO_3 + Zn(OH)_2$

$Zn(OH)_2 + NH_4OH \rightarrow Zn(OH)_2 + NH_4OH$

(iii) $2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2 + O_2$

Question 4

(a) (i) Copper

$CuSO_4 \rightarrow Cu^{2+} + SO_4^-$

$H_2O \rightarrow OH^- + H^+$

(ii) At cathode $Cu^{2+}_{(aq)} + 2e^- \rightarrow Cu_{(s)}$ (reduction)

At anode $Cu_{(s)} \rightarrow Cu^{2+}_{(aq)} + 2e^-$ (oxidation)

(iii) The sulphate ion does not take part in the reaction and the concentration of the $CuSO_4$ in solution does not change. The reaction is completed when the weight of Cu rod decreases and completely eaten away.

(b) (i) y

(ii) 2

(iii) Acidic, basic

(iv) very poor

(v) gives out, reducing.

Question 5

(a) (i) $3CuO + 2NH_3 \rightarrow 3Cu + 3H_2O + N_2$

(ii) $C + 4HNO_3 \rightarrow CO_2 + 4NO_2 + 2H_2O$

(iii)

$$C_{12}H_{22}O_{11} \xrightarrow[\text{dehydration}]{\text{Con.}H_2SO_4} 12C + 11H_2O$$

(b)

Name of the process	Temperature	Catalyst	Equation
Haber	673K	Fe_1Mo	$N_{2(g)} + 3H_{2(g)} \xrightarrow[673]{Fe} 2NH_3$ $\Delta H = -93.6$ KJ

(c) (i) Molten cryolite($Na_3AlF_{6)}$ which act as a good conductor of electricity.

(ii) $Al^{3+} + 3e^- \rightarrow Al$

(iii) O_2 liberated at anode attacks C- rods (anode) to form CO, CO_2. So anode is periodically removed.

Question 6

(a) (i) $CH_3I + H - H \rightarrow CH_4 + HI$

(ii)

$$CH_3 - CH_2 - OH \xrightarrow[-H_2O]{\text{Con } H_2SO_4} CH_2 = CH_2$$

(iii)

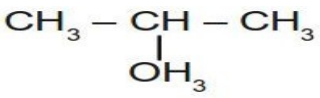
$$CaC_2 + \begin{matrix} H - OH \\ H - OH \end{matrix} \longrightarrow Ca(OH)_2 + C_2H_2$$

(iv) $CH_3 - CH_2 - Br + K\,OH \rightarrow CH_3 - CH_2 - OH + KBr$

(b) (i)

$$CH_3 - \underset{\displaystyle CH_3}{\overset{\displaystyle |}{CH}} - CH_3$$

(ii)



(iii) $CH_3 - CH_2 - O - CH_2 - CH_3$

(c) (i) Methane is a saturated hydrocarbon. So they do not react with hydrogen. But in ethane, because of the presence of double bond, they undergo addition reaction. One of C - C bonds breaks to form a covalent bond. In ethene the reaction can be written as, $C_2H_4 + H_2 \rightarrow C_2H_6$ (ethane)

(ii) Ethyne have pi bonds which are readily available to react so they undergo addition reactions. Single bond is most stable and is less reactive. Triple bond (Ethyne) is much reactive having weak bond.

(iii) Reason of the flammability of hydrocarbons they are used as excellent fuels.

Question 7

(a) (i) 67.2 l pf O_2 is evolved at NTP from $KClO_3$ = 245 gm
Therefore 6.72 lit of O_2 is evolved at STP from $KClO_3$

$$= \frac{245 \times 6.72}{67.2} = 24.5 \text{ gm}$$

(ii) No: of moles of O_2 in 6.72 lit O_2

$$= \frac{\text{Mass}}{\text{Molar mass}}$$
$$= \frac{32 \times 6.72}{22400} \Big/ 32$$
$$= 0.0003 \text{ mol}$$

No: of molecules of O_2 in 6.72 litres = no: of moles x Avogadro's no: (6.02×10^{23}) = 0.01806×10^{23}

(iii) 1 gm mole of CO_2 at NTP occupy volume = 22.4 litres
0.01 mol of CO_2 at STP occupy volume = 22.4 l x 0.01 mol
= 0.224 litres

(b) (i) NH_3

(ii) CH_3COOH

(iii) CO_2

(iv) H_2SO_4

(v) He