1. Chemical Reactions and Equations

1. Translate the following statements into chemical equations and then balance them.

(a) Hydrogen gas combines with nitrogen to form ammonia.

(b) Hydrogen sulphide gas burns in air to give water and sulpur dioxide.

(c) Barium chloride reacts with aluminium sulphate to give aluminium chloride and a precipitate of barium sulphate.

(d) Potassium metal reacts with water to give potassium hydroxide and hydrogen gas.

Solution:

(a) Hydrogen gas combines with nitrogen to form ammonia.

 $H_2(g)+N_2(g)\rightarrow NH_3$

The balanced equation for this reaction can be written as:

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

(b) Hydrogen sulphide gas burns in air to give water and sulphur dioxide.

 $H_2S(g)+O_2(g) \rightarrow H_2O+SO_2$

The balanced equation for this reaction can be written as:

 $2H_2S(g)+3O_2(g)\rightarrow 2H_2O+2SO_2$

(c) Barium chloride reacts with aluminium sulphate to give aluminium chloride and a precipitate of barium sulphate.

 $BaCl_2+Al_2(SO_4)_3 \rightarrow AlCl_3+BaSO_4\downarrow$

The balanced equation for this reaction can be written as:

 $3BaCl_2+Al_2(SO_4)_3 \rightarrow 2AlCl_3+3BaSO_4\downarrow$

(d) Potassium metal reacts with water to give potassium hydroxide and hydrogen gas.

 $K+H_2O\rightarrow KOH+H_2$

The balanced equation for this reaction can be written as:

 $2K+2H_2O\rightarrow 2KOH+H_2$

2. Write the balanced chemical equation for the following and identify the type of reaction in each case.
(a) Potassium bromide(aq) + Barium iodide(aq) → Potassium iodide(aq) + Barium bromide(s)
(b) Zinc carbonate(s) → Zinc oxide(s) + Carbon dioxide(g)
(c) Hydrogen(g) + Chlorine(g) → Hydrogen chloride(g)

(d) Magnesium(s) + Hydrochloric acid(aq) \rightarrow Magnesium chloride(aq) + Hydrogen(g)

Solution:

(a) Potassium bromide(aq) + Barium iodide(aq) \rightarrow Potassium iodide(aq) + Barium bromide(s)

 $2KBr(aq)+BaI_2(aq)\rightarrow 2KI(aq)+BaBr_2(s)$

In this reaction, both the reactants exchange ions to form two new products. Hence, it is a double displacement reaction

(b) Zinc carbonate(s) \rightarrow Zinc oxide(s) + Carbon dioxide(g)

 $ZnCO_3(s) \rightarrow ZnO(s) + CO_2(g)$

In this reaction, a single substance yields two different products. Hence, it is a decomposition reaction.

(c) Hydrogen(g) + Chlorine(g) \rightarrow Hydrogen chloride(g)

 $H_2(g)+Cl_2(g)\rightarrow 2HCl(g)$

In this reaction, two different reactants react with each other to form a single product. Hence, it is called a combination reaction.

(d) Magnesium(s) + Hydrochloric acid(aq) \rightarrow Magnesium chloride(aq) + Hydrogen(g)

 $Mg(s)+2HCl(aq)\rightarrow MgCl_2(aq)+H_2(g)$

In this reaction, more reactive Mg is replacing less reactive H. Hence, it is displacement reaction.

3. a) Rehmat classified the reaction between Methane and Chlorine in presence of sunlight as a substitution reaction. Support Rehmat's view with suitable justification and illustrate the reaction with the help of a balanced chemical equation.

b) Chlorine gas was prepared using electrolysis of brine solution. Write the chemical equation to represent the change. Identify the other products formed in the process and give one application of each.

Solution:

a) $CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$ (in the presence of sunlight)

			$h\nu$			$h\nu$			$h\nu$
	$CH_4 +$	Cl_2	\longrightarrow	$\mathrm{CH}_3\mathrm{Cl}$	$+ \operatorname{Cl}_2$	\longrightarrow	$\operatorname{CH}_2\operatorname{Cl}_2$	$+ \operatorname{Cl}_2$	\longrightarrow
			$-\mathrm{HCl}$			$-\mathrm{HCl}$			$-\mathrm{HCl}$
			$h\nu$						
	CHCl_3	$+ \operatorname{Cl}_2$	\longrightarrow	CCl_4					
b)			-HCl						

Carbon Tetrachloride is formed in the reaction.

4. Raina while doing certain reactions observed that heating of substance 'X' with vinegar like smell with a substance 'Y' (which is used as an industrial solvent) in presence of conc. Sulphuric acid on a water bath gives a sweetsmelling liquid 'Z' having molecular formula $C_4H_8O_2$. When heated with caustic soda (NaOH), 'Z' gives back the sodium salt of and the compound 'Y'. Identify 'X', 'Y', and 'Z'. Illustrate the changes with the help of suitable chemical equations.

Solution:

X is ethanoic acid whose molecular formula is CH₃COOH Y is ethanol whose molecular formula is C₂H₅OH Z is Ethyl ethanoate whose molecular formula is CH₃COOC₂H₅

The chemical equation in this case is:

 $\begin{array}{c} \text{CH}_{3}-\text{COOH}+\text{CH}_{3}-\text{CH}_{2}\text{OH} \rightleftharpoons \text{CH}_{3}-\text{C}-\text{O}-\text{CH}_{2}-\text{CH}_{3}+\text{H}_{2}\text{O} \\ \text{(Ethanoic acid)} & \text{(Ethanol)} & \overset{\text{II}}{\overset{\text{II}}{\overset{\text{O}}}{\overset{\text{O}}{\overset{\text{O}}{\overset{\text{O}}{\overset{\text{O}}{\overset{\text{O}}{\overset{\text{O}}}{\overset{\text{O}}{\overset{\text{O}}{\overset{\text{O}}{\overset{\text{O}}{\overset{\text{O}}{\overset{\text{O}}{\overset{\text{O}}{\overset{\text{O}}{\overset{\text{O}}{\overset{\text{O}}{\overset{\text{O}}{\overset{\text{O}}{\overset{\text{O}}{\overset{\text{O}}{\overset{\text{O}}{\overset{\text{O}}{\overset{\text{O}}{\overset{\text{O}}{\overset{\text{O}}{\overset{O}}{\overset{\text{O}}{\overset{\text{O}}{\overset{\text{O}}{\overset{\text{O}}{\overset{O}}{\overset{\text{O}}{\overset{\text{O}}{\overset{\text{O}}}{\overset{\text{O}}{\overset{\text{O}}{\overset{O}}}{\overset{O}}{\overset{O}}{\overset{O}}{\overset{O}}{\overset{O}}}{\overset{O}}{\overset{O}}{\overset{O}}{\overset{O}}}{\overset{O}}{\overset{O}}{\overset{O}}{\overset{O}}{\overset{O}}}{\overset{O}}{\overset{O}}{\overset{O}}{\overset{O}}}{\overset{O}}{\overset{O}}{\overset{O}}{\overset{O}}{\overset{O}}}{\overset{O}}{\overset{O}}{\overset{O}}{\overset{O}}}{\overset{O}}{\overset{O}}{\overset{O}}{\overset{O}}}{\overset{O}}}{\overset{O}}{\overset{O}}{\overset$

 $CH_3COOC_2H_5 \xrightarrow{NaOH} C_2H_5OH + CH_3COONa$

5. The table given below shows the hints given by the quiz master in a quiz.

S.NO	HINT						
(i)	Substance 'C' is used as a preservative.						
(ii)	'C' has two carbon atoms; 'C' is obtained by the reaction of 'A' in presence of alkaline Potassium permanganate followed by acidification.						
(iii)	Misuse of 'A' in industries is prevented by adding Methanol, Benzene, and pyridine to 'A'.						
(iv)	'F' is formed on heating 'A' in presence of conc Sulphuric acid.						
(v)	'F' reacts with Hydrogen gas in presence of Nickel and Palladium catalyst.						

Based on the above hints answer the following questions a) Give the IUPAC names of A and F

b) Illustrate with the help of chemical equations the changes taking place. (A \rightarrow C and $A \rightarrow F$)

Solutions:

a) The IUPAC names of A is Ethanol and F is Ethene $CH_{3}\text{-}CH_{2}OH \xrightarrow[A]{\text{Alkaline KMnO}_{4} + \text{Heat}} CH_{3}COONa \xrightarrow[H^{+}]{} CH_{3}COOH \xrightarrow[C]{} COOH$ $\mathrm{CH}_3 - \operatorname*{CH}_{\mathrm{A}}\mathrm{OH} \xrightarrow{\mathrm{Hot\ conc.}}_{\mathrm{H}_2\mathrm{SO}_4} \mathrm{CH}_2 \underset{\mathrm{F}}{=} \mathrm{CH}_2 + \mathrm{H}_2\mathrm{O}$ b)