CARBON DIOXIDE

Object :— To identify the given gas evolved.

S. No.	Experiment	Observation	Inference
1.	Few drops of dilute mineral acid are added to a metallic carbonate (Na_2CO_3) Sodium bicarbonate $NaHCO_3$ taken in a clean dry test tube.	A colourless, odourless gas is evolved with effervescence.	Carbon dioxide gas is present.
2.	Moist blue litmus paper is held into the gas.	It turns red due to the formation of weak carbonic acid.	Carbon dioxide gas is acidic in nature.
3.	The gas is passed through limewater.	It turns milky due to the formation of insoluble calcium carbonate.	Carbon dioxide gas is confirmed.
4.	A piece of filter paper soaked in acidified $K_2Cr_2O_7$ solution is held into the gas.	No change in colour.	Carbon dioxide gas is confirmed.

Reactions involved in the preparation of Carbon dioxide gas :

Point 1 :

$$NaHCO_3 + HCl\ (dil.) \longrightarrow NaCl + CO_2 + H_2O$$

$$Na_2CO_3 + 2HCl\ (dil.) \longrightarrow 2NaCl + CO_2\uparrow + H_2O$$

$$CuCO_3 + H_2SO_4\ (dil.) \longrightarrow CuSO_4 + CO_2\uparrow + H_2O$$

Point 3 :

$$\underset{\text{limewater}}{CO_2\uparrow + Ca(OH)_2} \longrightarrow \underset{\text{milky}}{CaCO_3} + H_2O$$

HYDROGEN SULPHIDE

Object :— To identify the given gas evolved.

S. No.	Experiment	Observation	Inference
1.	When dil. HCl or H_2SO_4 is added to Na_2S and the mixture is warmed in a clean dry test tube.	A colourless gas is evolved with the smell of rotten eggs.	Hydrogen sulphide (H_2S) gas is present.
2.	A piece of filter paper soaked in lead acetate or lead nitrate solution is held into the gas.	It turns silver black due to the precipitation of lead sulphide.	Hydrogen sulphide (H_2S) gas is confirmed.

Reactions involved in the preparation of Hydrogen Sulphide gas :

Point 1 :

Metallic sulphide/bisulphide + HCl/H_2SO_4(dil.) $\xrightarrow{\Delta}$ Salt + Hydrogen sulphide gas.

$$Na_2S + 2HCl\ (dil.) \xrightarrow{\Delta} 2NaCl + H_2S\uparrow$$

$$2NaHS + H_2SO_4\ (dil.) \xrightarrow{\Delta} Na_2SO_4 + 2H_2S\uparrow$$

Point 2 :

$$H_2S\uparrow + (CH_3COO)_2Pb \longrightarrow \underset{\text{silver black}}{PbS} + 2CH_3COOH$$

$$H_2S\uparrow + Pb(NO_3)_2 \longrightarrow PbS + 2HNO_3$$

AMMONIA

Object :— To identify the given gas evolved.

S. No.	Experiment	Observation	Inference
1.	NaOH solution is added to a small amount of NH_4Cl or $(NH_4)_2SO_4$ taken in a clean dry test tube and the mixture is heated.	A colourless gas is evolved with pungent smell.	Ammonia (NH_3) gas is present.
2.	Moist red litmus paper is held into the gas.	It turns blue due to the formation of NH_4OH.	Ammonia gas is basic in nature.
3.	A glass rod dipped in conc. HCl is held into the gas.	Dense white fumes of NH_4Cl are evolved.	Ammonia gas is confirmed.

Reactions involved in the preparation of Ammonia gas :

Point 1 :

$$NH_4Cl + NaOH \xrightarrow{\Delta} NaCl + NH_3\uparrow + H_2O$$

$$(NH_4)_2SO_4 + 2NaOH \xrightarrow{\Delta} Na_2SO_4 + 2NH_3\uparrow + 2H_2O$$

Point 2 :

$$NH_{3(9)}\uparrow + H_2O \longrightarrow NH_4OH$$

Point 3 :

$$NH_{3(9)}\uparrow + HCl\ (conc.) \longrightarrow \underset{\text{dense white fumes}}{NH_4Cl}$$

Note : A mixture of slaked lime water $Ca(OH)_2$ and NH_4Cl or $(NH_4)_2SO_4$ can also be used for the preparation of ammonia in laboratory :

$$2NH_4Cl + Ca(OH)_2 \xrightarrow{\Delta} CaCl_2 + 2NH_3\uparrow + 2H_2O$$

$$(NH_4)_2SO_4 + Ca(OH)_2 \xrightarrow{\Delta} CaSO_4 + 2NH_3\uparrow + 2H_2O$$

Ammonia gas is not liberated without heating.

SULPHUR DIOXIDE

Object :— To identify the given gas evolved.

S. No.	Experiment	Observation	Inference
1.	Few drops of dil. HCl / H_2SO_4 is added to a small amount of Na_2SO_3 taken in a clean dry test tube.	Colourless gas is evolved with the smell of burning sulphur.	Sulphur dioxide gas is present.
2.	Moist blue litmus paper is held into the gas.	It turns red due to the formation of sulphurous acid and then gets bleached (white).	Sulphur dioxide is acidic in nature.
3.	A piece of filter paper soaked in acidified potassium dichromate solution is held into the gas.	It turns green due to the formation of Chromium sulphate $Cr_2(SO_4)_3$.	Sulphur dioxide is a reducing agent.
4.	A piece of filter paper soaked in potassium permanganate solution is held into the gas.	It turns from pink to white due to the formation of manganese sulphate $MnSO_4$.	Sulphur dioxide is a reducing agent and is confirmed.

Fundamental concept :

Metallic sulphite/hydrogen sulphite + dil. acid (HCl or H_2SO_4) → Salt + Sulphur dioxide + Wate

Reactions involved in the preparation of Sulphur Dioxide gas :

Point 1 : $Na_2SO_3 + 2HCl\ (dil.) \longrightarrow 2NaCl + SO_2\uparrow + H_2O$

$Na_2SO_3 + H_2SO_4\ (dil.) \longrightarrow Na_2SO_4 + SO_2\uparrow + H_2O$

Point 2 : $SO_2\uparrow + H_2O \longrightarrow H_2SO_3$

sulphurous acid

Point 3 : $K_2Cr_2O_7 + H_2SO_4 + 3SO_2\uparrow \longrightarrow K_2SO_4 + Cr_2(SO_4)_3 + H_2O$

orange (conc.) green

Point 4 : $2KMnO_4 + 2H_2O + 5SO_2\uparrow \longrightarrow K_2SO_4 + 2MnSO_4 + 2H_2SO_4$

pink white

Note : Sulphur dioxide cannot be prepared by using calcium sulphite or