EXPERIMENT-1

To Prepare, collect and study some important physical and chemical properties of three gases, at least one each from the following groups :

a) Hydrogen /oxygen
b) Carbon-di-oxide/ hydrogen sulphide
c) Chlorine, hydrogen chloride or sulphur dioxide

1.1 OBJECTIVES

After performing this experiment, you should be able to :

- *set up the apparatus for preparation of gases, namely, H_2, O_2, CO_2, H_2S, SO_2, HCl and Cl_2*
- *prepare and collect the gases mentioned above;*
- *observe physical properties (e.g. colour, odour) of gases, and*
- *identify various gases by their characteristic chemical tests.*

1.2 WHAT YOU SHOULD KNOW

Gases, like hydrogen, oxygen, carbon-di-oxide, ammonia, hydrogen sulphide, chlorine, hydrogen chloride and sulphur di-oxide can be prepared in the school laboratory and it is possible to identify (characterise) them by suitable tests. Identification of gases is an important step in chemical analysis as most of the substances give off some gas when heated alone or when treated with certain reagents such as acids, alkalies, etc.

In this experiment, you will learn to prepare some gases and study their important properties.

1.3 PREPARATION OF HYDROGEN (H_2) GAS

Hydrogen gas can be prepared in the laboratory by adding dilute hydrochloric acid to zinc granules. The reaction is

$$Zn(s) + 2HCl(aq) \longrightarrow ZnCl_2 + H_2(g)$$

Materials Required

(1) Apparatus	(2) Chemicals
Waulfe's bottle, Delivery tube, Gas jar, Bark corks, Thistle funnel, Water trough	(i) Zinc metal granules (Zn) (ii) Dilute sulphuricacid (H_2SO_4) (iii) Distilled water

1.3.1 Procedure

Set up the apparatus as shown in the Fig. 1.1. Take 2-3 grams of zinc granules in a waulfe's bottle. Fix a thistle funnel and delivery tube as shown in the diagram. Fix the two hole corks tightly over the mouth of the waulfe's bottle and make the joints airtight by sealing them with wax.

Now slowly add about 10 ml of dilute hydrochloric acid from thistle funnel, so that zinc pieces are covered with acid. As soon as the acid comes in contact with zinc pieces, the gas starts evolving.

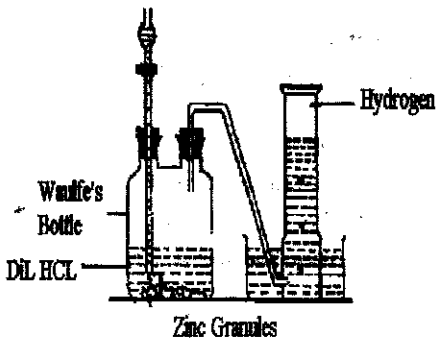

Fig. 1.1: *Laboratory Preparation of Hydrogen gas*

Since the solubility of hydrogen in water is very less, it can be collected by downward displacement of water as shown in the Fig. 1.1

Fill a gas jar with H_2 gas. Examine the properties and perform the tests.Note your observations as fallows:

(i) Observe the colour of the gas; it is colourless.
(ii) Carefully smell the gas; it is odourless.
(iii) Collect the gas in a test tube, the way you did for collecting it in a jar. Bring a lighted match stick near the mouth of the test-tube. There is a sudden pop sound and the gas burns with a pale-blue flame.

1.4 PREPARATION OF OXYGEN (O_2) GAS

Oxygen gas is prepared by heating a mixture of potassium chlorate and manganese dioxide. Potassium chlorate is decomposed by heat while manganese dioxide acts as catalyst. If potassium chlorate was to be heated alone, a higher temperature would be required to decompose it. Since solubility of the gas in water is less, collect the gas by downward displacement of water as shown in the Fig. 1.2.

$$2KClO_3(s) \xrightarrow[MnO_2]{} 2KCl\ (s) + 3O_2(g)$$

Materials Required

(1) Apparatus	(2) Chemicals
Round bottom flask (100 ml), Gas jar, Delivery tube, Water trough	(i) Potassium chlorate ($KClO_3$) (ii) Manganese dioxide (MnO_2)

1.4.1 Procedure

Set up the apparatus as shown in the Fig 1.2. Take approximately half a spatula of dry potassium chlorate in a watch glass and add a pinch of manganese dioxide. Mix the reagent and the catalyst. Take the mixture in the reaction tube and fix the delivery tube in its mouth. Make sure that the cork is fitted tightly in the mouth of the tube. Seal it with wax. Heat the mixture gently and collect the gas in a jar kept inverted on a bee-hive shelf in a water trough as shown in Fig. 1.2.

Care must be taken while heating the reagents, because potassium chlorate is a very powerful oxidising agent. If it is allowed to mix with carbon or any similar substance or dust, it can easily catch fire or even explode.

Fill two jars, examine the properties, perform the tests tat are listed and note your observations.

(i) Observe the colour of the gas. It is colourless.
(ii) Carefully smell the gas. It is odourless.
(iii) Light a splinter, then blow it out, leaving the end glowing. Bring the glowing end of the splinter near the mouth of the jar. The spliner bursts into a flame. This shows the presence of oxygen into the tube.

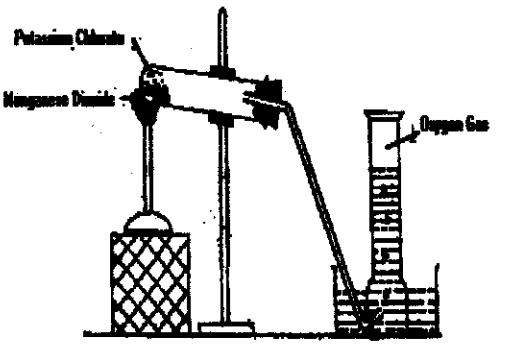

Fig. 1.2 : *Preparation of Oxygen gas*

1.4.2 Physical Properties

- Oxygen is a colourless and odourless gas.
- It is heavier than air (Density 1.428 g/cm^3).
- It is sparingly soluble in water.

1.4.3 Chemical Properties

(i) The electronic arrangement of oxygen atom is 2, 6. To attain eight electrons in its outer most shell, it has to gain two electrons. In doing so, it displays pronounced oxidising properties.

(ii) **Reaction with metals :** Noble metals such as gold, platinum etc. are resistant to oxygen. But the reactive metals (Na, K etc.) react spontaneously, giving their oxides.

$$4Na + O_2 \longrightarrow 2Na_2O$$

Less reactive metals such as Mg, Cu react with oxygen on heating.

$$2Mg + O_2 \longrightarrow 2MgO$$

$$2Cu + O_2 \longrightarrow 2CuO$$

1.5 PREPARATION OF CARBON DIOXIDE (CO_2) GAS

Carbon dioxide gas is prepared in the laboratory by the action of dilute hydrochloric acid on marble (calcium carbonate).

$$CaCO_3(s) + 2HCl(dil.) \longrightarrow CaCl_2(aq) + H_2O(1) + CO_2(g)$$

Materials Required

(1) Apparatus	(2) Chemicals
Round-bottom flask, Thistle funnel,	(i) Calcium carbonate ($CaCO_3$)
Gas jar	(ii) Dilute hydrochloric acid (HCl)

1.5.1 Procedure

Set up the apparatus as shows in the Fig. 1.3. Place a few small size marble pieces in a Waulfe's bottle. Cover the marble pieces with distilled water. Fix a thistle funnel so that its lower end dips in water contained in round bottom flask. Fix the two hole cork tightly in the mouth of the round bottom flask and make the joints airtight by sealing them with wax.

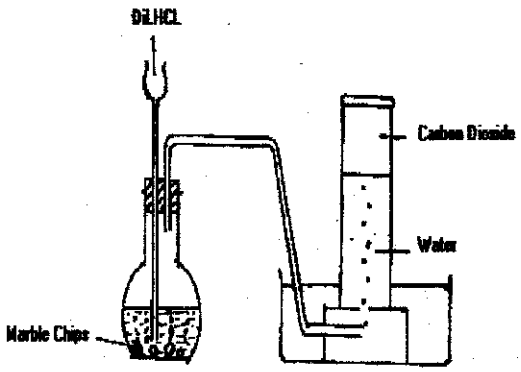

Fig. 1.3: *Preparation of Carbon-dioxide gas*

Add 2 to 3 ml of concentrated hydrochloric acid from the thistle funnel. Immediate reaction take place and carbon dioxide gas is produced. Allow some gas to escape as the initial release of carbon dioxide gas would displace air contained in gas jar. Collect the gas in a dry gas jar by the upward displacement of air.

To check, whether the gas is collected in the jar or not, bring a lighted match stick near the mouth of the gas jar. If it gets extinguished, the jar contains carbon dioxide gas. Place another jar at the delivery tube. Fill a few gas jars.

In order to examine the properties, perform the following tests and note your observations.

(i) Note the colour of the gas; it is colourless.
(ii) Carefully smell the gas; it is odourless.
(iii) Bring a lighted match stick near the mouth of the test tube, it gets immediately extinguished
(iv) Add 2-3 ml of lime water to the gas jar. The lime-water turns milky. This is due to the formation of insoluble calcium carbonate.

$$Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$$

1.5.2 Physical Properties

- Carbon dioxide is a colourless and odourless gas.
- It is denser than air.
- It is fairly soluble in water.

1.5.3 Chemical Properties

(i) Carbon dioxide dissolves in water to form carbonic acid, which turns blue litmus red.

$$H_2O + CO_2 \longrightarrow H_2CO_3$$

Carbonic acid

(ii) When carbon dioxide is passed through lime water, it turns milky due to the formation of insoluble calcium carbonate.

$$Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$$

(iii) On passing more CO_2, the milkiness disappears due to the formation of soluble calcium bicarbonate.

$$CaCO_3 + H_2O + CO_2 \longrightarrow Ca(HCO_3)_2$$

1.6 PREPARATION OF HYDROGEN SULPHIDE (H_2S) GAS

Hydrogen sulphide is prepared in the laboratory by the action of dilute sulphuric acid on iron sulphide.

$$FeS(s) + H_2SO_4(dil.) \longrightarrow FeSO_4(aq) + H_2S(g)$$

Materials Required

(1) Apparatus	(2) Chemicals
Round bottom flask bottle, Thistle funnel,	(i) Ferrous sulphide
Gas jar, Delivery tube	(ii) Dilute Sulphuric acid

1.6.1 Procedure

Fix up the apparatus as shown in the Fig. 1.4. Take a few small size pieces of iron sulphide (ferrous sulphide) in a round bottom flask. Moisten them with water. Add 2 - 3 ml of dilute sulphuric acid into the bottle through thistle funnel. The reaction takes place immediately and hydrogen sulphide gas evolves. The gas is collected by an upward displacement of air. Collect the gas in gas jars and make the following observations.

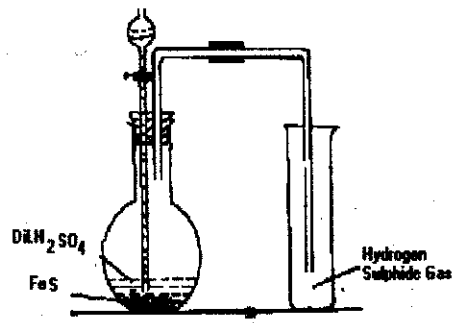

Fig. 1.4 : *Preparation of Hydrogen sulphide gas*

(i) Note the colour of the gas. It is colourless.

(ii) Carefully smell the gas. The smell is that of rotten eggs.

(iii) Add 2-3 ml of lead acetate solution to the gas jar. A black precipitate of PbS (s) is Obtained.

$$H_2S + Pb(CH_3COO)_2 \longrightarrow PbS(s) + 2CH_3COOH$$

Lead sulphide.

1.6.2 Physical Properties

- Hydrogen sulphide is a colourless gas.
- It has the smell of rotten eggs.
- It is heavier than air. The density is 1.538 g/cm^3.
- It is sparingly soluble in water.
- Hydrogen sulphide is combustible but does not support combustion.

1.6.3 Chemical Properties

(i) Hydrogen sulphide burns in air with a blue flame leaving a deposit of sulphur.

$$H_2S - O_2 \longrightarrow 2H_2O + 2S$$

(ii) Hydrogen sulphide is soluble in water and gives a weakly acidic solution.

$$H_2S(g) + H_2O(l) \longrightarrow \underset{\text{Hydroxonium ion}}{H_3O^+(aq)} + \underset{\text{Hydrogen sulphide ion}}{HS^-(g)}$$

$$HS^- + H_2O \longrightarrow H_3O^+ + \underset{\text{Sulphide ion}}{S^{2-}}$$

Hydroxonium ion is responsible for the acidic nature of aqueous solution of hydrogen sulphide.

(iii) Hydrogen sulphide gives two types of salts - (hydrogen sulphides and sulphides). When reacted with alkali like NaOH the following reactions take place. With excess of H_2S, Na_2S is the main product.

$$H_2S + NaOH \longrightarrow \underset{\text{Sodium hydrogen sulphide}}{NaHS} + H_2O$$

$$H_2S + NaHS \longrightarrow \underset{\text{Sodium sulphide}}{Na_2S} + 2H_2O$$

(iv) Hydrogen sulphide reduces concentrated sulphuric acid to sulphur. The reaction takes place is two steps.

$$H_2SO_4 + H_2S \longrightarrow 2H_2O + SO_2$$

$$2H_2S + SO_2 \longrightarrow 2H_2O + 3S$$

(v) Hydrogen sulphide reacts with bromine to form hydrogen bromide

$$\underset{\text{Reddish brown}}{Br_2} + H_2S \longrightarrow 2HBr + \underset{\text{colourless}}{S}$$

1.7 PREPARATION OF CHLORINE (Cl_2) GAS

Chlorine gas is prepared in the laboratory by the action of concentrated hydrochloric acid on manganese dioxide.

$$4HCl\,(aq) + MnO_2 \xrightarrow[\text{gentle heating}]{} MnCl_2\,(aq) + 2H_2O(l) + Cl_2\,(g)$$

Materials Required

(1) Apparatus	(2) Chemicals
Round bottom flask (100 ml), Delivery tube, Gas jar, Burner	(i) Conc. hydrochloric acid (HCl) (ii) Manganese dioxide (MnO_2)

1.7.1 Procedure

Set up the apparatus as shown in the Fig. 1.5. Place about 3 grams of powdered manganese dioxide in a 100 ml round bottom flask. Add to it sufficient concentrated hydrochloric acid through thistle funnel so as to cover all manganese dioxide. Heat the flask gently over a low flame with a Bunsen burner. When the reaction takes place, effervescences can be seen. Collect the gas in a gas jar by the upward displacement of air. Cover the gas jar with the lid. Fill up few gas jars with the gas and perform the following tests.

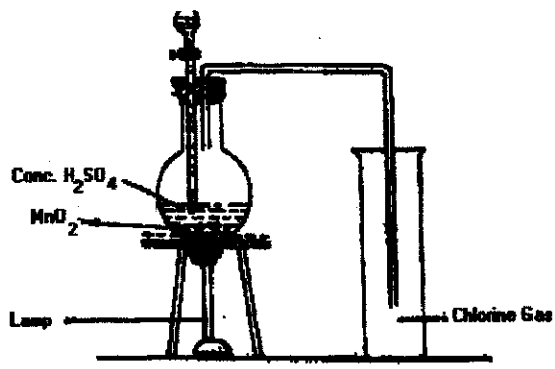

Fig. 1.5: *Preparation of Chlorine gas*

(i) Note the colour of the gas. It is pale green in colour.

(ii) Carefully smell the gas. It has pungent smell.

(iii) When chlorine is passed in cold dilute sodium hydroxide solution containing 1 drop phenolphthalein indicator, its pink colour disappears due to the formation of sodium chloride and sodium hypochlorite.

$$2NaOH(aq) + Cl_2(g) \longrightarrow NaCl(aq) + NaOCl(aq) + H_2O(l)$$

(iv) It displaces bromine and iodine from their salt solutions.

(a) $2KBr(aq) + Cl_2(g) \longrightarrow 2KCl(aq) + Br_2(g)$ (Brown)

(b) $2KI(aq) + Cl_2(g) \longrightarrow 2KCl(aq) + I_2(g)$ (Violet)

1.7.2 Physical Properties

- Chlorine is a greenish-yellow gas with a strong pungent smell.
- It is soluble in water. Its water solution is known as chlorine water.
- It is heavier than air. Its density is 3.214 gm/cm.^{3}

1.7.3 Chemical Properties

(i) Many metals react with chlorine gas and form respective metal chlorides.

$$Mg(s) + Cl_2(g) \longrightarrow MgCl_2(s)$$

(ii) Chlorine water oxidises the vegetable colouring matter to colourless substances and is called bleaching action. This is due to the formation of nascent oxygen in water.

$$Cl_2 + H_2O \longrightarrow 2HCl + (O)$$

Nascent oxygen

(iii) Chlorine has a high affinity for hydrogen.

(iv) Chlorine readily reacts with phosphorous and gives phosphorous pentachloride

$$P_4(s) + 10Cl_2(g) \longrightarrow 4PCl_5(s)$$

1.8 PREPARATION OF HYDROGEN CHLORIDE (HCl) GAS

Hydrogen chloride gas can be prepared by the reaction of conc. sulphuric acid on common salt (sodium chloride).

$$NaCl(s) + H_2SO_4(l) \longrightarrow NaHSO_4(s) + HCl(g)$$

colourless

Materials Required

(1) Apparatus	(2) Chemicals
Round bottom flask, Thistle funnel	(i) Sodium chloride
Delivery tube, Gas jar.	(ii) Conc. sulphuric acid

1.8.1 Procedure

Set up the apparatus as shown in Fig. 1.6. Take 2-3 grams of common salt in 250 ml round bottom flask. Add 5 ml of concentrated sulphuric acid through the thistle funnel and heat the mixture gently. Collect the gas by the upward displacement of air.

Fill few gas jars with HCl gas, perform the following tests and note your observations.

(i) Note the colour of the gas. It is colourless.

(ii) Carefully smell the gas. It has pungent suffocating smell.

(iii) Bring a glass rod dipped in ammonium hydroxide solution near the mouth of test tube.

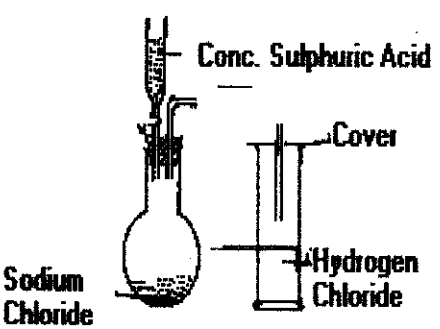

Fig. 1.6: *Preparation ofHydrogen Chloride gas*

Dense white fumes of ammonium chloride are formed.

$$HCl_{(g)} + NH_{3\,(g)} \longrightarrow NH_4Cl_{(S)}$$

Ammonium Chloride

1.8.2 Physical Properties

- Hydrogen chloride is a colourless gas.
- It has a pungent and chocking odour.
- It is heavier than air. The density is 1.639 g/cm^3.
- It fumes with moist air, due to the formation of small droplets.

1.8.3 Chemical Properties

(i) Hydrogen chloride gas is acidic in water. It turns blue litmus red.

(ii) It reacts with ammonia and forms ammonium chloride.

$$NH_3(g) + HCl(g) \longrightarrow H_4Cl$$

(iii) It reacts with silver nitrate solution and forms, a white curdy precipitate of silver chloride (AgCl).

$$Ag^+ + HCl \longrightarrow AgCl + H^+$$

(iv) Water solution of hydrogen chloride reacts with magnesium to librate hydrogen gas.

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

1.9 PREPARATION OF SULPHUR DIOXIDE (SO_2) GAS

Sulphur dioxide gas can be prepared in the laboratory by the action of dilute hydrochloric acid on sodium sulphite.

$$Na_2SO_3(s) + 2HCl(l) \longrightarrow 2NaCl(s) + H_2O(l) + SO_2(g)$$

Materials Required

(1) Apparatus	(2) Chemicals
Round Bottom flask (100 ml)	(i) Sodium sulphite
Thistle funnel, Delivery tube, Gas jars	(ii) Dilute hydrochloric acid

1.9.1 Procedure

Set up the apparatus as shown in the Fig. 1.7 Take 1-2 grams sodium sulphite in a 100 mL round bottom flsk and add 5 ml hydrochloric acid from thistle funnel dropwise.

Fill few gas jars with SO_2 gas, perform the following tests and note your observations.

$$Cu + 2\,H_2SO_4 \longrightarrow CuSo_4 + SO_2 + 2\,H_2O$$

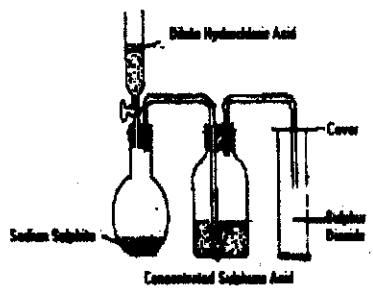

Fig.1.7: *Preparation of Sulphur dioxide gas*

(i) Note the colour of gas. It is colourless.
(ii) Carefully smell the gas. It has smell of burning sulphur.
(iii) Drop a piece of filter paper dipped in acidified potassium dichromate solution into jar. The filter paper turns green from orange.

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

1.9.2 Physical Properties

- Sulphur dioxide is a poisonous, colourless gas.
- It has a characteristic choking smell of burning sulphur.
- It is denser than air. Its vapour density is 32 compared with that of air which is 14.2 unit.
- It is highly soluble in water and forms an acidic solution.

1.9.3 Chemical Properties

(i) Sulphur dioxide is an acidic oxide. Its solution in water is highly acidic in nature.

$$SO_2 + H_2O \longrightarrow \underset{\text{Sulphurous acid}}{H_2SO_3}$$

Sulphur dioxide acts as a reducing agent as well as an oxidising agent.

(ii) **Reducing Properties of Sulphur dioxide**

(a) Sulphur dioxide reduces bromine to bromide ion

$$Br_{2\,(aq)} + SO_2\,(g) + 2H_2O \longrightarrow \underset{\text{Hydrogen bromide}}{2HBr} + H_2SO_4\,(aq)$$

(b) Sulphur dioxide reduces iron (III) to iron (II) ions

$$\underset{\text{Iron(III) chloride}}{2FeCl_3(aq)} + SO_2(aq) + 2H_2O(l) \longrightarrow \underset{\text{Iron(II) chloride}}{2FeCl_2(aq)} + H_2SO_4(aq) + 2HCl$$

(c) Sulphur dioxide decolourises purple potassium permanganate (VII) solution in acidic medium, due to the reduction of permanganate ions, MnO^-_4, to manganese (II) ions, Mn^{2+}. Manganese is in +7 oxidation state in MnO_4^- ion.

$$MnO_4^- + 8H^+ + 5e \longrightarrow Mn^{2+} + 4H_2O \times 2 \qquad \text{(i)}$$

$$SO_2 + 2H_2O \longrightarrow SO_4^{2-} + 2e^- + 4H^+ \times 5 \qquad \text{(ii)}$$

On adding equations (i) and (ii) and cancelling the common species on both the sides. We get the overall equation as follows:

$$\underset{\text{Purple}}{2MnO_4^-} + 5SO_2 + 2H_2O \longrightarrow \underset{\text{Colourless}}{2Mn^{2+}} + 5SO_4^{2-} + 4H^+$$

(d) When sulphur dioxide is bubbled through an acidified solution of dichromate ions, $Cr_2O_7^{2-}$, the colour of the solution changes from orange to green due to the formation of chromium (III) ions, Cr^{3+}. In $Cr_2O_7^{2-}$ ion, chromium is in + 6 oxidation state

$$Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O \quad \text{(iii)}$$

$$SO_2 + 2H_2O \longrightarrow SO_4^{2-} + 4H^+ + 2e^- \times 3 \quad \text{(iv)}$$

On adding equations (iii) and (iv) and cancelling the common species, on both the sides of arrow, the overall equation is

$$\underset{\text{Orange}}{Cr_2O_7^{2-}} + 2H^+ + 3SO_2 \longrightarrow \underset{\text{Green}}{2Cr^{3+}} + H_2O + 3SO_4^{2-}$$

(iii) Oxidizing Properties of Sulphur Dioxide

(a) Sulphur dioxide oxidizes those substances which are stronger reducing agents than itself. e.g. magnesium is oxidised to magnesium oxide.

$$2Mg(s) + SO_2(g) \longrightarrow 2MgO(s) + S(s)$$

(b) When hydrogen sulphide is bubbled through a solution of sulphur dioxide, a pale yellow precipitate of sulphur is formed due to the oxidation of the hydrogen sulphide to sulphur.

$$2H_2S(g) + SO_2(aq) \longrightarrow 2H_2O(l) + 3S(s)$$

1.10 GENERAL PRECAUTIONS

(i) Wherever required, chemicals should be dried properly.
(ii) Wherever water is to be used, distilled water should be used.
(iii) Some of the reactions are explosive in nature, care should be taken while carrying out such reactions.
(iv) Contamination of chemicals should be avoided.
(v) All the reactions should be performed in a fume cupboard.
(vi) In the preparation of hydrogen gas , there should be no flame near the apparatus because when air and hydrogen come in contact, explosion takes place.
(vii) Fix the corks tightly in the mouth of the woulfe's bottle or round bottom flask and make the joints airtight by sealing them with wax.
(viii) Smell the gases by puffing with hand..
(ix) Heat the reaction mixture gently, wherever required.

1.11 CEHCK YOUR UNDERSTANDING

Q.1 What happens when CO_2 is bubbled through lime water ?

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Q. 2 How would you show that corbon dioxide is acidic in nature?

.....

Q. 3 Name the physical property of chlorine gas which can help in its identification chemical tests.

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Q. 4 What is the role of MnO_2 in the preparation of chlorine gas ?

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Q. 5 Describe any one method of laboratory preparation of hydrogen gas ?

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Q. 6 Compare the dènsity of hydrogen gas with air and tell which one is heavier?

.....

Q. 7 Name the type of compound formed by the reaction of metal and hydrogen gas?

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Q. 8 What are the physical properties of oxygen gas ?

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Q.9How is carbon dioxide prepared in the laboratory ? Write the reaction?

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Q. 10. Can we use of dilute H_2SO_4 in place of dil.HCl in the preparation of carbon dioxide? Give reason.

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1.12 NOTE FOR THE TEACHER

When students perform these experiments, the teacher should ensure that the students are using proper set up of the apparatus. They should also see that students are using chemicals of required purity. While collecting gases, it should be properly collected as stated under individual gas preparation and the gas should not be allowed to leak in the laboratory.

1.13 CHECK YOUR ANSWERS

Ans.1: The lime water, $Ca(OH)_2$ turns milky due to the formation of insoluble calcium carbonate, $CaCO_3$.

$$Ca(OH) + CO_2 \longrightarrow CaCO_3 + H_2O$$

Ans.2: To a jar containing CO_2 gas, put a piece of most blue litmus. A change of colour from blue to red indicates acidic character of the gas.

Ans.3: (i) Greenish - yellow colour

(ii) Pungent - suffocating odour

Ans. 4: It acts as a cataly A.

Ans.5: Hydrogen gas is prepared in the laboratory when granules of zinc reacts with cold dilute sulphuric acid.

$$Zn + H_2SO_4 \longrightarrow Zn\,SO_4 + H_2$$

Ans.6: (i) Air is denser than hydrogen gas and air is heavier too.

Ans.7: The reaction of metal and hydrogen gas gives the metal hydrite.

Ans.8: (i) Oxygen is a colourless and odourless gas

(ii) It is heavier than air.

(ii) It is fairly soluble in water.

Ans.9: Carbon dioxide is prepared in the laboratory by the action of dilute hydrochloric acid on marble chips.

$$CaCO_3 + \text{dil. } HCl \longrightarrow CaCl_2 + CO_2 + H_2O\ (l)$$

Ans10: No, Sulphuric acid can not be used because the reaction remains incomplete as the reaction between sulphuric acid and marble chips gives calcium sulphate which being insoluble, deposits, on the marble chips and hence the reaction is left incomplete.

$$CaCO_3 + H_2SO_4 \longrightarrow CaSO_4 + H_2O + C_2O$$