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AIM OF THE EXPERIMENT :- To prepare Carbon dioxide gas in the laboratory and study its Physical and Chemical properties

APPARATUS REQUIRED :-

1. Woulf's bottle 2. Thistle funnel 3. Delivery tube
4. Rubber cork 5. Gas jar with lid 6. Few test tubes

CHEMICALS REQUIRED :-

1. Marble chips ($CaCO_3$) 2. Dil. Hydrochloric acid
3. Litmus paper 4. Magnesium ribbon 5. Lime water
6. Phenolphthalein solution.

THEORY :- In laboratory, Carbon dioxide gas is prepared by the action of dilute hydrochloric acid (HCl) upon marble chips ($CaCO_3$) in a Woulf's bottle. It is collected by upward displacement of air as Carbon dioxide is heavier in nature.

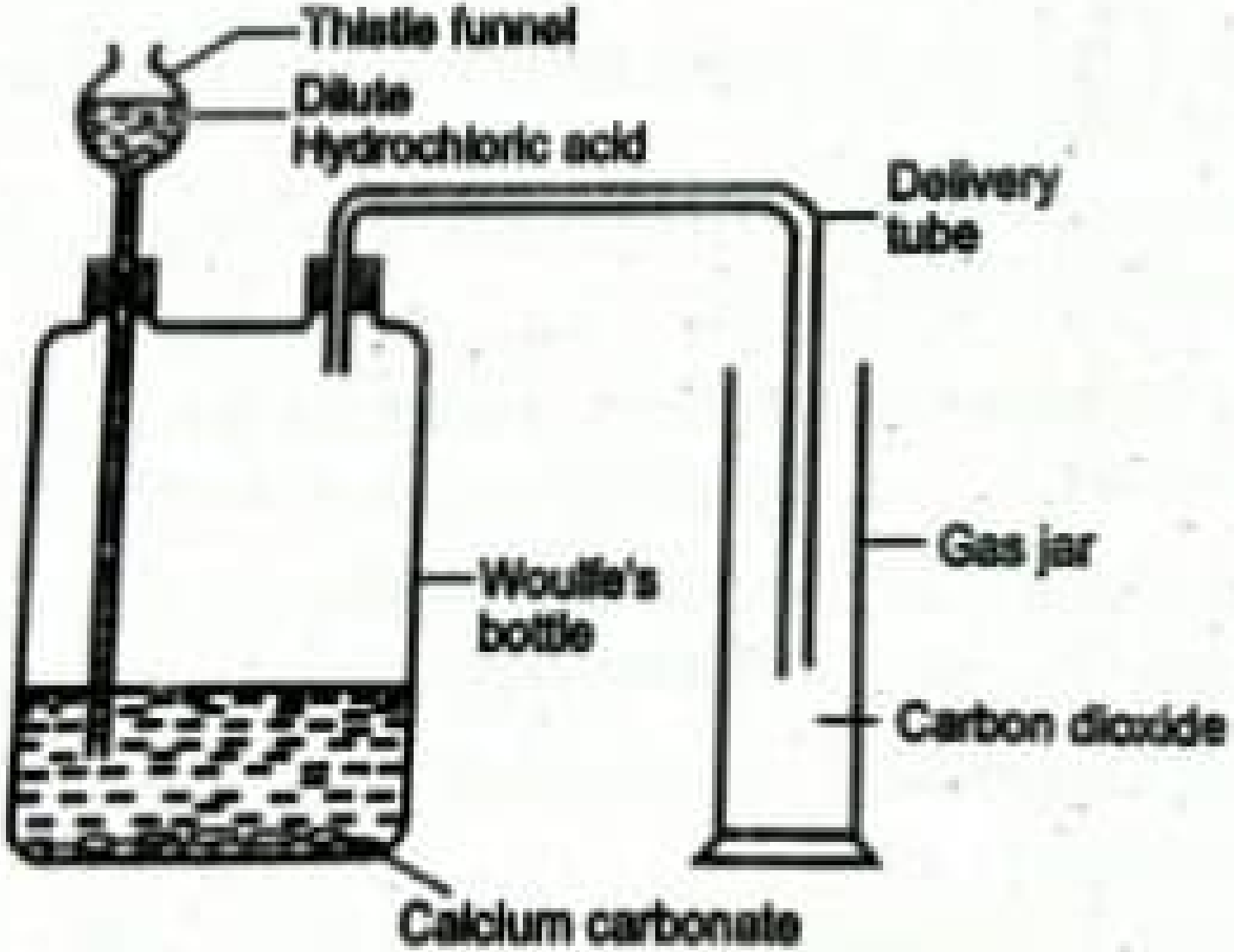
Chemical Equation :

$$CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_2\uparrow$$

(The symbol ↑ indicates that the gas is collected by upward displacement of air)

WORKING PROCEDURE :-

1. A Woulf's bottle fitted with rubber cork, thistle funnel and delivery tube was taken & examined that it was perfectly airtight. In case of air leakage, melted paraffin wax or grease may be used.
2. Few small marble chips were introduced into the woulf's bottle by opening one of its mouths.
3. Now some water was poured into the Woulf's bottle through the thistle funnel so as to cover the marble chips.
4. The thistle funnel was inserted more into the Woulf's bottle such that its extreme end was remained inside the water.


Thistle funnel
Dilute Hydrochloric acid
Delivery tube
Woulfe's bottle
Gas jar
Carbon dioxide
Calcium carbonate

5. Little quantity of the dil. Hydrochloric acid was now added through the thistle funnel. Excess amount of acid was not added at a time to exhaust the marble chips before the experiment was completed.
6. Then the carbon dioxide gas was collected in the gas jare by upward displacement of aire. The collected gas was tested in the jare by shewing a burning splintere at the mouth of the gas jare.
7. The properties of carbon dioxide were studied by collecting the gas in different test tubes.

OBSERVATION :-

Physical Properties :-

Sl. No.	Experiment	Observation	Inference
1.	Colour of the gas	No colour was observed.	CO_2 gas is colourless.
2.	Odour of the gas	No smell was observed	CO_2 gas is odourless.
3.	A glowing splintere was entered into a test tube full of CO_2 gas	The glowing splintere was extinguished	CO_2 gas is neither combustible nore the supporter of combustion. It is a non-flammable gas.
4.	The test tube full of CO_2 gas was inverted overe anothere empty test tube containing aire. Then a	The lime watere turned into milky.	CO_2 gas is heaviere than aire.

little lime water was added to the test tube containing air initially.		
5. The gas was collected in a test tube half-filled with water. The test tube was shaked vigorously by putting the thumb at its mouth and the thumb was removed and the level/volume of water was observed in the test tube.	Water was rushed inside the test tube.	CO_2 gas is soluble in water. $H_2O + CO_2 \rightarrow H_2CO_3$ (Carbonic acid)

Chemical Properties :-

Sl. No.	Experiment	Observation	Inference
1.	A piece of moist blue litmus paper was shown to the gas.	Blue litmus paper turned to red.	The gas is acidic in nature.
2.	The CO_2 gas was passed through 2-3 ml of dilute solutions of sodium hydroxide (NaOH) containing one drop of Phenolphthalein solution.	The pink colour of the solution was became colourless.	CO_2 gas is acidic in nature.
3. (a)	The gas was passed through lime water ($Ca(OH)_2$).	(a) milky coloured solution was appeared. $Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$	(a) It is due to the formation of Calcium Carbonate.
(b)	The gas was passed in excess.	(b) milky colour was disappeared. $CaCO_3 + H_2O + CO_2 \xrightarrow{\text{Excess}} Ca(HCO_3)_2$	(b) It is due to the formation of Calcium bicarbonate which is colourless.

(c) Now the solution was boiled.	(c) The milky colour was again appeared.	(c) This is due to the formation of $CaCO_3$ again. $Ca(HCO_3)_2 \xrightarrow{\Delta} CaCO_3 + H_2O + CO_2$
4.(a) A burning Magnesium ribbon was introduced into a test tube/gas jar containg CO_2 gas.	(a) Magnesium ribbon was burnt brightly producing white residue with black solid.	CO_2 is supporter of burning Mg-ribbon to form MgO (white) and C (black). $Mg + CO_2 \longrightarrow MgO + C$
(b) Now dil. HCl was added after the ribbon was burnt.	(b) White residue went into solution and the black solid floats on it.	MgO is soluble in HCl forming $MgCl_2$. $MgO + 2HCl \rightarrow MgCl_2 + H_2O$ (Magnesium Chloride)

CONCLUSION :-

Carbon dioxide gas is prepared at laboratory by using Calcium Carbonate ($CaCO_3$) and dil. Hydrochloric acid (HCl). CO_2 gas is acidic in nature. It is soluble in water and the gas is heavier than air.