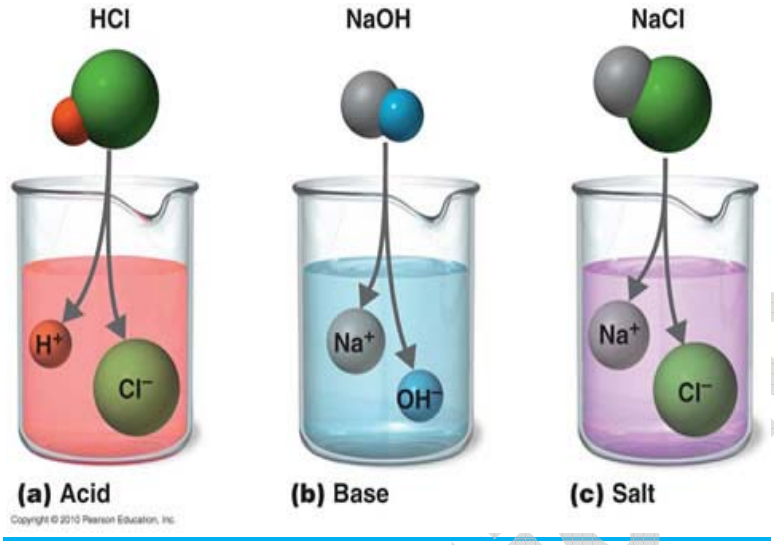
Acids, Bases and Salts



Synopsis

Substances are classified into acids, bases and salts depending on their chemical behavior and properties. Acids are of sour taste and turn blue litmus to red. Bases are soapy to touch and turn red litmus to blue. According to Lewis, electron pair acceptor is an acid and electron pair donor is a base.

The strength of acid or base depends on the concentration of H_3O^+ ions or OH^- produced in the solution. If an acid consists more H_3O^+ ions, then it is a strong acid, if the H_3O^+ ions are fewer then it is a weak acid.

A scale for measuring hydrogen ion concentration in a solution is called 'pH' scale. The pH scale ranges from 0 to 14. Acid pH value varies from 0 to 7. Neutral substances have pH value 7. pH value is 7 to 14 for Base.

When acid reacts with base, it forms salt and water. Sodium chloride is the most common salt. Sodium hydroxide, Bleaching powder, baking soda, washing soda are some of the salts obtained from common salt. Plaster of Paris is obtained from gypsum.

4 Mark Questions

1. Five solutions A, B, C, D and E when tested with universal indicator showed pH as 4, 1, 11, 7 and 9 respectively, Which solution is

a) neutral b) strongly alkaline c) strongly acidic d) weakly acidic

e) Weakly alkaline. Arrange the PH in increasing order of hydrogen ion concentration (AS_1).

Ans:

Solution		pH value
A	_____	4
B	_____	1
C	_____	11
D	_____	7
E	_____	9

a) Solution 'D' is neutral

b) Solution 'C' is strongly alkali metals

c) Solution 'B' is strongly acidic

d) Solution 'A' is weakly acid

e) Solution 'E' is weakly alkali metals

$pH = -\log [H^+]$

A) $4 = -\log [H^+]$; $[H^+] = 10^{-4}$

B) $1 = -\log [H^+]$; $[H^+] = 10^{-1}$

C) $11 = -\log [H^+]$; $[H^+] = 10^{-11}$

D) $7 = -\log [H^+]$; $[H^+] = 10^{-7}$

E) $9 = -\log [H^+]$; $[H^+] = 10^{-9}$

Increasing order of hydrogen ion concentration

i.e. 10^{-11}, 10^{-9}, 10^{-7}, 10^{-4}, 10^{-1}

C', E', D', A', B'

2. Compounds such as alcohols and glucose contain hydrogen but are not categorized as acids. Describe an activity to prove it?

Ans: Prepare solutions of glucose and alcohol. Fix two iron nails on a rubber cork and place the cork in a beaker as shown in the figure.

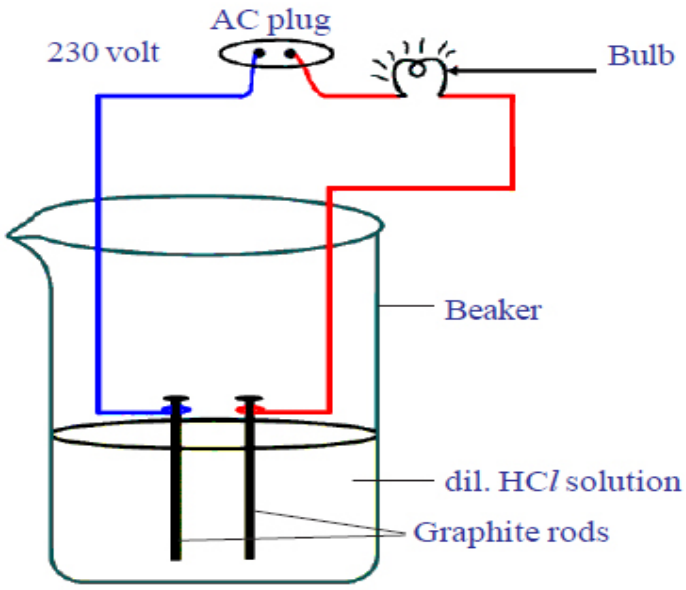


fig-3: Acid solution in water conducts electricity

Connect the nails to the two terminals of a battery through a switch and a bulb. Now pour glucose solution ($C_6H_{12}O_6$) and switch on the current. The bulb does not glow. This shows that glucose solution does not conduct electricity.

Repeat this experiment with alcohol solution in the beaker. The bulb does not glow again, that means alcohol solution does not conduct electricity.

Due to the absence of ions in glucose and alcohol solutions they do not conduct electricity. Glucose and alcohol do not dissociate in water to produce H^+ ions even though they contain hydrogen. Thus glucose and alcohols are not categorized as acids because they do not produce H^+ ions in water.

3. What is meant by "Water of Crystallization" of a substance?

- Describe an activity to show the water of crystallization?

Ans. **<u>Water of Crystallization:</u>** water of crystallizations is the fixed number of water molecules present in one formula unit of salt.

Ex: $Cuso_4.5H_2O$

In means that five water molecules are present in one formula unit of copper sulphate.

Activity:

1) Take a few crystals of copper sulphate in dry test tube and heat the test tube.
2) We observe water droplets on the walls of the test tube and salt turn white.
3) Add 2 – 3 drops of water on the sample of copper sulphate obtained after heating.
4) We observe the blue color of copper sulphate crystals is restored.

Reason: In the above activity, copper sulphate crystals which seem to be dry contain the water of crystallization, when these crystals are heated, water present in crystals is evaporated and the salt turns White. When the crystals are moistured with water, the blue color reappears.

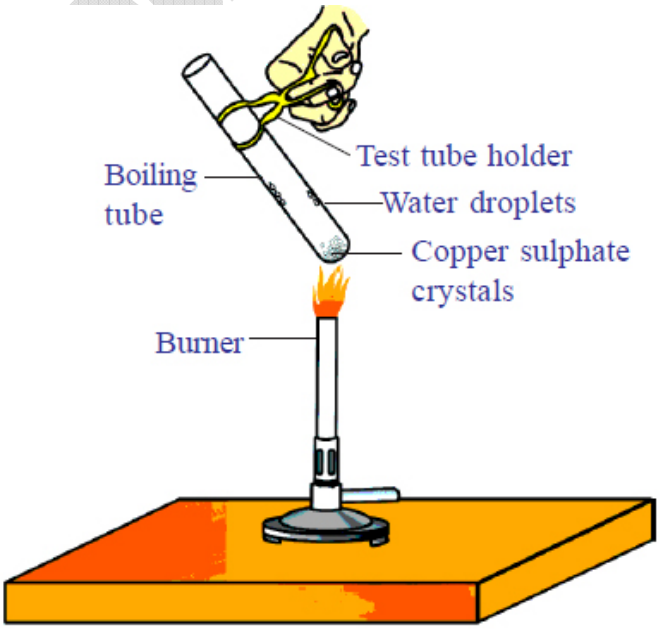


fig-10: Removing water of crystallisation

2 Mark Questions

1. What is neutralization reaction? Give two examples? (AS_1)

A. The reaction of an acid with a base to give a salt and water is known as neutralization. In general, neutralization reaction can be writer as-

$$Base + Acid \longrightarrow salt + Water$$

$$Ex: \quad NaoH + Hcl \longrightarrow Nacl + H_2o$$

2. What happens when an acid or base is mixed with water? (AS_7)

A. Mixing of an acid or base with water results in decrease in the concentration of ions per unit volume. Such a process is called dilution and the acid or the base is said to be diluted.

3. Why does tooth decay start when the pH of mouth is lower than 5.5 (As_1)?

A. The pH value of saliva is 6.4 to 6.9. It is almost neutral in nature. When sugar and food particles degraded by the bacteria in mouth produce free acid. Due to this the pH of the mouth falls. Tooth enamel, made of calcium phosphate. It is the hardest substance in the body. It does not the dissolve in water, but is corroded when the pH in mouth is below 5.5. Tooth decay starts when the pH of the mouth is lower than 5.5.

4. Why does not distilled water conduct electricity?

A. Liquids conduct electricity only due to ions. In distilled water, the concentration of both H_3o^+ and OH^- is same. Hence they do not form ions. As there is no formation of ions in electrolysis, distilled water do not conduct electricity.

5. Dry hydrogen chloride gas does not turn blue litmus to red. Whereas hydrochloric acid does. Why?

A. Dry hydrogen chloride gas do not dissociate in the absence of water. Hence it does not turn blue litmus to red. So dry hydrogen chloride gas is not acidic. The Hcl

(Hydrochloric acid) dissociates in the presence of water. Hence it turns blue litmus to red. So, Hcl is acidic.

The dissociation will be as follows.

$$Hcl + H_2o \longrightarrow H_3o^+ + cl^-$$

6. A milkman adds a very small amount of baking soda to fresh milk.

a) Why does he shift pH of the fresh milk from 6 to slightly alkaline?

b) Why does this milk take a long time to set as curd?

A. a) The chemical name of the compound is sodium hydrogen carbonate (Na HCO_3) and its pH value is 8.1. When milk man adds a little baking soda to fresh milk to make it slightly alkaline so that it can be preserved for longer time.

b) Lactic acid which was formed initially reduces the basic nature of the baking soda. Then more lactic acid is needed to convert milk into curd. That is why it takes time to produce more lactic acid and hence the milk takes a long time to become curd.

7. Plaster of Paris should be stored in moisture-proof container. Explain. (As_2).

A. Plaster of Paris chemical name is calcium sulphate hemihydrates ($caso_4$. ½ H_20).

It is a white powder and on mixing with water, it sets into hard solid mass due to the formation of gypsum.

$$CaSo_4.\frac{1}{2}H_2o + 1\frac{1}{2} \longrightarrow Caso_4.2H_2o$$

Because of the above reason plaster of Paris should be stored in moisture proof container.

8. Why acetic acid does not turn blue litmus to red.

A. Acetic acid is a weak acid, changing the color of litmus paper depend on the strength of the acid. Being a weak acid, acetic acid does not turn the blue litmus to red.

9. Fresh milk has a pH of 6. Explain why the pH changes as it turns into curd? (AS_3).

A. Fresh milk has a pH of 6. Lacto bacillus bacteria turns milk to curd by releasing 'Lactic acid'. That means curd contains more acid than milk. Hence, the pH value decreases than 6.

10. Equal lengths of magnesium ribbons are taken in test tubes A and B. Hydrochloric acid is added to tube A, while acetic acid is added to test tube B. Amount and concentration of the both the acids is same. In which test tube the fizzing occurs more vigorously and why?

A. Magnesium is a metal strong acid vigorously reacts with metals and releases Hydrogen gas. Hydrochloric acid is strong acid than acetic acid. So in test tube A, the reaction occurs vigorously as it contains strong acid.

11. How do you prepare your own indicator using beetroot? Explain (AS_5)

A. Take two beetroots and prepare juices. Dip a filter paper into the beetroot juices. The paper changes into "Red color". Now add a few drops of vinegar on the piece of beetroot paper. Observe whether the color is changed or not. There is no change in color.

Now add a few drops of soap solution on the piece of beetroot paper. Observe whether the color is changed or not. It turns yellow. From this, we conclude that beetroot paper act as an indicator and this is a natural indicator.

12. How does the flow of acid rain into a river make the survival of aquatic life in a river difficult? (As_7)

A. When the pH of rain water is less than 5.6 it is called acid rain. When acid rain water flows in river, it lowers the pH value after river water to such an extent that the survival of aquatic animal becomes difficult. The high acidity of river water can even kill the aquatic animals like fish.

13. What is backing powder? How does it make the cake soft and spongy?

A. Baking powder is a mixture of baking soda and a mild edible acid such as tartaric acid. When baking powder is heated or mixed in water, the following reaction takes place.

$NaHco_3 + H^+ \longrightarrow Co_2 + H_2O$ + sodium salt of acid

Carbon dioxide produced during the reaction causes bread or cake to rise making them soft and spongy.

14. Give two important uses of washing soda and baking soda.

A. Uses of washing soda: 1) Sodium carbonate (washing soda) is used in glass, soap and paper industries.

2) It is used in the manufacture of sodium compound such as borax.

3) Sodium carbonate can be used as a cleaning agent for domestic purpose.

Uses of baking soda: 1) Baking soda is sometimes added for faster cooking.

2) Baking soda (sodium hydrogen carbonate) is also an ingredient in antacids.

3) It acts as mild antiseptic.

1 Mark Questions

1. What are antacids?

A. Antacids are mild alkalis. These are used for getting relief from acidity and indigestion.

Ex: Milk of magnesia.

2. What are olfactory indicators?

A. There are some substances whose odour changes in acidic or basic media. These are called olfactory indicator.

3. What is neutralization reaction?

A. The reaction of an acid with a base to give a salt and water is known as a neutralization reaction.

Base + Acid $\longrightarrow$ Salt + Water

4. What is bleaching powder? Write its formula?

A. Beaching powder is produced by the action of chlorine on dry slaked lime.

$$ca(OH)_2 + cl_2 \longrightarrow caocl_2 + H_2o$$

Formula of bleaching powder is $caocl_2$.

5. What is the range of pH scale?

A. The range of PH scale is from 0 to 14.

6. What are alkalis?

A. Bases which are soluble in water are called alkalis.

7. What is water of crystallization?

A. Water of crystallization is the fixed number of water molecules present in one formula unit of salt.

8. Write the reaction of copper oxide with hydrochloric acid?

A. $Cuo_{(s)} + 2Hcl_{(aq)} \longrightarrow Cucl_{2(aq)} + H_2O_{(l)}$

9. What are the salts obtained from common salt?

A. The various salts obtained from common salt are sodium hydroxide, baking soda, washing soda, bleaching powder and many more.

10. Where acid is added to water, what type of reaction is it?

A. When acid is added to water, it is an exothermic reaction.

11.How do you decide the strength of acid or base?

A. The strength of acid or base can be decided on the basis of no of H_3O^+ ions or OH^- ions produced in solution.

12.What is a pH scale?

A. A scale for measuring hydrogen ion concentration in a solution is called pH scale.

Fill in the Blanks

1. i. _____ taste is a characteristic property of all acids in igneous solution. **[Sour]**

ii. Acids react with some metals to produce _____ gas. **[Hydrogen]**

iii. Because igneous acid solutions conduct electricity, they are identified Gas _____. **[Conductors]**

iv. Acids react with bases to produce a _____ and water. **[Salt]**

v. Acids turn _____ different colors. **[Indicators]**

2. i. Bases tend to taste _____ and feel ____. **[Bitter, Soapy]**

ii. Like acids, aqueous basic solutions conduct _____, and are identified as _____. **[Electricity, conductor]**

iii. Bases react with _____ to produce a salt and _____. **[Acid, water]**

iv. Bases turn _____ different colors. **[Indicators]**

3. The strength of the base is measured by the number of _____ ions it produces in a solution. **[OH^-]**

4. An aqueous solution of sodium chloride is _____. **[brine]**

5. The irritation and pain due to indigestion can be reduced by using substances called _____. **[Antacids]**

6. The chemical name of Plaster of Paris is _____. **[Calcium sulphate hemihydrate]**

7. When the blue color of copper sulphate crystals are heated the salt turns _____. **[white]**

8. Baking powder is a mixture of baking soda and a _____. **[mild edible acid]**

9. Bleaching powder is represented by formula _____. **[$caocl_2$]**

10._____ used as a reagent in the preparation of chloroform. **[bleaching powder]**

11. Magnesium hydroxide is an _____ that neutralizes the excess acid in stomach. **[antacid]**

12. Substances whose odour changes in acidic or basic are called _____. **[Olfactory indicators]**

13. $2NaOH + zn \longrightarrow Na_2zno_2 + \_\_\_\_\_$ **[H_2]**

(Sodium Zincates)

14. $Metal\ carbonate + Acid + \longrightarrow salt + \_\_\_\_\_ + water$ **[carbon dioxide]**

15. To know the strength of acid or base _____ indicator can be used. **[Universal]**

16. In pH, p stands for _____. **[potent]**

17. The pH value of neutral solution is _____. **[7]**

18. When pH of rain water is _____ it is called acid rain. **[less than 5.6]**

19. Tooth decay starts when the pH of the mouth is lower than _____. **[5.5]**

20._____ is the hardest substance in the body. **[calcium phosphate]**

21. Tooth pastes which are generally _____. **[basic]**

22. Magnesium hydroxide [$Mg(OH)_2$].which is used antacid is _____. **[mild base]**

23. Stinging hair of leaves of nettle plant injects _____ causing burning pain. **[Methanoic acid]**

24. 24. $2Nacl_{(aq)} + 2H_2O_{(l)} \longrightarrow 2NaOH + \_\_\_\_\_ + H_{2\,(g)}$ **[cl_2]**

25. _____ used for disinfecting drinking water to make it free of germs.

[Bleaching powder]

26._____ used for removing permanent hardness of water. **[Sodium carbonate]**

Multiple Choice Questions

1. The color of methyl orange indicator in acidic medium is _____. **[d]**

a) Yellow b) Green c) Orange d) red

2. The color of phenolphthalein indicator in basic solution is _____. **[c]**

a) Yellow b) Green c) Pink d) red

3. Color of methyl orange in alkali condition_____. **[b]**

a) Orange b) Yellow c) red d) Blue

4. A solution turn red litmus into blue, its pH is likely to be? **[d]**

a) 1 b) 4 c) 5 d) 10

5. A solution reacts with crushed egg – shells to give a gas that turns lime water milky the solution contains_____. **[b]**

a) Nacl b) Hcl c) Licl d) Kcl

6. If a base dissolved in water by what name is it better known? **[d]**

a) Neutralization b) basic c) acid d) alkali

7. Which of the following substances when mixed together will produce table salt? **[d]**

a) Sodium thiosulphate and sulphur dioxide

b) Hydrochloric acid and Sodium hydroxide

c) Chlorine and oxygen

d) Nitric acid and sodium hydrogen carbonate

8. What color would hydrochloric acid (PH_{31}) turn universal indicator? **[d]**

a) Neutralization b) basic c) acid d) alkali

9. Which one of the following types of medicine is used for treating indigestion? **[c]**

a) Antibiotic b) analgesic c) Antacid d) Antiseptic

10. What gas is produced when magnesium is made to react with hydrochloric acid? **[a]**

a) Hydrogen b) Oxygen

c) Carbon dioxide d) No gas is produced

11. Which of the following is the most accurate way of showing neutralizations? **[b]**

a) $Acid + Base \longrightarrow acid - base\ solution$

b) $Acid + Base \longrightarrow salt + water$

c) $Acid + Base \longrightarrow sodium\ chloride + hydrogen$

d) $Acid + Base \longrightarrow Neutral\ solution$

12. Which of the following indicators is not an acid – base indicator? **[b]**

a) Phenolphthalein b) Vanilla c) Litmus d) Methyl orange

13. The acid formed in stomach which help in digestion is _____. **[a]**

a) Hcl b) H_2So_4 c) CH_3COOH d) citric acid

Match the Following

Group - A		Group – B
a) Plaster of Paris	[4]	1) $Caocl_2$
b) Gypsum	[5]	2) $NaHCo_3$
c) Beaching Powder	[1]	3) Na_2co_3
d) Baking soda	[2]	4) $CaSo_4$ 1/2 H_2o
e) Washing soda	[3]	5) $CaSo_4.2H_2o$

Group - A		Group – B
1) Plaster of Paris	[b]	a) enhance the taste of food
2) Washingsoda (sodium carbonate)	[c]	b) Making toys
3) Baking soda	[d]	c) Glass industry
4) Bleaching Powder	[e]	d) Mild non – corrosive base
5) Common salt	[a]	e) Oxidizing agent

Group - A		Group – B
1) Hcl	[b]	a) Strong Base
2) NaOH	[a]	b) Strong Acid
3) CH_3cooH	[d]	c) Weak Base
4) NH_4oH	[c]	d) Weak Acid

Important Images

1. Draw a neat diagram showing acid solution in water conducts electricity.

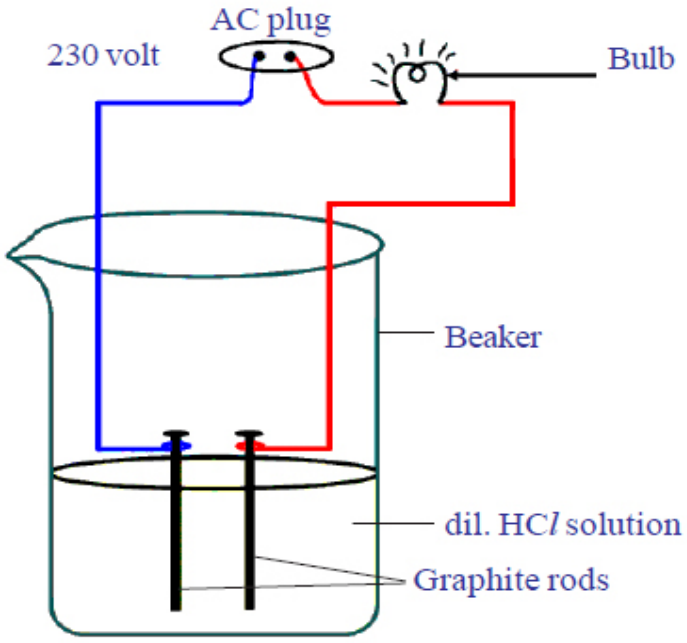


fig-3: Acid solution in water conducts electricity

2. HCL and testing hydrogen gas by a burning match stick

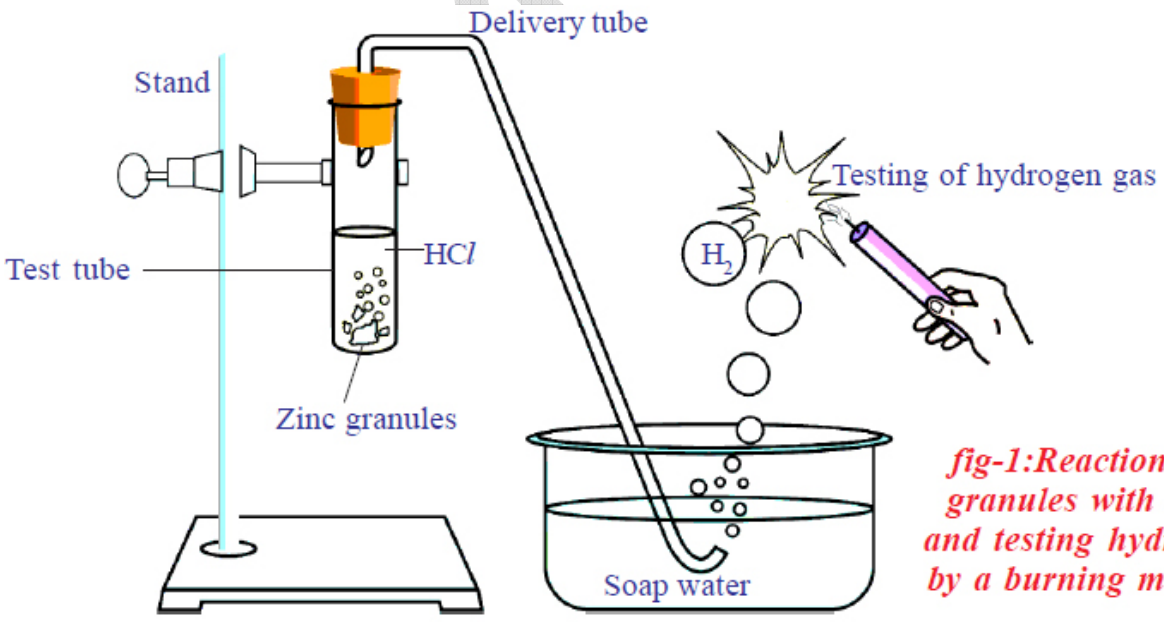


fig-1:Reaction of zinc granules with dil. HCl and testing hydrogen gas by a burning match stick

2. Passing CO_2 gas through $Ca(OH)_2$

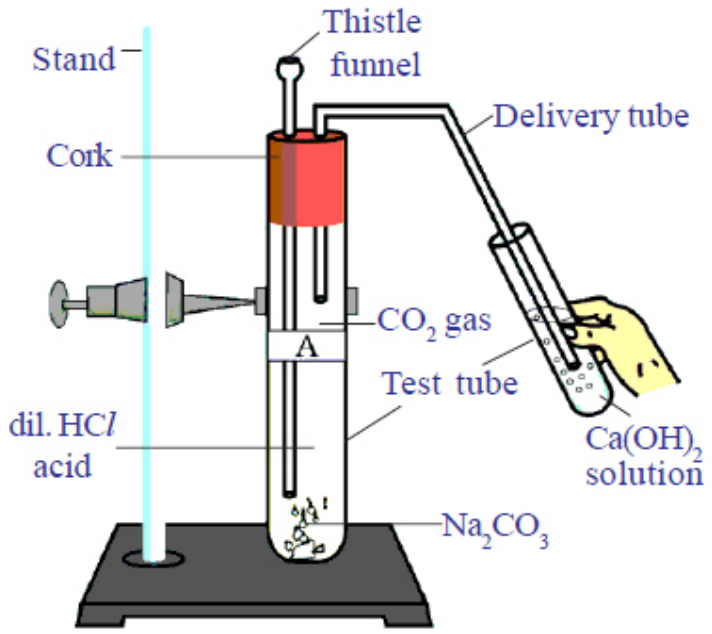


fig-2: Passing CO_2 gas through $Ca(OH)_2$ solution