CHAPTER - 2
ACIDS, BASES AND SALTS

Acids: Non- metal oxides react with water to from acids
Examples of acids: HCl, H_2SO_4, HNO_3, CH_3COOH
Acids are sour to taste and turn blue litmus to red

Bases: Metals react with water to form bases
Examples of bases: NaOH, KOH, $Ca(OH)_2$, $Zn(OH)_2$, NH_4OH
Bases are soapy to touch and turn red litmus to blue.

Types of Indicators: Natural and Synthetic indicators

Natural Acid-base indicators : Litmus, extract of red cabbage, turmeric solution and extracts of coloured petals of some flowers contain dye molecules

Synthetic Acid-base indicators: Methyl orange and phenolphthalein

Activity-1 (Chemical properties of Acids and Bases)

Aim: Identify the sample as acidic or basic solution.

Material required: Acids, Bases, watch glasses, Blue litmus, Red litmus, Methyl orange, Phenolphthalein

Procedure:

Take four watch glasses and put one drop of the first solution in each one of them and test the solution as follows.

i. dip the blue litmus paper in the first watch glass.
ii. dip the red litmus paper in the second watch glass.
iii. add a drop of methyl orange to the third watch glass, and
iv. add a drop of phenolphthalein to the fourth watch glass.

Indicators	Acid	Base
Blue litmus	**Red**	**No change**
Red litmus	**No change**	**Blue**
Methyl orange	**Red**	**Yellow**
Phenolphthalein	**No change**	**Pink**

Reaction of Acids with Metals
(Lab activity)

Aim: To show that acid produce hydrogen gas reacted with metals.

Materials required: test tube, delivery tube, glass trough, candle, soap water, dil. HCl, and zinc granules.

Procedure:

1)Set the apparatus as shown in figure.
2)Take about 10ml of dilute HCl in a test tube and add a few zinc granules to it.
3) We observe a gas is evolved from the zinc granules
4)Pass the gas being evolved through the soap water.
5)We observe some bubbles formed in the soap solution.
6)Bring a burning candle near the gas filled bubble.
7) The candle turn off with a pop sound
8) The pop sound indicates that the gas evolved in H2
Acid + Metal → Salt + Hydrogen
2 HCl (aq) + Zn(s) → $ZnCl_2$ (aq) + H_2 (g)
9) Repeat this experiment with remaining acids

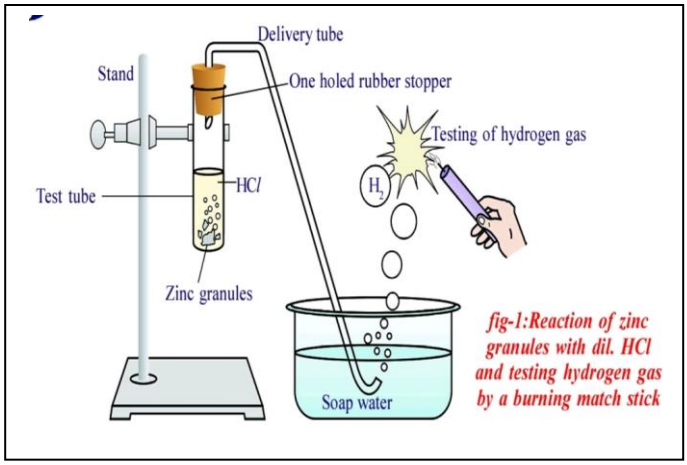


fig-1:Reaction of zinc granules with dil. HCl and testing hydrogen gas by a burning match stick

Conclusion: We conclude that hydrogen gas is produced when acid reacts with metals.

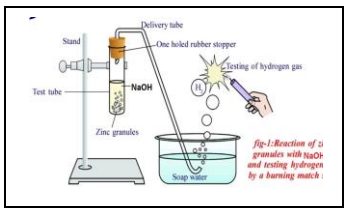
Reaction of Bases with Metals

Aim: To show that certain bases produce hydrogen gas reacted with metals.

Materials required: Test tube, delivery tube, glass trough, candle, soap water,NaOH, and zinc granules.

Procedure:

1)Set the apparatus as shown in figure.
2)Take about 10ml of NaOH solution in a test tube and add a few zinc granules to it.
3) We observe a gas is evolved from the zinc granules
4)Pass the gas being evolved through the soap water.
5)We observe some bubbles formed in the soap solution
6)Bring a burning candle near the gas filled bubble.
7) The candle turn off with a pop sound
8) The pop sound indicates that the gas evolved in H_2



9) Repeat this experiment with remaining bases

Conclusion: We conclude that certain bases produce hydrogen gas reacted with metals.

Reaction of Acids with carbonates and metal hydrogen carbonates

(Activity-4)

Show that the reaction of carbonates and metal hydrogen carbonate with acids produces carbondioxide gas (OR) How do you produce and test carbon dioxide gas in your lab

Procedure:

1) Take two test tubes; label them as A and B.
2) Take about 0.5 gm of sodium carbonate (Na2CO3) in test tube A and about 0.5 gm of sodium hydrogen carbonate ($NaHCO_3$) in test tube B.
3) Add about 2 ml of dilute HCl to both the test tubes.
4) Pass the gas produced in each case through lime water (calcium hydroxide solution) and record your observations
5) The reactions occurring in the above activities are as follows:

Na_2CO_3 (S) + 2 HCl (aq) → 2 NaCl (aq) + H_2O (*l*) + CO_2 (g)

$NaHCO_2$ (S) + HCl (aq) → NaCl (aq) + H_2O (*l*) + CO_2 (g)

Pass the gas evolved through lime water.

$Ca(OH)_2$ (aq) + CO_2 (g) → $CaCO_3$ + H_2O (*l*)

(White precipitate)

On passing excess carbon dioxide the following reaction takes places:

$CaCO_3$ (S) + H_2O (*l*) + CO_2 (g) → Ca $(HCO_3)_2$ (aq)

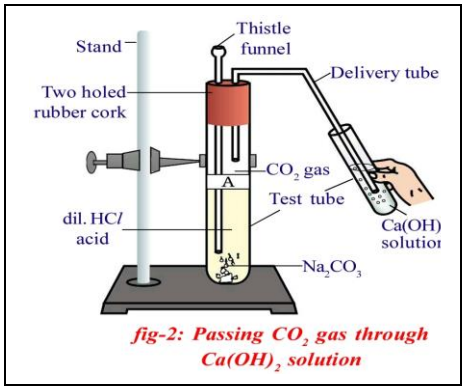


fig-2: Passing CO_2 gas through $Ca(OH)_2$ solution

Conclusion: The reaction of metal carbonates and hydrogen carbonates with acids give a corresponding salt,carbon dioxide and water.We can write generalized form of these chemical reactions as shown below:

metal carbonate + acid → salt + carbon dioxide + water

metal hydrogen carbonate + acid → salt + carbon dioxide + water

Neutralization reaction

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

In general, a neutralization reaction can be written as:

Base + Acid → Salt + Water

Activity-5

1)Take about 2 ml of dilute NaOH solution in a test tube and add one drop of phenolphthalein indicator. Observe the colour of the solution.
2) The solution turn into Pink
3) Add dilute HCl solution to the above solution drop by drop. The pink colour disappears.
4) Now add one or two drops of NaOH to the above mixture.
5) In the above activity you observe that the pink colour disappears on adding HCl because NaOH is completely reacted with HCl. The effect of base is nullified by an acid. Pink colour reappears on adding a drop of NaOH because the solution becomes basic once again.
6) The reaction occuring between acid and base in the above activity can be written as:

NaOH (aq) + HCl (aq) → NaCl (aq) + H2O (l)

Reaction of Acids with metal oxides

(Activity-6)

1)Take a small amount of copper oxide (CuO) in a beaker and slowly add dilute hydrochloric acid while stirring.
2) You will notice that the copper oxide present in the beaker dissolves in dilute HCl and the colour of the solution becomes blueish-green.
3) The reason for this change is the formation of copper chloride in the reaction.
4) The general reaction between a metal oxide and an acid can be written as:

Metal oxide + Acid → Salt + Water

5) In above reaction metal oxide reacts with acid to give salt and water. This reaction is similar to the reaction of a base with an acid(neutralization reaction)
6) Thus metal oxides are basic in nature

Reaction of base with non-metal oxide

Calcium hydroxide, which is a base, reacts with carbon dioxide to produce a salt and water. This reaction is similar to the reaction between a base and an acid. Thus we can conclude that carbon dioxide which is a non metal oxide is acidic in nature. In general all nonmetal oxides are acidic in nature.

What do acids have in common?

(Activity-7)

(Compounds such as alcohols and glucose contain hydrogen but are not categorized as acids)

1) Prepare solutions of glucose, alcohol, hydrochloric acid and sulphuric acid etc.,
2) Connect two different coloured electrical wires to graphite rods separately in a 100 ml beaker as shown in figure.
3) Connect free ends of the wire to 230 volts AC plug and complete the circuit as shown in the fig by connecting a bulb to one of the wires.
4) Now pour some dilute HCl in the beaker and switch on the current.
5) We observe that the bulb glows.
6) Repeat activity with dilute sulphuric acid and glucose and alcohol solutions separately.
7) You will notice that the bulb glows only in acid solutions but not in glucose and alcohol solutions.
8) Glowing of bulb indicates that there is flow of electric current through the solution. Acid solutions have ions and the moment of these ions in solution helps for flow of electric current through the solution.

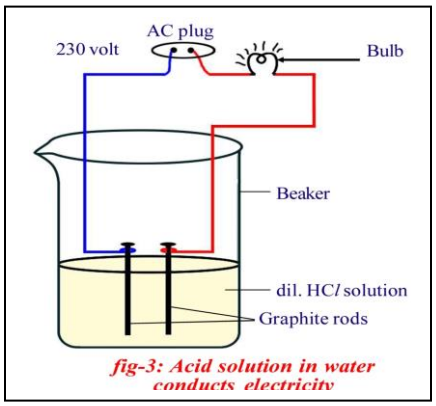


fig-3: Acid solution in water conducts electricity

9) The positive ion (cation) present in HCl solution is H+. This suggests that acids produce hydrogen ions H+ in solution, which are responsible for their acidic properties.
10) In glucose and alcohol solution the bulb did not glow indicating the absence of H+ ions in these solutions. The acidity of acids is attributed to the H+ ions produced by them in solutions.

What do Bases have in common?

1) Repeat the Activity-7 using alkalis such as sodium hydroxide, calcium hydroxide solutions etc., instead of acid solutions.
2) We observed that the bulb glows in basic solutions also. They having **OH^-** ions.

Hydrogen ion concentration

Hydrogen ion concentration is the composition of hydrogen ions in a solution.

The acidic, basic and neutral nature of a solution can be found out by the Hydrogen ion concentration

p^H Scale : A scale for measuring hydrogen ion concentration in a solution is called p^H scale.

- p^H values from 0 to 14
- The p^H is an indication of concentration of H+.

p^H value	**0 to below 7**	**7**	**Above 7 to 14**
Nature of Solution	**Acidic**	**Neutral**	**Basic**

fig -7: pH value as shown by different colour in universal indicator

Importance of p^H in everyday life

1. Plants and animals has sensitive p^H values

- Living organisms can survive only in a narrow p^H range.
- When pH of rain water is less than 5.6, it is called acid rain.
- When acid rain flows in to the rivers, it lowers the pH of the river water, the survival of aquatic life in such rivers becomes difficult.

2. Tooth decay

- Tooth decay starts when the pH of the mouth is lower than 5.5.
- Tooth enamel, made of calcium phosphate is the hardest substance in the body.
- But is corroded when the pH in the mouth is below 5.5.

3. p^H in our digestive system

- During indigestion the stomach produces too much acid and this causes pain and irritation.
- To get rid of this pain, people use bases called antacids.
- These antacids neutralize the excess acid in the stomach. Magnesium hydroxide (milk of magnesia), a mild base, is often used for this purpose.

4. p^H of the soul

- Plants require a specific pH range for their healthy growth.

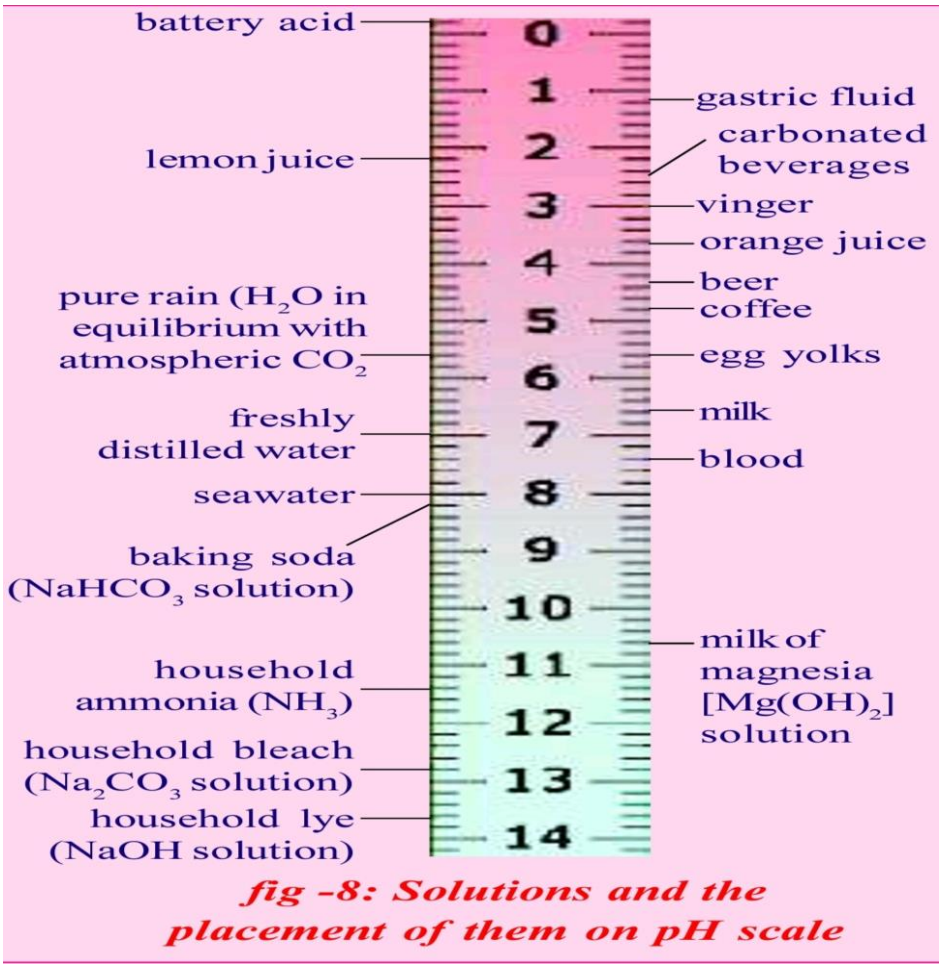


fig -8: Solutions and the placement of them on pH scale

a) What is the nature of blood?
Ans: Basic nature
b) Which of the substances in the scale are used as antacids?
Ans: Milk of magnesia[$Mg(OH)_2$]
c) Which substance is neutral from above scale?
Ans: Freshly distilled water
d) Which substance acts as strong base?
Ans: Household bleach and Household lye
e) Which substance acts as strong acids?
Ans: Battery acid and Gastric fluid
f) What is the P^H range of bases?
Ans: Above 7 to 14
g) Which is the neutral solution?
Ans: Freshly distilled water
h) What is the chemical name of milk of magnesia?
Ans: Magnesium hydroxide
i) What is nature of gastric juice based on strength?
Ans: Strong acidic nature

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