ACID, BASES AND SALTS (MODULE-1/4)

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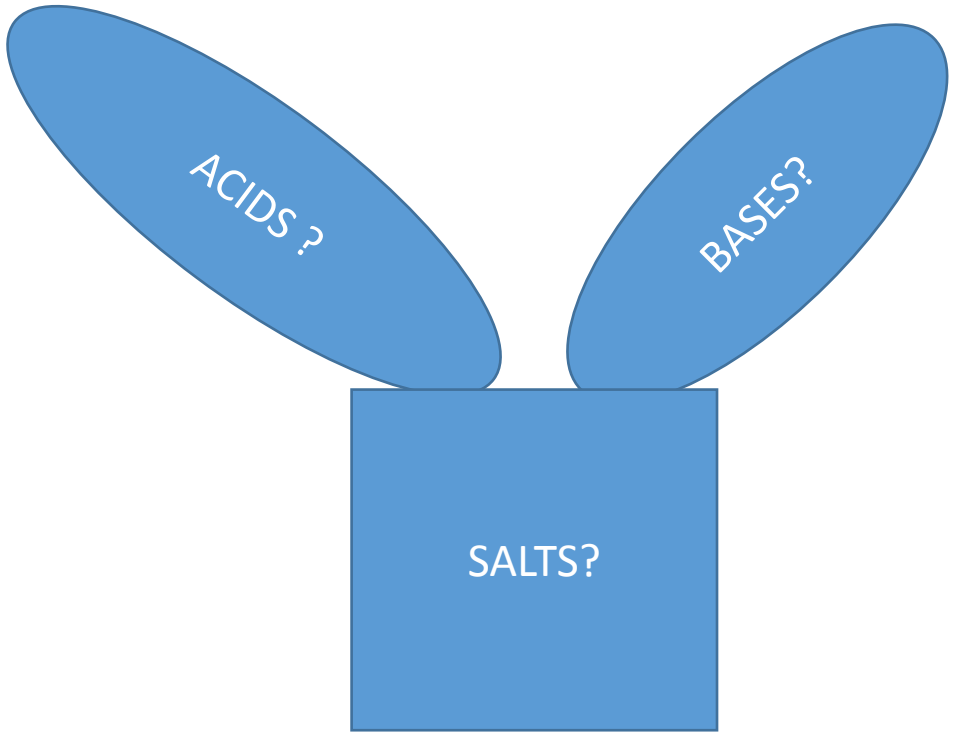
ACID BASES AND SALTS

- 115 elements combine to form different compounds.
- Based on chemical properties they are classified as acids, bases and salts.
- These substances are identified using natural, synthetic and olfactory indicators.
- Salts are formed by combination of acids and bases



INDICATORS FOR TESTING ACIDS AND BASES:

•NATURAL INDICATORS:

Litmus solution is purple dye (neutral)extracted from lichen,we get as blue litmus or red litmus

Litmus solution / paper changes from Blue to Red when it is dipped in Acid and Red to Blue when it is dipped in Base.

Turmeric, red in basic solution

Red cabbage leaves remain red in acid but changes to green in basic solution

Hydrangea plant is blue but turns pink in the base.

•SYNTHETIC INDICATORS:

Methyl orange changes from red (acid)to yellow(base)

Phenolphthaleine changes from colourless(acid)to pink(base)

Universal indicators is mixture of many different indicators which gives different colours at different pH values of entire pH scale(to make out whether the given solution is strong acid or base or weak acid or base.)

•OLFACTORY INDICATORS: those substances whose smell changes in acidic or basic solution. Such as

•**onion** – **no** characteristic smell in basic solution

•**vanilla extract- no** characteristic smell in basic solution

ACIDS

- An acid may be defined as a substance capable of releasing one or more H+ ions in aqueous solution
- Acids change the colour of blue litmus to red
- They are good electrolyte.
- They are sour in taste
- Acids can be organic acids or inorganic acids
- Organic acids are weak acids originating from plant or animal such as acetic acid, citric acid, lactic acid, tartaric acid etc
- Inorganic acids are also called as mineral acids which are strong except carbonic acid such as HCl, H_2SO_4,HNO_3 etc.
- They give litmus test only in wet condition (when dissolved in water)

CHEMICAL PROPERTIES OF ACIDS

- Action with METALS.
- Action with METAL OXIDES OR HYDROXIDES.
- Action with METAL CARBONATES OR METAL BICARBONATES.
- NEUTRALIZATION REACTION with BASE.
- CORROSIVE NATURE of ACIDS

Action with METALS

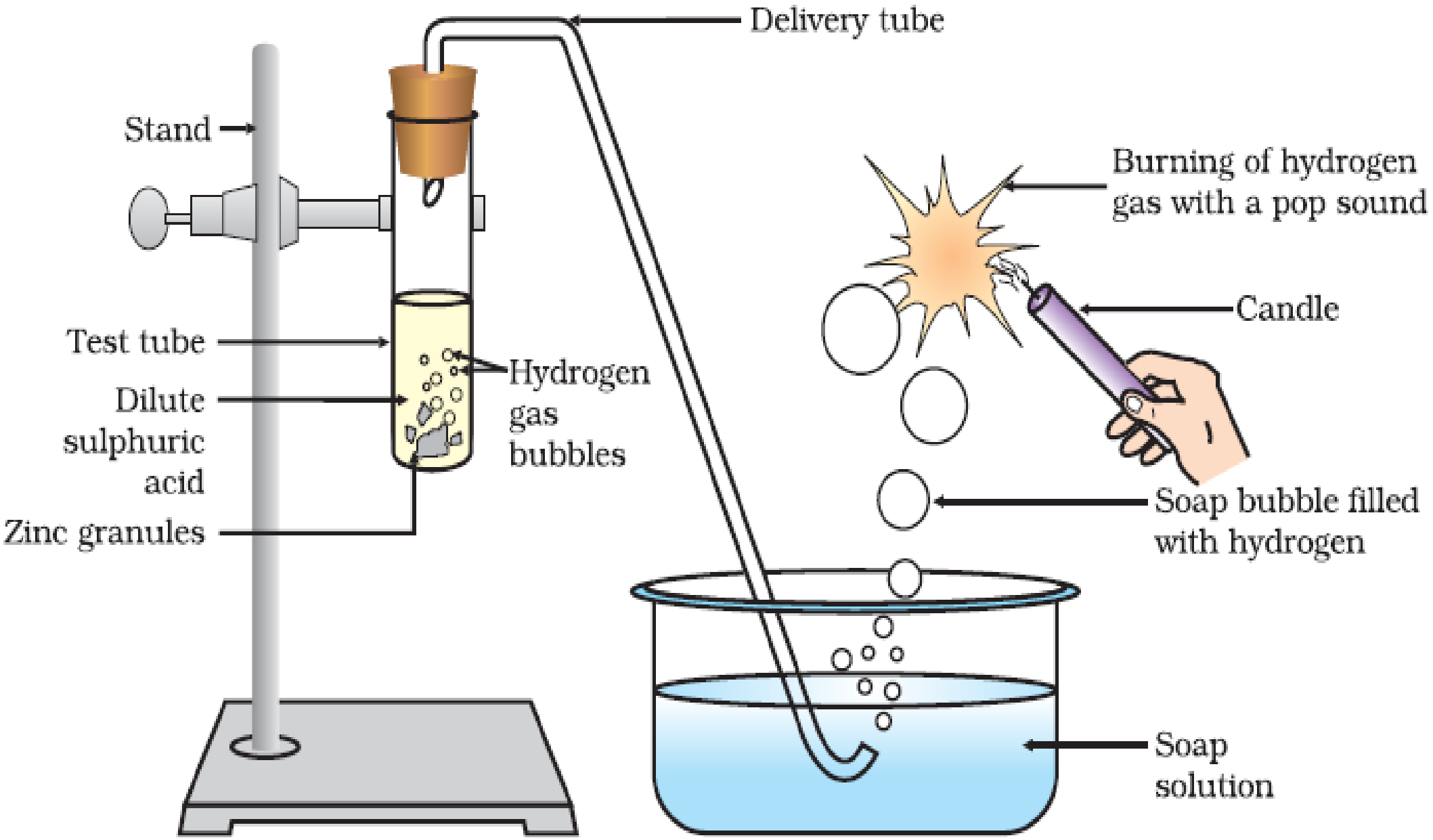
- Dilute acids like HCl and H_2SO_4 react with certain active metals to evolve hydrogen gas.

  Metal + Dilute acid → Metal salt + Hydrogen

  $2Na(s) + 2HCl\ (dilute) \rightarrow 2NaCl(aq) + H_2(g)$

  $Mg(s) + H_2SO_4\ (dilute) \rightarrow MgSO_4\ (aq) + H_2(g)$

- Metals which can displace hydrogen from dilute acids are known as active metals. e.g. Na, K, Zn, Fe, Ca, Mg etc.
- Most of the acids reacts with metals to form salt and evolve hydrogen gas. This shows that hydrogen is common to all acids.
- Hydrogen gas produced on burning gives pop sound.


Delivery tube
Stand
Burning of hydrogen gas with a pop sound
Candle
Test tube
Hydrogen gas bubbles
Dilute sulphuric acid
Zinc granules
Soap bubble filled with hydrogen
Soap solution

Hydrogen gas is not evolved when a metal reacts with nitric acid.

- It is because HNO_3 is a strong oxidising agent.

- It oxidises the H_2 produced to water and
- itself gets reduced to any of the nitrogen oxides (N_2O, NO, NO_2).

- But Magnesium (Mg) and Manganese (Mn) react with very dilute HNO_3 to evolve H_2 gas.

Action with METAL OXIDES

- Mostly on heating metal oxides with an acid undergoes kind of neutralization reaction forming SALT and WATER.

  eg: $CuO(black) + 2HCl(aq) \rightarrow CuCl_2(aq) + H_2O(l)$

  The acids react with metal hydroxides to form salt and water.

- The antacid called " Milk of Magnesia" which is used to remove indigestion (caused by too much HCl in the stomach) is a metal hydroxide called ' magnesium hydroxide'. Magnesium hydroxide is a base, it reacts with HCl in stomach and neutralizes it.

Action with METAL CARBONATES AND METAL BICARBONATES

- Both metal carbonates and bicarbonates react with acids to evolve $CO_2(g)$ and form salts. For example,

  Metal carbonate + Acid → Salt + Water + CO_2

  $CaCO_3$ (s) + 2HCl(aq) → $CaCl_2$(aq) + H_2O(aq) + CO_2(g)

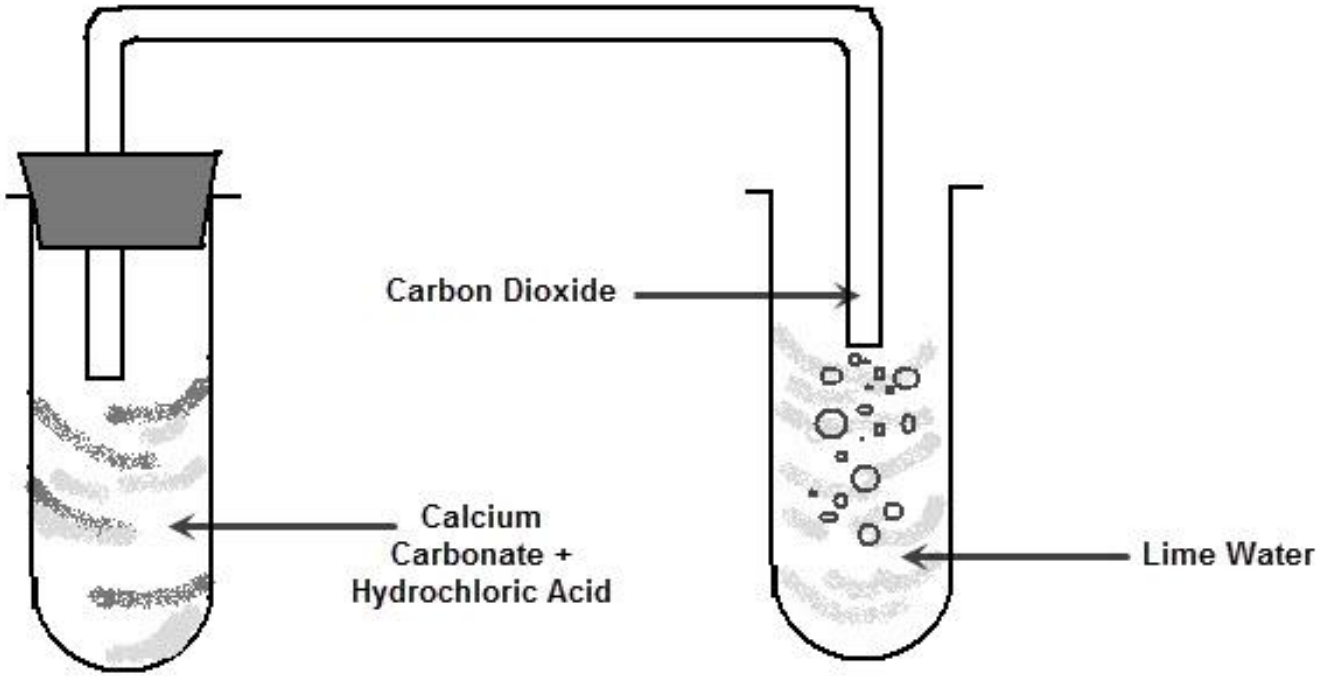
  (Calcium carbonate)

  $2NaHCO_3$(s) + H_2SO_4(aq) → Na_2SO_4 (aq) + H_2O(aq) + CO_2(g)

  (Sodium bicarbonate)

- A bicarbonate is also called hydrogen carbonate.
- $CaCO_3$ is insolube in water while $(Ca(HCO_3))_2$ is water soluble.

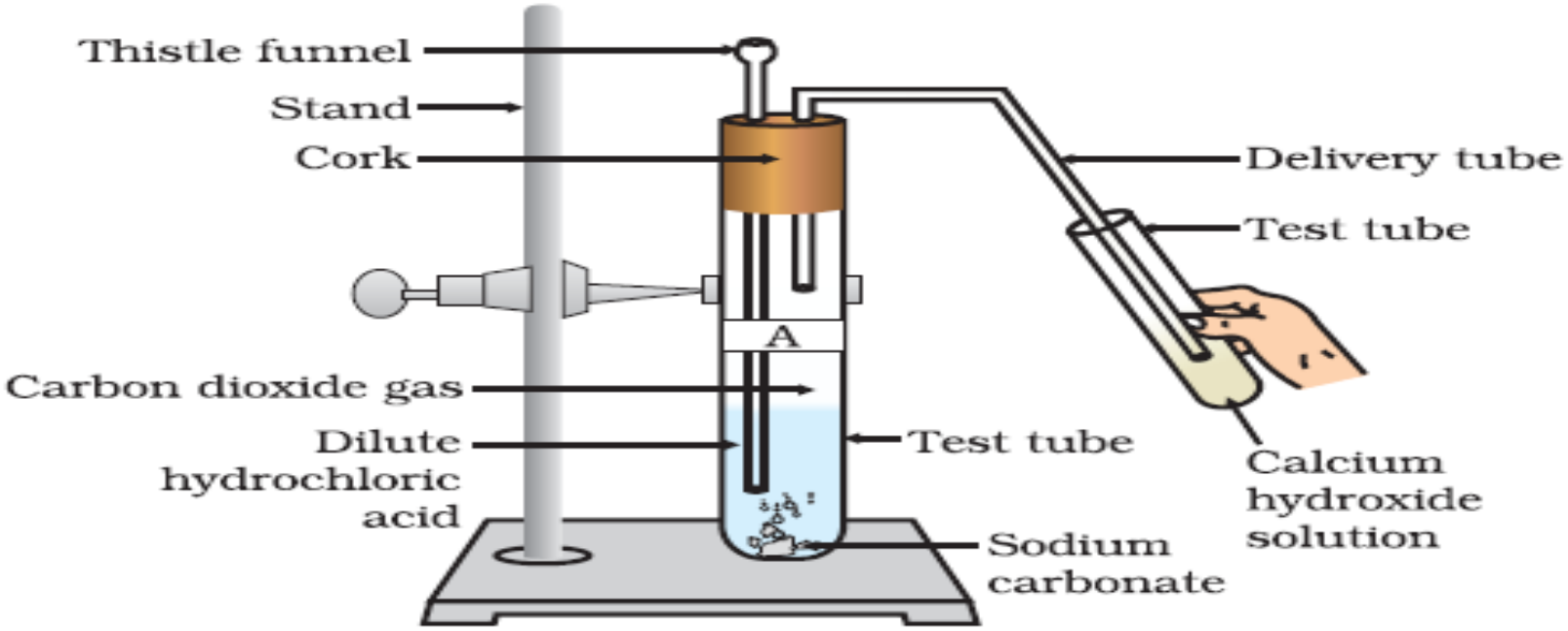
Test for carbondioxide gas when passed in lime water it turns milky.



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

LIME WATER — CALCIUM CARBONATE(WHITE PPT)

Passing carbon dioxide gas through calcium hydroxide solution



When excess of carbondioxide gas is passed through lime water, then the white ppt formed first dissolves due to the formation of soluble salt of calcium hydrogen carbonate and the solution becomes clear.

The reactions occurring in the above Activity are written as

- Test tube A:

  $Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$

- Test tube B:

  $NaHCO_3 + HCl \rightarrow NaCl + H_2O + C0_2$

- On passing the carbon dioxide gas evolved through lime water,

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

  (LIME WATER) (White Precipitate)

On passing excess carbon dioxide the following reaction takes place:

- $CaCO_3 + H_2O + CO_2 \rightarrow Ca(HCO_3)_2$

  (Calcium Bi Carbonate)

  (Soluble in water)

- Limestone, chalk and marble are different forms of calcium carbonate.
  All metal carbonates and hydrogen carbonates react with acids to give a corresponding salt, carbon dioxide and water.

Action with BASES OR ALKALIS

- When an acid reacts with a base then a salt and water are formed
  - ACID + BASE → SALT + WATER
  - $HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$
  - This is an example of a neutralization reaction .

  - In this reaction, sodium hydroxide base and hydrochloric acid neutralize each other to form sodium chloride salt which is neither acidic nor basic, it is neutral.
- ACID HAVE CORROSIVE NATURE AND SO THEY ARE NEVER STORED IN METAL CONTAINER. ACIDS ARE STORED IN CONTAINERS MADE OF GLASS AND CERAMICS BECAUSE THEY ARE NOT ATTACKED BY ACIDS

Do you know….. *Aqua regia*

- **Aqua regia, (Latin for 'royal water') is a freshly prepared mixture of concentrated hydrochloric acid and concentrated nitric acid in the ratio of 3:1.**
- **It can dissolve gold, even though neither of these acids can do so alone.**
- Aqua regia is a highly corrosive, fuming liquid.
- It is one of the few reagents that is able to dissolve gold and platinum.

BASES

- A Base may be defined as a substance capable of releasing one or more OH^- ions in aqueous solution
- They are bitter in taste.
- They are soapy in touch.
- Bases conducts electricity in solution.
- Bases change the colour of red litmus to blue.
- All the metal oxides and metal hydroxides are bases.
- Metal carbonates and metal hydrogen carbonates are also considered to be bases because they neutralize the acids.
- A base which is SOLUBLE in water is called an ALKALI

CHEMICAL PROPERTIES OF BASES

- **ACTION WITH METALS**

  Metals like zinc, tin and aluminium react with strong alkalis like NaOH (Caustic potash) to evolve hydrogen gas

  $Zn(s) + 2NaOH(aq)$ (on heating)$\rightarrow Na_2ZnO_2(aq\ salt) + H_2(g)$

  However such reactions are not possible with all metals.

- **ACTION WITH NON-METALLIC OXIDES**

  Bases reacts with oxides of non metals(eg CO_2, SO_2, SO_3 etc.) to form salt and water

  $2NaOH(aq) + CO_2(g) \rightarrow Na_2CO_3(aq) + H_2O(l)$

  The reaction of non metal oxides with bases to form salts and water shows that non metal oxides are acidic in nature.

- **BASES REACTS WITH ACIDS TO FORM SALT AND WATER(NEUTRALIZATION)**