Chap 2. Acids, Bases and Salts

1. What are acids and bases in terms of their ions?

Acids are substances that produce H^+ (hydrogen) ions or H_3O^+ (hydronium) ions when dissolved in water. eg: HCl, H_2SO_4, CH_3COOH

Bases are substances that produce OH^- (hydroxide) ions when dissolved in water. Bases soluble in water are called alkalis. eg: NaOH, $Mg(OH)_2$, $Ca(OH)_2$

2. Define pH scale

It is used to measure the acidic, basic or neutral nature of substance.

For neutral solution like pure water, pH value is 7.

For acidic solution, pH is less than 7, in the range 0-6.

For basic solution, pH is greater than 7, in the range 8-14.

The lower the pH, the stronger the acid. The higher the pH, the stronger the base.

3. What is a neutralisation reaction?

A neutralisation reaction is a reaction between an acid and a base that produces salt and water.

Acid + Base ---> Salt + water

For eg:

HCl + NaOH ---> NaCl + H_2O

The H^+ from HCl combines with OH^- from NaOH to form water. The remaining Na^+ and Cl^- form sodium chloride (common salt).

4. What happens when a metal reacts with a dilute acid?

When a metal reacts with a dilute acid, it produces a salt and hydrogen gas. For eg:

$Zn + H_2SO_4 \text{ ---> } ZnSO_4 + H_2$

5. What happens when an acid reacts with a metal carbonate?

When an acid reacts with a metal carbonate or bicarbonate, it produces salt, water, and carbon dioxide gas.eg:

$H_2SO_4 + Na_2CO_3 \text{ ---> } Na_2SO_4 + H_2O + CO_2$

6. What is baking soda? How it helps in baking?

The chemical name of baking soda is Sodium hydrogen carbonate or Sodium Bicarbonate. Its formula is $NaHCO_3$

When heated or reacted with acid in dough, it releases CO_2 gas, which makes the dough rise and become soft and spongy.

$2NaHCO_3 \text{ ---> } Na_2CO_3 + H_2O + CO_2$

7. What is washing soda? How is it prepared from baking soda?

The chemical name of washing soda is Sodium carbonate decahydrate. Its formula is $Na_2CO_3 \cdot 10H_2O$

By heating baking soda we get sodium carbonate. On recrystallising with water, we get washing soda.

$2NaHCO_3 \text{ ---> } Na_2CO_3 + H_2O + CO_2$

$Na_2CO_3 + 10H_2O \text{ ---> } Na_2CO_3.10H_2O$

Washing soda is used for softening hard water, and as a cleaning agent in glass and soap industries.

8. What is water of crystallisation ?

It is the fixed number of water molecules chemically bonded inside a substance's crystal structure. For example, copper sulphate crystals which seem to be dry, contain water of crystallisation. When we heat the crystals, this water is removed and the salt turns white. If you moisten the salt again with water, you will find that blue colour of the crystals reappears.

Water of crystallisation is the fixed number of water molecules present in one formula unit of a salt. Five water molecules are present in one formula unit of copper sulphate. Chemical formula for hydrated copper sulphate is $CuSO4.5H_2O$

9. What is gypsum?

Gypsum is a naturally occurring mineral whose chemical formula is calcium sulfate dihydrate ($CaSO4.2H_2O$). It is used in the manufacturing of Plaster of Paris, Cement manufacturing, for soil conditioning in agricuture, and also in food and cosmetics industry.

10. What is Plaster of Paris?

On heating gypsum at 373 K, it loses water molecules and becomes calcium sulphate hemihydrate ($CaSO4.1/2H_2O$). This is called Plaster of Paris, the substance which doctors use as plaster for supporting fractured bones in the right position.

It is also used in making dustless blackboard chalk, molds and castings, art and sculptures.

Plaster of Paris is a white powder and on mixing with water, it changes to gypsum once again giving a hard solid mass.

11. How does pH play a role in tooth decay?

Bacteria in the mouth break down sugars and produce acids. When mouth pH falls below 5.5, the acid corrodes tooth enamel (calcium phosphate), causing tooth decay (dental caries).

Toothpastes are mildly basic — they neutralise the acids produced by bacteria, keeping mouth pH above 5.5 and protecting the enamel.

12. What are antacids?

Antacids are mildly basic substances taken orally to relieve excess acidity (HCl) in the stomach. Milk of magnesia [$Mg(OH)_2$] and baking soda ($NaHCO_3$) are commonly used antacids.

$Mg(OH)_2 + 2HCl \text{ ---> } MgCl_2 + 2H_2O$

$NaHCO_3 + HCl \text{ ---> } NaCl + H_2O + CO_2$

13. What is acid rain?

Normal rain water has pH around 5.6. It is slightly acidic due to dissolved CO_2 forming H_2CO_3.

When industrial emissions of SO_2 and NO_2 dissolve in rain water, the pH falls below 5.6 — this is called acid rain.

$SO_2 + H_2O \text{ ---> } H_2SO_3$

$NO_2 + H_2O \text{ ---> } HNO_3$

Acid rain creates lot of negative impact. It damages crops, agricultural soil, and aquatic life.