ACIDS

Acid is a substance which provides hydrogen ions (or protons) as the only positive ion when dissolved in water.

The characteristic properties of an acid in solution are due to the presence of these hydrogen ions. This is seen when dry hydrogen chloride gas is dissolved in water and in methyl benzene. In water, it forms hydrogen ions and behaves like a typical acid but it does not form hydrogen ions in methyl benzene and thus does not show any acidic properties.

Classes of Acids

Acids are usually classified either based on source or ionization.

Based on Source: Acids can either be organic or inorganic (or mineral). Organic acids are usually sourced from natural products in plants and animals, but inorganic acids are prepared from mineral or inorganic matter. Examples of organic

acids are ethanoic acid (from Vinegar), lactic acid (milk), citric acid (lemon lime), amino acids (proteins), fatty acids (lipids) and ascorbic acid (from Orange), etc. Examples of inorganic acids are hydrochloric acid (HCl), trioxonitrate (V) acids (HNO_3) and tetraoxosultphate (VI) acid, (H_2SO_4).

Based on Ionization: Acids can be either strong or weak when classified based on ionization. Strong acids ionize completely in water to yield hydrogen ions, but weak ackds ionize partially in water. The concentration of hydrogen ions is very high, in strong acids, in relation to the anion. But in weak acids, ionizatin yields low concentration of hydrogen ions. Examples of weak acids are ethanoic acid (CH_3COOH), trioxo-carbonate (IV) acid, (H_2CO_3), tetraoxophosphate (V) acid, (H_3PO_4), trioxosulphate (IV) acid, (H_2SO_3).

Basicity of an Acid

The basicity of an acid is the number of replaceable hydrogen ions, H^+, in one molecule of the acid. For example, HCl is monobasic, H_2SO_4 is dibasic, and H_3PO_4 is tribasic.

Physical Properties of Acids

1. Dilute acids have sour taste
2. Acids turns blue litmus to red
3. The concentrated forms of strong acids like hydrochloric acid, trioxonitrate (V) acid, and tetraoxosulphate (VI) acid are corrosive.
4. Hot acids usually splatter water on addition of water to the acid.

Chemical Properties of Acids

1. Acids undergo hydrogen displacement reactions with metals of a higher electronegativity than hydrogen. For example: Zn, Fe, and Mg.

$$2HCl\,(aq) + Zn\,(s) \rightarrow ZnCl_2 + H_2\,(g)$$

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

2. Acids undergo neutralization reactions with insoluble bases and alkalis to form salt and water as the only products. For example:

$$H_2SO_4\ (aq) + 2KOH\ (aq) \rightarrow K_2SO_4\ (aq) + 2H_2O\ (l)$$

$$2HCl\ (aq) + CaO\ (s) \rightarrow CaCl_2\ (aq) + H_2O\ (l)$$

3. Acids react with trioxocarbonates (IV) to liberate carbon (IV) oxide. For example:

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

Preparation of Acids

1. Acids can be prepared by dissolving an acid anhydride in water. Examples are

$$CO_2\ (g) + H_2O\ (l) \rightarrow H_2CO_3\ (aq)$$

$$SO_2\ (g) + H_2O\ (l) \rightarrow H_2SO_3\ (aq)$$

$$SO_3\ (g) + H_2O\ (l) \rightarrow H_2SO_4\ (aq)$$

These non-metallic oxides which dissolve in water to produce various acids are known as

acid anhydrides. For example, CO_2 is the acid anhydride of H_2CO_3 acid.

2. Acids can also be prepared by combining the constituent elements. For example:

$$H_2\,(g) + Cl\,(g) \xrightarrow{\text{Activated charcoal}} 2HCl\,(g)$$

$$H_2\,(g) + Br_2\,(g) \xrightarrow{\text{Platinum}} 2HBr\,(g)$$

3. Acids can also be prepared by using a strong acid to displace a weak acid or a volatile acid from its salt. For example:

$$H_2\,SO_4\,(aq) + 2NaNO_3\,(s) \rightarrow Na_2SO_4\,(aq) + 2HNO_3\,(aq)$$

$$2KCl\,(s) + H_2\,SO_4\,(aq) \rightarrow K_2SO_4\,(aq) + 2HCl\,(g)$$

$$2HCl\,(aq) + CaCO_3\,(s) \rightarrow CaCl_2\,(aq) + H_2CO_3\,(aq) \rightarrow CaCl_2\,(aq) + H_2O\,(l) + CO_2\,(g)$$

Uses of Acids

Name	Uses
Hydrochloric acid	Needed by industries to make chemicals; Used to remove rust
Tetraoxosulphate (VI) acid	Needed by industries to make chemicals; Used as a drying and dehydrating agent; Used as an electrolyte in lead-acid accumulators; Required in oil refineries.
Trioxonitrate (V) acid	Needed by industries for making fertilizers, explosives, etc.
Boric acid	Used as a mild antiseptic or germicide
Tartaric acid	Used in making baking soda, soft drinks and health salts.
Acetic acid (ethanoic acid)	used for preserving food; Used in dyeing silk and other textiles
Citric acid	Used in making fruit juice
Fatty acid (e.g. palmitic and stearic acid)	Used in the manufacture of soap (saponification, fatty acid + caustic soda → soap + water)