**13.2 Reactions Involving Acids and Bases**

* Acids react with many metals.
* These reactions produce a solution of a metal salt and hydrogen gas.
* Salts are compounds usually made up of a metal cation and a non-metal anion.
* The salt produced will depend on the acid used in the reaction.
* Acids also react with many compounds such as metal hydroxides and metal carbonates.

**Reaction Type 1: Acid + reactive metal salt + hydrogen**

* Reactive metals include Ca, Mg, K and Zn but not Cu, Ag or Au
* When dilute acids are added to main group metals and some transition metals, bubbles of hydrogen are released and a salt is formed.

The reaction between dilute hydrochloric acid and zinc metal.

This reaction can also be represented by an ionic equation.

**Reaction Type 2: Acid + metal hydroxide salt + water**

* Metal hydroxides include NaOH, Ca(OH)2 and Mg(OH)2.
* The products of an acid-base reaction are a salt and water.

The reaction between sulphuric acid and sodium hydroxide.

The sulphuric acid is ionised in solution and both sodium hydroxide and sodium sulphate are ionic and therefore dissociated in solution. Water being a covalent molecular substance does not ionise to any significant extent. So the full equation is:

The ionic equation therefore is:

**Reaction Type 3: Acid + Metal oxide salt and water**

* Metal oxides include Na2O, MgO, CaO and ZnO.
* When an acid is added to a metal oxide, a salt and water are produced

The reaction between dilute nitric acid and solid calcium oxide is:

The calcium oxide is solid so the ions do not dissociate. The nitric acid is ionised in solution and calcium nitrate is ionic and therefore dissociated when dissolved in solution. So the equation becomes:

The ionic equation is then:

**Reaction Type 4: Acid + metal carbonate salt + water + carbon dioxide**

* Metal carbonates include Na2CO3, MgCO3 and CaCO3.
* Acids reacting with metal carbonates produce carbon dioxide gas together with a salt and water.

The reaction between nitric acid and solid magnesium carbonate is:

Write the full equation and identify the spectator ions and hence the ionic equation:

**Reaction Type 5: Acid + Metal hydrogen carbonate**

**Salt + water + carbon dioxide.**

* Metal hydrogen carbonates include NaHCO3, KHCO3 and Ca(HCO3)2.
* Acids added to metal hydrogen carbonates (bicarbonates) also produce carbon dioxide with a salt and water.

The reaction between hydrochloric acid and sodium hydrogen carbonate is:

Write the full equation and identify the spectator ions and hence the ionic equation:

**Reaction Type 6: Acidic oxide (non-metal oxide) + base salt + water**

* Acidic oxides include SO2, SO3, P4O10 and CO2.
* When non-metals react with oxygen they tend to produce acidic oxides.
* The reactions of these bases produce a salt and water.

The reaction between carbon dioxide and a solution of calcium hydroxide is:

The table below lists some common acidic oxides and the anions they produce in reactions

|  |  |  |
| --- | --- | --- |
| Acidic oxide | Acid formed when oxide is added to water | Anion produced in reactions with bases |
| CO2 | Carbonic acid (H2CO3) | Carbonate (CO32-) |
| SO2 | Sulfurous acid (H2SO3) | Sulfite (SO32-) |
| SO3 | Sulfuric acid (H2SO4) | Sulfate (SO42-) |
| P4O10 | Phosphoric acid (H3PO4) | Phosphate (PO43-) |

**Chapter Review: 1 – 4, 8, 10, 11**

**Worksheet 27**