Acids and bases

An **acid** is a substance which forms hydrogen ions (H^+) in solution. The behaviour that acids have in common is due to the hydrogen ion.

The hydrogen in an acid may be replaced by a metal to form a **salt.**

Examples of Acids

Formula	Chemical Name	Common Name
HCI	Hydrochloric acid	Spirits of salts, muriatic
H_2SO_4	Sulphuric acid	Acid oil of vitriol, battery
$H_2S_20_7$	Fuming sulphuric	Acid oleum
HNO_3	Acid nitric acid	Aqua Fortis
HCN	Hydrogen cyanide	Prussic acid
C_6H_5OH	Carbolic acid	
CH_3COOH	Acetic acid	Vinegar

Hydrochloric, sulphuric and nitric acids are strong acids - that is, nearly all of the hydrogen they contain is in the form of hydrogen ions in solution.

Properties of Acids

- Taste sour
- Change the colours of certain dyes ("Indicators')
  e.g. litmus- blue to red.

• pH is less than 7

• Solutions of acids are good conductors of electricity.

• Corrode the more reactive metals eg. Mg,Zn,Fe,Al, to form hydrogen gas (flammable hazard) and a salt.

$H_2S0_4 + Mg$ ---------$MgSO_4 + H_2$
acid + metal a salt + hydrogen gas

- React with carbonates and bicarbonates to form carbon dioxide gas and a salt.

$2HCI + Na_2CO_3$ ------- $C0_2$ + $2NaCI + H_2O$
acid + carbonate --- carbondioxide + a salt + water

All carbonates can be used to neutralise acid spills e.g.
limestone (chalk) $CACO_3$
soda ash Na_2C0_3
baking soda $NAHCO_3$

- * Acids are neutralised by bases and alkalis

H_2SO_4 + $Ca(OH)_2$ + $CASO_4$ + $2H_20$
+
acid + alkali + a salt + water
+

Slaked lime $Ca(OH)_2$ may be used in acid spills, but many other bases and alkalis are corrosive themselves and difficult to handle
e- g. caustic soda NaOH and lime CaO.

Concentrated Acids (those with a high acid to water ratio)

Acids are **much more hazardous** in their concentrated forms.

They generally have toxic and corrosive fumes and vapours.

$HNO_3$and H_2SO_4 decompose on heating to give toxic fumes.

* HNO_3 and H_2SO_4 have strong oxidising properties (they will attack metals such as copper). -

* H_2S0_4 will give off large amounts of heat if water is added to it.

* HCI reacts with oxidising agents to form toxic chlorine Cl2 gas.

Bases and Alkalis

A base is the oxide or hydroxide of a metal.

e.g. MgO magnesium oxide
. CaO lime
$Ca(OH)_2$ slaked lime

Alkalis are soluble hydroxides (so all alkalis are also bases),

e.g. NaOH caustic soda
KOH caustic potash
NH_4OH "ammonia" solution

Properties of Bases and alkalis

- They change the colour of indicators
  e.g. litmus: red to blue
- pH is greater than 7
- They neutralise acids (see equation for acids)

Sodium hydroxide (caustic soda)

This alkali is used extensively in industry (particularly in the manufacture of soap and paper)-

- It is sold as sticks, pellets and flakes.
  These are extremely corrosive and should never be handled without protection.
- Caustic soda dissolves in water with heat given off. The solution is strongly caustic and slippery.
- Solutions of caustic soda can attack aluminium and zinc metals, with hydrogen gas given off.

Summary

- Acids all form hydrogen ions H^+ in solution which gives them common properties.
- HCl, H_2SO_4, HNO_3 are strong acids.
- Acid solutions are good conductors of electricity.
- Acids react with reactive metals to form hydrogen gas (flammable).
- Acids react with carbonates and bicarbonates to form carbon dioxide gas.
- Acids are neutralised by bases and alkalis.
- $CaCO_3$ chalk, Na_2CO_3 soda ash, $NaHCO_3$ baking soda, $Ca(OH)_2$ slaked lime are suitable substances for neutralising acid spills.
- Concentrated acids are much more hazardous than their dilute solutions.
- A base is the oxide or hydroxide of a metal.
- Alkalis are soluble hydroxides.
- Sodium hydroxide (caustic soda) is a hazardous substance because of its corrosive properties. It will attack aluminium and zinc metals, to give flammable hydrogen gas.