

# 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**.

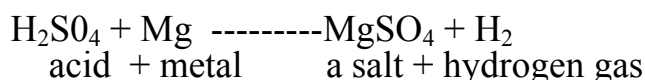
## Examples of Acids

Formula	Chemical Name	Common Name
HCl	Hydrochloric acid	Spirits of salts, muriatic
H <sub>2</sub> SO <sub>4</sub>	Sulphuric acid	Acid oil of vitriol, battery
H <sub>2</sub> S <sub>2</sub> O <sub>7</sub>	Fuming sulphuric acid	Acid oleum
HNO <sub>3</sub>	Nitric acid	Aqua Fortis
HCN	Hydrogen cyanide	Prussic acid
C <sub>6</sub> H <sub>5</sub> OH	Carbolic acid	
CH <sub>3</sub> COOH	Acetic acid	Vinegar

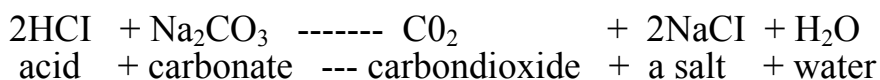
Hydrochloric, sulphuric and nitric acids are strong acids - that is, nearly all of the hydrogen they contain is in the form of hydrogen ions in solution.

## 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.



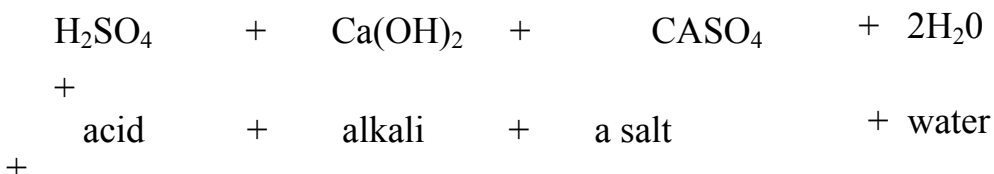
- React with carbonates and bicarbonates to form carbon dioxide gas and a salt.



All carbonates can be used to neutralise acid spills e.g.

limestone (chalk)  $\text{CaCO}_3$   
soda ash  $\text{Na}_2\text{CO}_3$   
baking soda  $\text{NaHCO}_3$

- \* Acids are neutralised by bases and alkalis



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

## 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.

$\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$  decompose on heating to give toxic fumes.

- \*  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$  have strong oxidising properties (they will attack metals such as copper).
- \*  $\text{H}_2\text{SO}_4$  will give off large amounts of heat if water is added to it.
- \*  $\text{HCl}$  reacts with oxidising agents to form toxic chlorine  $\text{Cl}_2$  gas.

## Bases and Alkalis

**A base** is the oxide or hydroxide of a metal.

- e.g.  $\text{MgO}$  magnesium oxide
- $\text{CaO}$  lime
- $\text{Ca}(\text{OH})_2$  slaked lime

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

- e.g.  $\text{NaOH}$  caustic soda
- $\text{KOH}$  caustic potash
- $\text{NH}_4\text{OH}$  "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.