C5 Chemical Changes

Displacement reactions and metal extraction

potassium	most reactive	K
sodium		Na
calcium		Ca
magnesium		Mg
aluminium		Al
carbon		C
zinc		Zn
iron		Fe
tin		Pb
lead		H
hydrogen		Cu
copper		Ag
silver		Au
gold	least reactive	Pt
platinum		

Reactivity depends on tendency to form metal ion

A and C are Cations (Positive Ions)
B and D are Anions (Negative Ions)
Double Displacement Reaction

HT: OILRIG
Oxidation Is Loss of electrons
Reduction Is Gain of electrons

Metal + Oxygen → Metal Oxide

Metal + Water → Metal Hydroxide + hydrogen

Metal + acid → Metal salt + Hydrogen

Reactions of acids

Acid+metal → salt + hydrogen
Acid + alkali → salt + water
Acid + insoluble base → salt + water
Acid + carbonate → salt + water + carbon dioxide

HT: OILRIG
e.g. $2HCl + Mg \rightarrow MgCl_2 + H_2$
Magnesium is oxidised
$Mg \rightarrow Mg^{2+} + 2e^-$

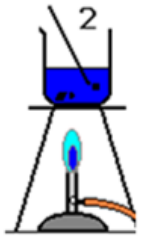
Hydrochloric Acid → Chlorides
HCl
Nitric Acid → Nitrates
HNO_3
Sulphuric Acid → Sulphates
H_2SO_4

RP: Preparation of a dry sample of a soluble salt

Choose correct acid

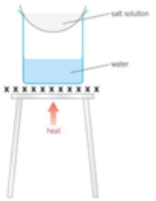
Add base to excess

warm

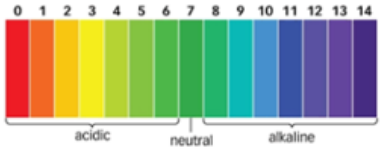


Filter off excess

Evaporate off water



Neutralisation



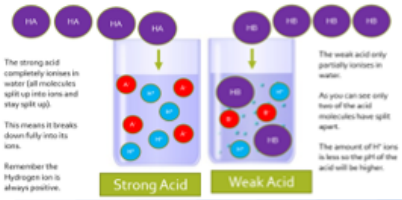
Acids produce H^+ ions
Alkalis produce OH^- ions

$H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$

HT: Strong and Weak acids

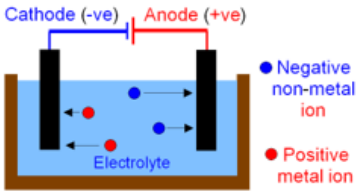
Concentration of hydrogen ions in mol/dm³	pH
0.10	1.0
0.010	2.0
0.0010	3.0
0.00010	4.0

Strong and weak acids



Electrolysis

..of molten:

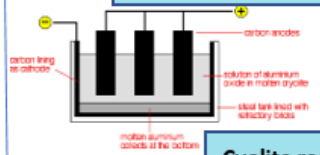


Higher:
At the cathode
$Pb^{2+} + 2e^- \rightarrow Pb$

Higher:
At the anode
$2Br^- \rightarrow Br_2 + 2e^-$
or
$2Br^- - 2e^- \rightarrow Br_2$

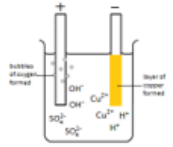
..to extract aluminium:

Oxygen goes to anode → CO_2 (needs replacing)



Cyolite reduces the melting point

..of solutions:



At the anode:
Halide (Gp7)
Oxygen

At the cathode:
Least reactive

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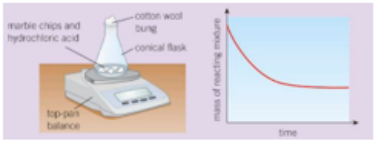
C8 Rates and Equilibrium

Measuring Rate

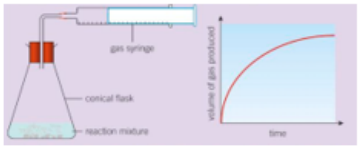
To measure the rate of a reaction you can:

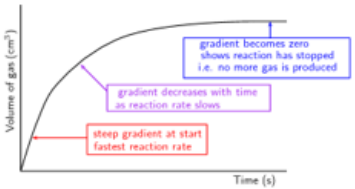
- **Measure how fast the reactants are used up**
- **Measure how fast the products are made**

e.g. Measure mass lost due to gas formed



e.g. Measure volume of gas made

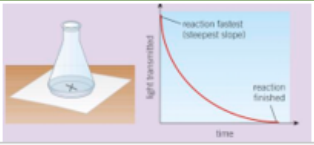




Rate = volume of gas ÷ time

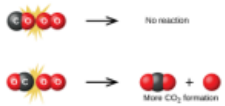
cm³/s

e.g. Measure time for insoluble product to form



Collision theory

For a reaction to happen reactants must: **collide** with **enough energy** (activation energy)



A successful collision is one that leads to a reaction

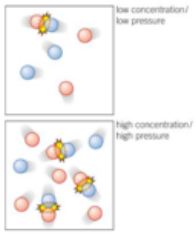
So to increase the rate of a reaction you must either

- **Increase the frequency of collisions**
- **Increase the energy of the collisions**
- **Decrease the energy needed for a collision to be successful**

Factors affecting rate

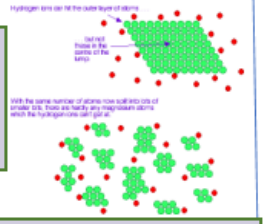
Concentration and Pressure

More particles in the same space. **More frequent collisions**



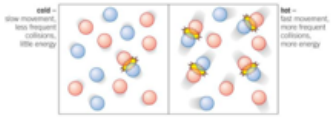
Surface area

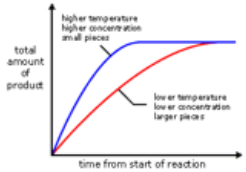
More particles available to react. **More frequent collisions**



Temperature

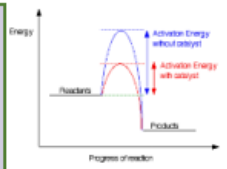
Particles **move faster**.
So they **collide more frequently**.
Particles collide **with more energy**.
So more of the collisions are **successful**.





Catalysts

Lower the energy needed for successful collisions. (Activation energy)
Not used up.
Biological catalysts are called **enzymes**

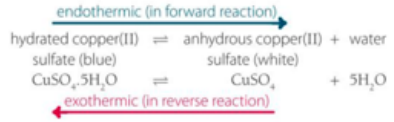


Reversible reactions

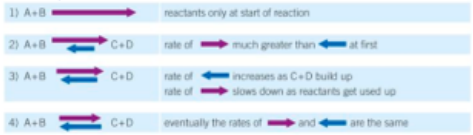
Can go in both directions.

$$A + B \rightleftharpoons C + D$$

If a reaction is exothermic in one direction it is endothermic in the other direction.

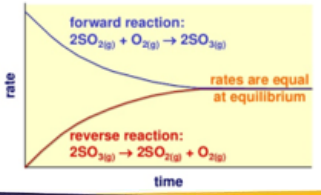


In a **closed system** (where nothing can get in or out) an **equilibrium** is reached where the **rate of reaction is the same in both directions.**



At equilibrium:

- Rate of forward reaction = rate of reverse reaction.
- Mount of products and reactants don't change.



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