o Renewable
o Lots of energy
o Common element

● Disadvantages
  o Expensive
  o High pressure
  o Explosive/flammable
  o Hydrogen is manufactured using fossil fuels

**Topic 6- Groups in the periodic table**

Elements in the periodic table are split into groups depending on the column (period) they are in. Elements are arranged by number of electrons in the outer shell.

**Group 1- Alkali metals**

● Properties
  o Soft
  o Low melting points
  o Dull

● Reactions with water
  o Lithium
    ▪ Small fizzing
    ▪ Disappears
  o Sodium
    ▪ Fizzles rapidly
    ▪ Moves around surface
    ▪ May burn with orange flame
  o Potassium
    ▪ Moves around surface rapidly
    ▪ Lilac flame
    ▪ May explode
    ▪ Hydrogen ignites immediately

● Order of reactivity: alkali metals

<table>
<thead>
<tr>
<th>Physical state</th>
<th>Yellow-green</th>
<th>Red-brown</th>
<th>Purple</th>
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</table>

- Further down the table, the higher the melting point
  o Gases to solids
- Further down the table, the darker the element

Chemical test: Chlorine

- Sharp, choking smell
- Damp blue litmus turns red then bleaches white
- Damp starch-iodine paper turns blue black

Halogen reactions:

- Halogens and metals
  o Forms salts called metal halides
    o sodium + chlorine → sodium chloride
- Hydrogen halides
  o One part halogen, one part hydrogen
  o Dissolve in water to become acidic solutions
- Halogen in aqueous solution
  o The most reactive halogen displaces and becomes part of the solution
  o Solution turns colour of displaced solid
- Displacement reactions
  o Same as above
  o Redox because halogens gain electrons, halides lose electrons
  o Ie Br₂ + 2I⁻ → I₂ + 2Br⁻
    Bromine gains electrons- reduced Iodide loses electrons- oxidised

Becomes less reactive as it goes down table

- Each additional shell shields electrons from attraction of the nucleus
- Needs to gain 1 electron and has less force of attraction as it goes down the table

**Group 0- Noble gases**

- Chemically inert
  o Has a full outer shell
- Uses
  o Lightbulb
    ▪ Inertness
    ▪ Non-flammable
  o Balloons

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</table>
• Low density
• Non-flammable

• Physical properties
  o Low boiling point
  o Low density
  o Colourless
  o Non-metals

### Topic 7 - Rates of reaction and energy changes

- Marble chips and hydrochloric acid
  - Put a small pile of marble chips in the bottom of a conical flash
  - Drip hydrochloric acid onto it
  - Gas travels down tube, into upside down test tube in water trough
  - CO₂ collects in the top

\[ 2\text{HCl} + \text{CaCO}_3 = \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2 \]

- Sodium thiosulphate and hydrochloric acid
  - Put a small amount of sodium thiosulphate in a conical flask
  - Put the flask on a piece of paper with a cross on it
  - Add hydrochloric acid
  - Wait for sulphur to be formed and turn the liquid cloudy, so the cross appears to disappear

\[ \text{Na}_2\text{S}_2\text{O}_3 + 2\text{HCl} = 2\text{NaCl} + \text{S} + \text{SO}_2 + \text{H}_2\text{O} \]

- Rate of reaction
  - Measure mass before and after
    - Reactant
    - Product

\[ \text{Rate of reaction} = \text{change in mass/time taken} \]

- Reactions
  - Occur when particles collide
  - Increase with increase in:
    - Frequency of collisions
    - Energy of collisions
  - Catalyst- substance that speeds up rate of reaction without altering products, without changing chemically or in mass
  - Catalyst lowers activation energy
  - Creates alternate pathway
  - Enzymes are biological catalysts
    - Used to produce alcoholic drinks

### Changes in energy
- Exothermic
  - Give out energy to surroundings
  - Ie
    - Neutralisation
    - Respiration
    - Combustion
    - Making of bonds

- Endothermic
  - Take in energy from surroundings
  - Ie
    - Electrolysis
    - Thermal decomposition
    - Photosynthesis
    - Breaking of bonds

\[ \text{Energy change} = \text{total (bond breaking)}/\text{Total (bond making)} \]

### Topic 8 - Fuels and Earth science

Hydrocarbons- only hydrogen and carbon

- Crude oil:
  - Complex mixture of hydrocarbons
  - Contains molecules where carbon atoms are in chains or rings
  - Important source of useful substances
    - Fuels
    - Feedstock for petrochemical

- Finite

Fractional distillation:
- Separates all parts of crude oil
- Industrial fractional distillation
  - The higher the tower, the cooler the temperature
- When condensed, liquid is siphoned off separately

Heat changes in chemical reactions