Topic: C2.4- How much How Fast

Equations

$$\text{Rate of reaction} = \frac{\text{Amount of product produced}}{\text{Time taken to produce the product}}$$

$$\text{Rate of reaction} = \frac{\text{Amount of mass lost}}{\text{Time taken to lose the mass}}$$

$$\text{Concentration} = \frac{\text{mass of solute}}{\text{Volume of solvent}}$$

Prior Knowledge:

- Catalysts
- Surface area
- Temperature
- Concentration
- Pressure
- Graph skills

Rates of reaction

The factors that affect the rate of a reaction are concentration, temperature, pressure, and surface area. A catalyst will also increase the rate of a reaction.

$$\text{Rate of reaction} = \frac{\text{Amount of product produced}}{\text{Time taken to produce the product}}$$

$$\text{Rate of reaction} = \frac{\text{Amount of mass lost}}{\text{Time taken to lose the mass}}$$

Concentration

Increasing concentration of a solute in a solution increases the number of particles available to react. This increases the number of collisions between particles which increases the chances having more energy than the activation energy for the reaction. This increases the number of successful collisions which increases the rate of a reaction.

$$\text{Concentration} = \frac{\text{mass of solute}}{\text{Volume of solvent}} = \frac{\text{number of moles}}{\text{Volume of solvent}}$$

$1\ dm^3 = 1000\ ml = 1l$

Temperature

Increasing the temperature of a reaction increases the energy of particles involved in the reaction. This means that the collisions have more energy which increases the chances having more energy than the activation energy for the reaction. This increases the number of successful collisions which increases the rate of a reaction.

Surface Area and catalyst

Increasing the surface area of a solid reactant of a certain mass – by decreasing the size of the pieces used in the experiment – increases the rate of a reaction. This is because increasing surface area increases the number of particles available to react. This increases the number of collisions between particles which increases the chances having more energy than the activation energy for the reaction. This increases the number of successful collisions which increases the rate of a reaction.

A catalyst is a substance that increases the rate of a reaction without being used up in the reaction. The mass of a catalyst in a reaction remains constant.

Combustion

Complete combustion

Fuel + Oxygen → Carbon Dioxide + Water

Incomplete combustion

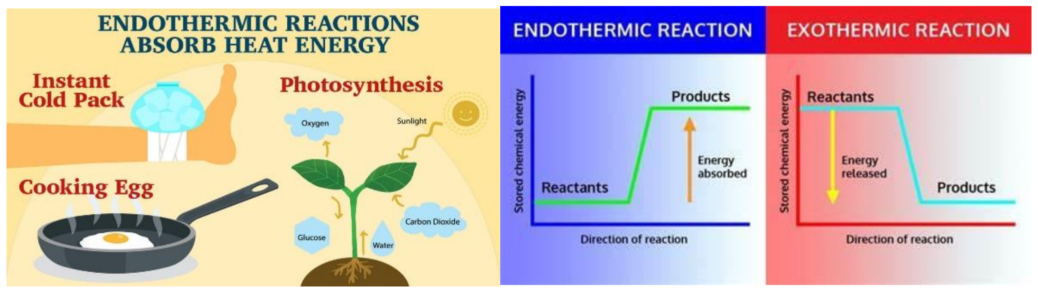
Fuel + Oxygen → Carbon monoxide + carbon + water

Dangers of carbon monoxide are that it binds to haemoglobin preventing oxygen being carried to cells to the victim suffocates.

Exothermic and endothermic

Exothermic reactions – release heat energy into the environment so temperature increases

Endothermic reactions – take heat from the environment (to support the reaction) so temperature decreases



Key Ideas

Chemical reactions can be sped up using different techniques including the concentration of an aqueous solution, the temperature of the reactants, the surface area of a solid reactant, the pressure in a gas/gas reaction or the use of a catalyst. This is important because we need to produce as much of a product as possible in the quickest time. However, there are always other factors involved – such as the costs of producing the reactants required, the risks associated with generating the appropriate conditions and whether or not the by-products are useful and can, therefore, be sold.

Chemical reactions depend entirely on collisions between particles. Particles need to collide with enough energy to exceed the activation energy for the reaction. If enough energy is involved in the collision the collision is called a successful collision – the more successful collisions in a given time – the faster the rate of reaction.

'Expect Excellence'

Keywords and Definitions

Mole	6.02 x 1023 particles (atoms, ions or molecules) with a mass equal to the relative atomic mass or relative formula mass in grams
Concentration	The amount (in moles or grams) of a solute dissolved in a given volume of a solute to form a solution
Catalyst	A substance that increases the rate of a reaction without being used up in a reaction
Solvent	A liquid that can dissolve a substance to form a solution
Solute	An ionic solid that can be dissolved in a solvent to form a solution
Solution	A mixture of a solute and solvent