

Activation Energy – the minimum amount of energy required for a chemical reaction to take place.

Catalysts – increase the rate of a reaction. Catalysts provide an alternative pathway for a chemical reaction to take place by **lowering** the activation energy.

Bond Making and Bond Breaking

In an **endothermic** reaction, energy is needed to break chemical bonds. The **energy change (ΔH)** in an endothermic reaction is **positive**.

You may also find, in some textbooks, ΔH referred to as the **enthalpy change**.

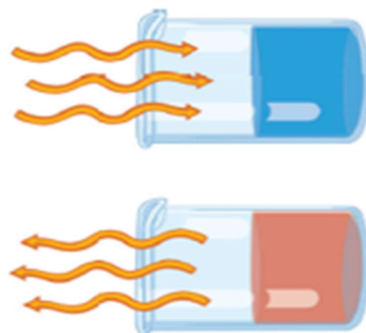
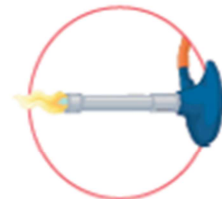
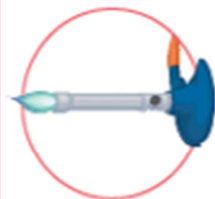
In an **exothermic** reaction, energy is needed to form chemical bonds. The **energy change (ΔH)** in an exothermic reaction is **negative**.

Bond energies are measured in **kJ/mol**.

Combustion

Complete combustion occurs when there is enough oxygen for a fuel to burn. A hydrocarbon will react with oxygen to produce carbon dioxide and water.

Incomplete combustion occurs when there isn't enough oxygen for a fuel to burn. The products in this reaction are water and poisonous carbon monoxide.



Endothermic

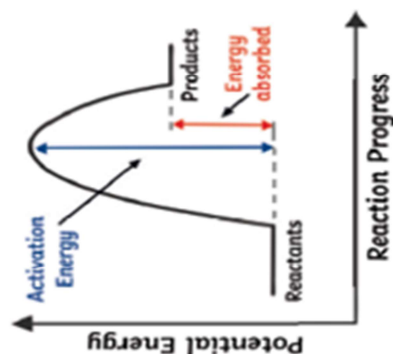
Exothermic

produces a cooling effect. Another example is **instant ice packs** that are used to treat sporting injuries.

Reaction Profiles – Endothermic

In an **endothermic** reaction, the **reactants** are at a **lower** energy level than the products.

In an **endothermic** reaction, the difference in energy is **absorbed** from the surroundings and so the **temperature** of the surroundings **decreases**.



Exothermic and Endothermic Reactions

When a chemical reaction takes place, **energy** is involved. Energy is transferred when chemical bonds are broken and when new bonds are made.

Exothermic reactions are those which involve the transfer of energy from the reacting chemicals to the surroundings. During a practical investigation, an exothermic reaction would show an **increase in temperature** as the reaction takes place.

Examples of exothermic reactions include **combustion**, **respiration** and **neutralisation** reactions. Hand-warmers and self-heating cans are examples of everyday exothermic reactions.

Endothermic reactions are those which involve the transfer of energy from the surroundings to the reacting chemicals. During a practical investigation, an endothermic reaction would show a **decrease in temperature** as the reaction takes place.

Examples of endothermic reactions include the **thermal decomposition** of calcium carbonate.

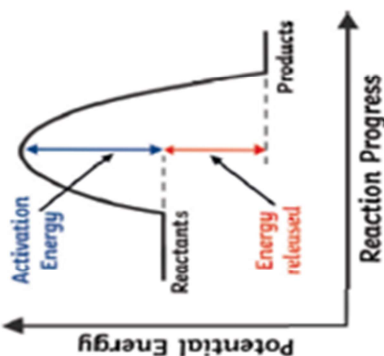
Eating **sherbet** is an everyday example of an endothermic reaction. When the sherbet dissolves in the saliva in your mouth, it produces a cooling effect.

Reaction Profiles – Exothermic

Energy level diagrams show us what is happening in a particular chemical reaction. The diagram shows us the **difference in energy** between the reactants and the products.

In an **exothermic** reaction, the **reactants** are at a **higher** energy level than the products.

In an **exothermic** reaction, the difference in energy is **released** to the surroundings and so the **temperature** of the surroundings **increases**.



Conservation of Mass

No atoms can be created or made during a chemical reaction, so the mass of the reactants will equal the mass of the product.

Reactions can be shown as a word or symbol equation.

magnesium + oxygen → magnesium oxide



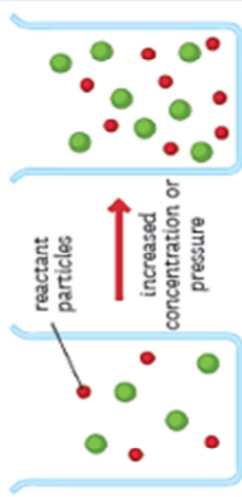
Symbol equations should also be balanced; they should have the same number of atoms on each side.



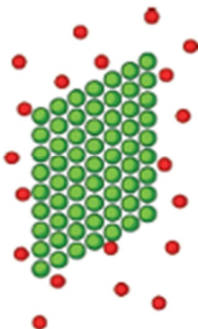
Knowledge organiser

Concentration and Pressure

If the number of reactant particles in a given space is doubled, there will be more frequent successful collisions between reactant particles, therefore, increasing the rate of reaction.

**Surface Area**

Large lumps of a solid have a small surface area to volume ratio. If the solid is broken up into smaller lumps or crushed into a powder, this will increase the surface area to volume ratio.

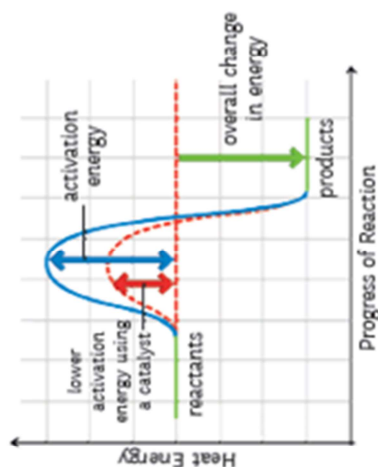


A larger area of the solid is now exposed to other reactant particles. This increases the frequency of successful collisions thus increasing the rate of reaction.

Factors Affecting the Rate of a Chemical Reaction

- concentration and pressure
- catalyst
- surface area
- temperature

The rate of a chemical reaction will be increased if there are more frequent successful collisions between reactant particles.

Catalyst

A catalyst is a substance that speeds up a chemical reaction without getting used up itself. Catalysts are able to offer an alternative pathway at a lower activation energy.

Biological catalysts are called enzymes.

When a catalyst is used in a chemical reaction (not all reactions have a catalyst that is suitable to use), the frequency of collisions is unchanged. More particles are able to react. The particles have energy greater than that of the activation energy. Consequently, there is an increase in the rate of successful collisions.