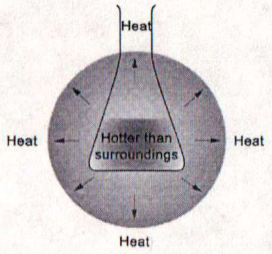
Lesson 1: Exothermic and endothermic reactions

When a chemical reaction happens, energy is transferred to or from the surroundings and often there is a temperature change. For example, when a fire burns it transfers heat energy to the surroundings. Objects near a fire become warmer and the temperature rise can be measured with a thermometer.

Exothermic reactions

These are reactions that **transfer energy to the surroundings**. The energy is usually transferred as heat energy, causing the reaction mixture and its surroundings to get hotter. The temperature increase can be detected using a thermometer. Some examples of exothermic reactions are:

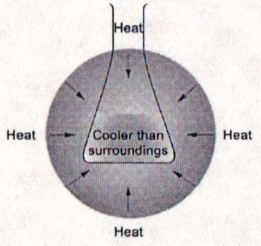
- Burning (combustion)
- neutralisation reactions between acids and alkalis, and
- the reaction between water and calcium oxide



Endothermic reactions

These are reactions that **take in energy from the surroundings**. The energy is usually transferred as heat energy, causing the reaction mixture and its surroundings to get colder. The temperature decrease can be detected using a thermometer. Some examples of endothermic reactions are:

- **the** reaction between barium hydroxide and ammonium chloride
- the reaction between ethanoic acid and sodium carbonate



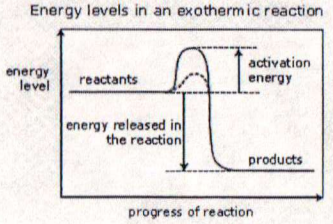
Energy level diagrams

Chemical energy

The chemical energy stored in the bonds in a substance gives us a measure of a chemical's energy level. The higher the energy level of a substance, the more chemical energy is stored in its bonds. The reactants and products in a chemical reaction usually have different energy levels, which are shown in a type of graph called an energy level diagram. The vertical axis on this diagram represents the energy level and the horizontal axis represents the progress of the reaction from reactants to products.

Energy level diagrams for exothermic reactions

In an exothermic reaction, **reactants have a higher energy level than the products**. The difference between these two energy levels is the energy released to the surroundings in the reaction, and an energy level diagram shows this as a vertical drop from a higher to a lower level:



Usually some extra energy is needed to get the reaction to start. This is called the **activation energy** and is drawn in energy level diagrams as a hump. Catalysts reduce the activation energy needed for a reaction to happen - this lower activation energy is shown by the dotted red line in the diagram here.

Energy level diagrams for endothermic reactions

In endothermic reactions the **reactants have a lower energy level than the products**. The difference between these two energy levels is the energy gained from the surroundings in the reaction, represented in an energy level diagram as a vertical jump from a lower to a higher level - the bigger the jump, the more energy is gained.