

**Lesson
58**

Energy Changes during Reactions

Aims

By the end of this lesson you should be able to:

- understand that chemical reactions in which heat energy is given out are described as exothermic and those in which heat energy is taken in are endothermic

Context

This lesson covers Section 3.1 of the specification.



Edexcel International GCSE (9-1) Chemistry Student Book, pages 207-210.



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Introduction

Energy is the mysterious “something” which makes things happen, which gets work done. It is measured in units called **joules (J)**, and it can take many different forms, each able to do useful jobs:

- **Chemical energy** is energy stored in substances like food, fuels, and electric cells.
- **Heat** is a form of energy which raises the temperature of objects which contain it: the more heat energy in joules an object contains, the higher its temperature in °C.
- Other forms of energy include electrical, sound, light, kinetic (movement) and nuclear energy.

Energy cannot be created or destroyed, made or used up. But it *can* be changed from one form into another. Whenever a chemical reaction occurs, the amount of *chemical* energy stored in substances changes: the products will either have more or less chemical energy than the reactants. This means that some other form of energy either appears or disappears during the reaction. This other form of energy is most often *heat*.



Log on to Twig and look at the film titled: **Energy Change of Reactions**

www.ool.co.uk/1450rd

Some reactions take in energy and some release energy. Why? And what are some common examples of each type of reaction?

Exothermic and Endothermic Reactions

Any chemical reaction can be represented like this:

reactants ----> products

If the products have *less* chemical energy than the reactants, the lost chemical energy is turned into heat, and the

chemicals increase in temperature (warm up). This is an **exothermic** reaction.

But if the products have *more* chemical energy than the reactants, the extra chemical energy is gained from heat, and the chemicals decrease in temperature (cool down). This is an **endothermic** reaction.

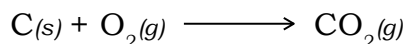
Imagine a chemical reaction taking place in a test tube held in your hand. If the test tube starts to feel hot, then the reaction is exothermic. But if it starts to feel cold, the reaction is endothermic.

Exothermic reactions

Whenever a substance **burns**, an exothermic reaction is going on to produce heat.

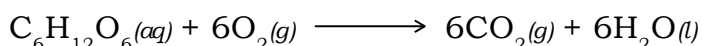
Coal and coke, for example, are mostly carbon which burns to form the gas carbon dioxide, releasing heat as it does so:

carbon + oxygen → carbon dioxide



The **respiration** which goes on in our bodies' cells, releasing the energy we need to live from food, is also an exothermic reaction, which is why our bodies are warm:

glucose + oxygen → carbon dioxide + water



Many other common reactions are also exothermic, for example:

- the reactions of metals with water or acids to produce hydrogen (see Lesson 54)
- neutralisation reactions between acids and bases (see Lesson 55)

Activity 1

Visit You Tube at www.youtube.com. Put "exothermic reactions" into the search box to see a variety of these being demonstrated.

Endothermic Reactions

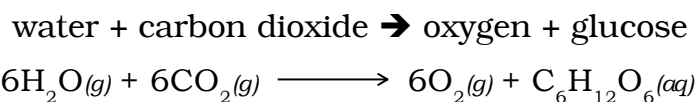
Endothermic reactions are usually more difficult to spot, but there are many common examples.

The dissolving of ammonium nitrate in water is an endothermic process: the water gets colder as the solid dissolves.

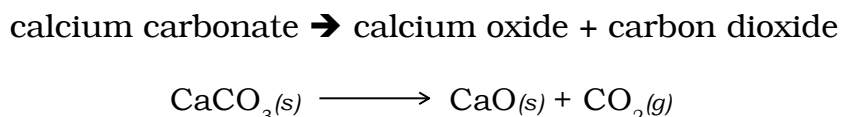


This reaction is the basis of the instant cold packs used to cool sprains in First Aid.

Photosynthesis, used by plants to make their food, is also an endothermic reaction. In this case the energy used to provide the extra chemical energy in the products is light rather than heat:

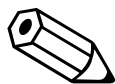


Reactions where you need to heat the reactants over a Bunsen burner to get the reaction to work are also often endothermic. A good example is the **thermal decomposition** (breaking up by heating) of calcium carbonate:



Activity 2

(1) Visit You Tube at www.youtube.com. Put "dissolving ammonium nitrate" into the search box to see this endothermic reaction, and others, demonstrated.



(2) Home experiment.

Take a few ice cubes, place them in a container and, as they begin to melt, place a thermometer into the vessel. Note the temperature. Sprinkle plenty of salt onto the ice and take the temperature again.

When the salt is added, the ice begins to melt faster but the temperature drops. Energy is taken in to break the strong ionic bonds between the sodium and chloride ions in the salt as the solid dissolves:





You should now read through *Edexcel International GCSE (9-1) Chemistry Student Book*, pages 207-210. The following questions are relevant to your specification: page 224 Q1a, 2a, 3abcf, 4.

Keywords

energy

joule (J)

respiration

photosynthesis

thermal decomposition

activation energy

Summary

Lesson 58: Energy changes during reactions

Types of energy

Exothermic and endothermic reactions

What you need to know

- the meanings of the terms printed in **bold** in this lesson

What you might be asked to do

- identify and give examples of endothermic and exothermic reactions

Self-Assessment Test: Lesson 58

1. Classify each of the following changes as exothermic or endothermic. Some of the reactions may be new to you, and you may have to draw on your knowledge of Chemistry from Lessons 44-58.
 - (a) The reaction between sodium and water.

- (b) Burning ethanol.
- (c) The reaction between sodium carbonate and ethanoic acid: a thermometer placed in the reaction mixture shows a fall in temperature.
- (d) When you dissolve solid sodium hydroxide in water, the solution gets hot.

Suggested Answers to Self-Assessment Test: Lesson 58

- 1.
 - (a) exothermic
 - (b) exothermic
 - (c) endothermic
 - (d) exothermic