C1 Chapter 3: Reactions

Knowledge organiser

A **chemical reaction** is a change in which atoms rearrange and join together differently to make new substances. **Physical changes** are changes that do not make new substances.

Equations

The substances that you start with in a reaction are called reactants, and the ones you finish with are the products.

We can represent a reaction with a **word equation**.

The reactants are on the left
The products are on the right
There is an → from the reactants to the products

copper + oxygen → copper oxide

reactants — products

We can also use a **balanced formula equation** to represent a reaction.

$$2Cu + O_2 \rightarrow 2CuO$$

A balanced formula equation shows:

- the formula of each substance in the reaction
- how the atoms are rearranged
- the relative number (ratio) of atoms of each substance.

What happens during a reaction?

If a chemical reaction is happening you might:

1. see flames or sparks
2. notice a smell
3. Here fizzing or a bang
4. feel the temperature of the reaction mixture going up or down

Speed of reactions

Some reactions are very fast but others can be very slow.

Adding a **catalyst** can speed up a reaction, for example, to make a product more quickly.

Different reactions require different catalysts.

A catalyst isn't used up in the reaction but helps the reaction along.

Chemical reactions are normally not **reversible**.

This means that you cannot turn the products back into reactants.

All chemical reactions involve an energy transfer to or from the surroundings:

Energy transfer	Temperature of surroundings	Type of reaction	Example
from the surroundings to the reaction mixture	decreases	**endothermic**	thermal decomposition
to the surroundings from the reaction mixture	increases	**exothermic**	combustion

Conservation of mass

In a reaction, atoms are not created or destroyed – they are just rearranged.

The total mass of the reactants is always equal to the total mass of the products.
This is called **conservation of mass**.

If the mass seems to increase, it is because atoms have been added from a gas.

magnesium + oxygen (gas) → magnesium oxide

If the mass seems to have decreased, it is because atoms have rearranged and formed a gas that has escaped.

calcium + water → calcium hydroxide + hydrogen (gas)

Changes of state are not chemical reactions, but they are reversible. This is called a **physical change**.

This is because no new substances are made.

For example, Water, ice, and steam are all made of molecules of the same substance (H_2O) in different states, and the change from one state to another is reversible.

Types of reaction

Thermal decomposition reactions

A **decomposition** reaction is when a substance breaks down into simpler substances.

Most decomposition reactions need heat to happen – this is called **thermal decomposition**.

Oxidation is when substances react with oxygen.

Combustion is a type of oxidation reaction where a **fuel** reacts (burns) with oxygen this transfers energy by heating.

Petrol, diesel, and coal are all **fossil fuels** and take millions of years to form.

They cannot be replaced when used, and will eventually run out, so are called **non-renewable** (finite).

Fossil fuels produce carbon dioxide and water when combusted. Extra carbon dioxide released into the air can cause climate change.

Hydrogen can also be combusted and used as fuel.

This may be better than using fossil fuels because it only produces water as a product.

$$2H_2 + O_2 \rightarrow 2H_2O$$

Key Words

Make sure you can write a definition for these key terms.

balanced formula equation *catalyst* *chemical reaction* *combustion reaction* *conservation of mass* *decomposition* *endothermic change* *exothermic change* *fossil fuel* *fuel* *non-renewable* *oxidation reaction* *physical change* *product* *ratio* *reactants*

C1 Chapter 4: Acids and alkalis

Knowledge organiser

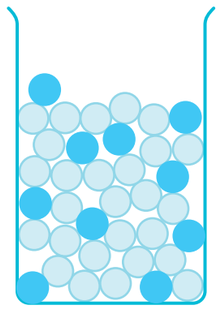
Acids and alkalis

Acids and **alkalis** are special solutions which are chemical opposites to each other.

If a solution is exactly between acid and alkaline it is **neutral**.

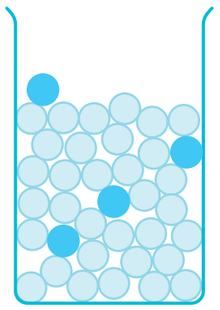
Acids and alkalis can be:

concentrated



Lots of acid/alkali particles in a small amount of water

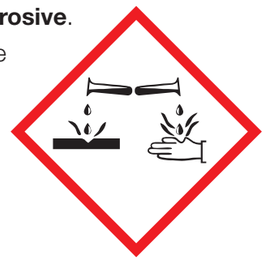
dilute



A small number of acid/alkali particles in a lot of water.

Some acids and alkalis are **corrosive**.

This means that they can cause burns if they get on your skin.



Acids and alkalis can be extremely dangerous, depending on the type of acid/alkali and its concentration.

As a general rule the more concentrated the solution, the more dangerous it can be.

Indicators

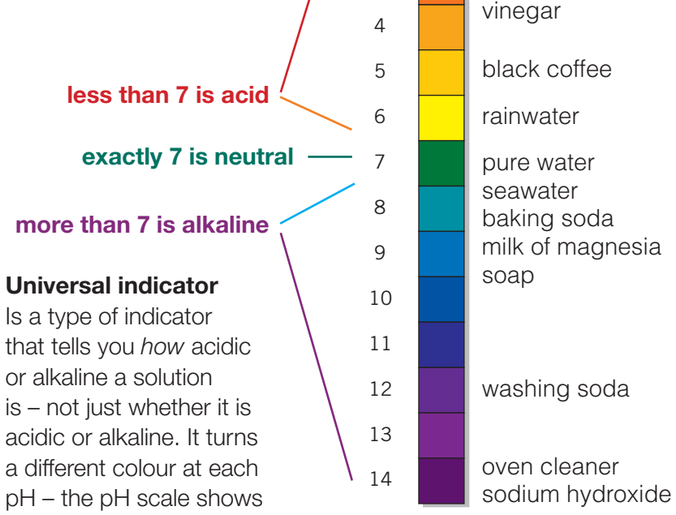
If you want to know if something is an acid or alkali, you need to use an **indicator.** Indicators contain a dye that turns different colours in acidic and alkaline solutions.

Litmus paper is a type of indicator. It can be either **red** paper or **blue** paper.

In acid – **blue** paper turns **red**

In alkali – **red** paper turns **blue**.

The **pH scale** measures how acidic or alkaline something is.



Universal indicator
Is a type of indicator that tells you *how* acidic or alkaline a solution is – not just whether it is acidic or alkaline. It turns a different colour at each pH – the pH scale shows the colours of universal indicator in solutions of different pH.

Reactions with acids

When an acid reacts with a metal element or compound a **salt** is formed.
The hydrogen atoms of the acid are replaced with atoms of the metal element.

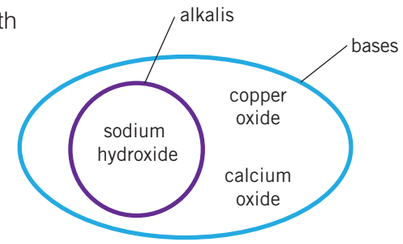
$$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$$

zinc + sulfuric acid → zinc sulfate + hydrogen

A **base** is a compound that can react with an acid to make a **neutral** solution.

This is called **neutralisation**.

Bases that are soluble in water are alkalis.



Neutralisation reactions produce water and a salt.

base + acid → salt + water

for example,

sodium hydroxide + hydrochloric acid → sodium chloride + water

copper oxide + sulfuric acid → copper sulfate + water

Metals can also react with acids, but they produce a salt and hydrogen gas.

for example,

magnesium + hydrochloric acid → magnesium chloride + hydrogen

Naming salts

The name of the metal comes first, e.g., **magnesium** chloride.

Different acids produce different types of salt:

- hydrochloric acid produces metal **chlorides**
- sulfuric acid produces metal **sulfates**
- nitric acid produces metal **nitrates**

Key Words

Make sure you can write a definition for these key terms.

acid *alkali* *base* *concentrated* *corrosive* *dilute* *indicator* *litmus* *neutral* *neutralisation* *pH scale* *salt* *universal indicator*

P1 Chapter 3: Light

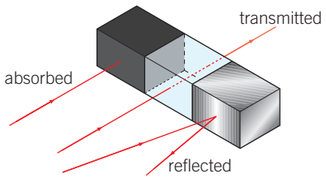
Knowledge organiser

How does light travel?

Luminous objects are sources of light, e.g., the Sun.

Non-luminous objects do not produce their own light, e.g., the Moon.

When light hits an object it can be **absorbed**, **reflected**, or **transmitted**.



If an object is:

transparent – most light is transmitted

translucent – light is scattered

opaque – no light is transmitted so a shadow is produced.

Light can travel through gases, some solids and liquids, and completely empty space (a vacuum).

The speed of light in a **vacuum** is about 300 000 km/s.

Distances in space are measured in **light-time**. Remember that light-time is a distance (not a measure of time).

A light-minute is the distance light travels in one minute.

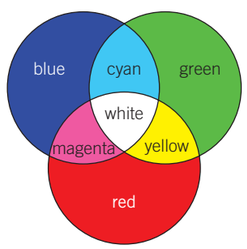
A light-year is the distance light travels in one year.

Colours of light

A **prism** refracts different colours of light by different amounts. This disperses light into a continuous **spectrum** of colours.

The **primary colours** of light are **red**, **green**, and **blue**.

Secondary colours are produced when any two primary colours are mixed.



Filters subtract colours from white light, so that only one colour of light is transmitted.

Objects appear to be different colours because they reflect some colours of light and absorb others.

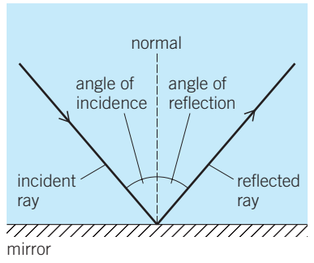
Black objects absorb all colours and white objects reflect all colours.

Reflection and refraction of light

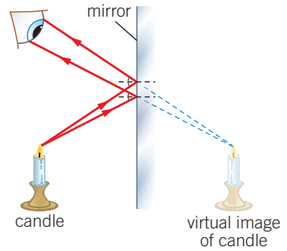
The **law of reflection** states that:

The **angle of incidence** is equal to the **angle of reflection**.

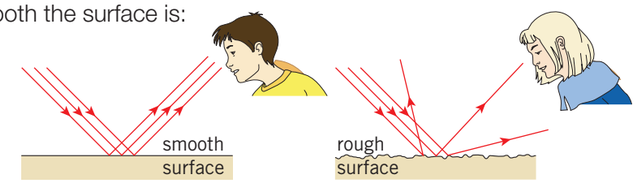
The **normal** is an imaginary line at 90° to the mirror.



Images in mirrors are **virtual** – they look like they are behind the mirror.



Whether or not you can see a clear reflected image depends on how smooth the surface is:



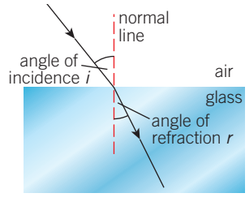
specular reflection **diffuse scattering**

Refraction is when light changes direction when it travels from one **medium** (material, such as air or water) to another.

Refraction happens because light travels at different speeds in different materials.

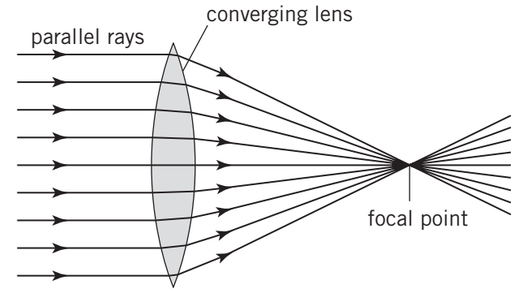
Rays of light will be refracted:

- towards the normal if they slow down, such as going from air to glass
- away from the normal if they speed up, such as going from water to air.



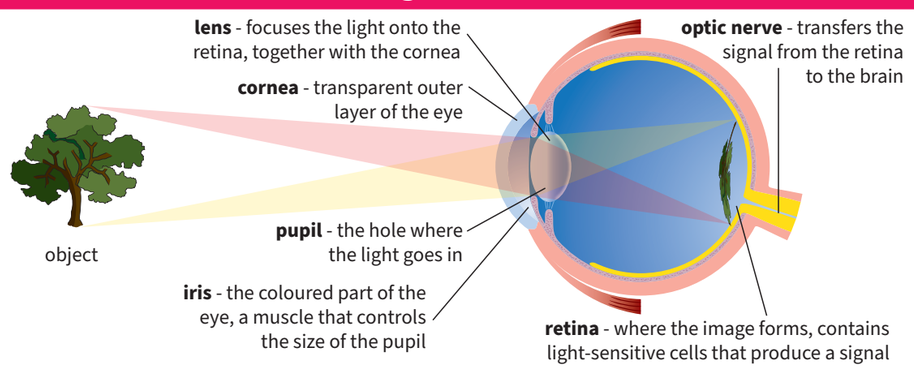
Lenses use refraction to spread out or **focus** light.

Convex (or **converging**) lenses (like the ones in your eyes) are shaped to focus the light to a point – called the **focal point**.



How do eyes and cameras work?

Light entering your eye is refracted by the **lens**, focusing it on the **retina** and creating an inverted image. **Photoreceptors** detect the light hitting your retina and send an electrical impulse to your brain.



Cameras work in the same way as your eye – light passes through an opening and a **real image** is formed on a screen or film.

Digital cameras now have a **charge-coupled device** (**CCD**) instead of film – when light hits a **pixel** it produces an electrical charge.

Key Words

Make sure you can write a definition for these key terms. ***absorb*** ***angle of incidence*** ***angle of reflection*** ***aperture*** ***camera*** ***charge-coupled device*** ***continuous*** ***converging*** ***convex*** ***cornea*** ***diffuse scattering*** ***dispersion*** ***emit*** ***eye*** ***filter*** ***focal point*** ***focus*** ***image*** ***incident ray*** ***inverted*** ***iris*** ***law of reflection*** ***lens*** ***light-time*** ***luminous*** ***medium*** ***non-luminous*** ***normal*** ***opaque*** ***optic nerve*** ***photoreceptors*** ***pixel*** ***plane*** ***primary colour*** ***prism*** ***pupil*** ***ray*** ***real image*** ***reflect*** ***reflected ray*** ***refraction*** ***retina*** ***secondary colour*** ***source*** ***spectrum*** ***specular reflection*** ***translucent*** ***transmit*** ***transparent*** ***virtual image***

P1 Chapter 4: Space

Knowledge organiser

Space

A **galaxy** is a collection of billions of **stars**. The Earth is in the **Milky Way** galaxy.

Planets are large objects that orbit stars, and do not **produce** light.

Asteroids are rocky objects smaller than planets, that also orbit stars.

Satellites are objects that orbit planets. This includes **natural satellites** (moons) and **artificial satellites** (e.g., the International Space Station).

Meteors are bits of rock which burn up in Earth's atmosphere. They are called **meteorites** once they hit the ground.

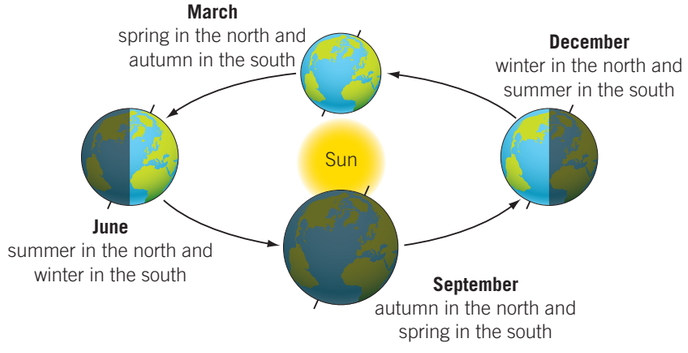
The Universe
contains billions of
Galaxies
contain billions of
Stars
are orbited by
Planets, asteroids, and comets
planets may have
Moons

The Earth

The Earth is the only place we have found life in the **Universe**.

It takes a **year** for the Earth to orbit the Sun - 365.2442 days. We add one day every fourth year (a leap year) because of the extra 0.2442 days.

The Earth's **axis** is tilted 23.4 degrees, which causes **seasons** (which have different day lengths and temperatures).

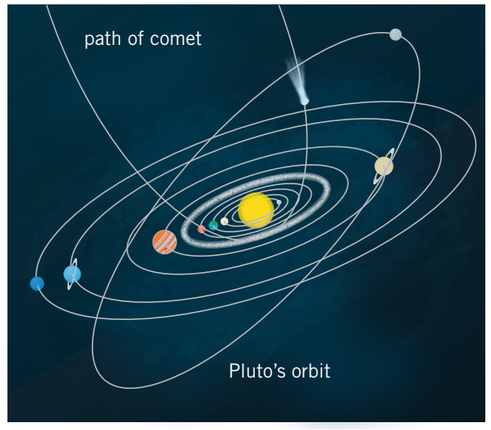


The Earth spins on its axis every 24 hours, giving us **day** and **night**.

The Solar System

Our **Solar System** is everything that orbits around the Sun. This includes:

- Inner planets – the **terrestrial** (rocky) planets
  - Mercury
  - Venus
  - Earth
  - Mars
- **Asteroid belt** (Including the **dwarf planet** Ceres)
- Outer planets **–** the **gas giants**
  - Jupiter
  - Saturn
  - Uranus
  - Neptune
- Kuiper belt objects (such as Pluto)
- **Comets** (balls of ice)



The further a planet is from the Sun, the colder its temperature is (apart from Venus, because of its thick atmosphere).

Gravity pulled gas and dust together to form the Sun about 5 billion years ago. The planets then formed from a spinning disc of gas and dust around the Sun.

An exoplanet is a planet that is orbiting a star that is not the Sun.

A group of stars is called a **constellation**. Different constellations are seen in winter and summer because the Earth is moving around the Sun.

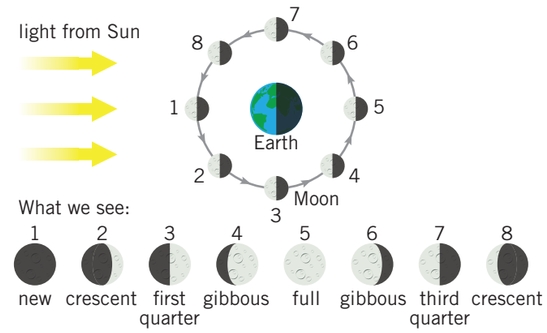
The Moon

The **Moon** orbits the Earth every 27 days and 7 hours.

It takes the same amount of time to spin on its axis, so we always see the same side.

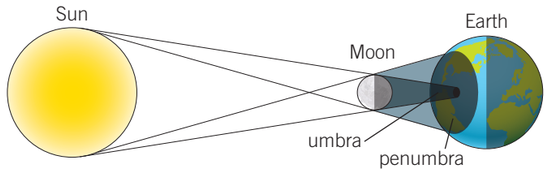
Phases of the moon

As the Moon moves around the Earth different parts are lit by the Sun, so it looks different to us.



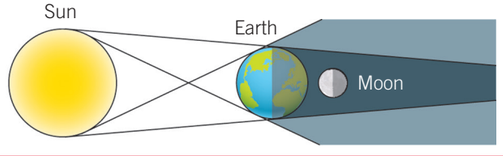
Solar eclipses

The Moon blocks light hitting part of the Earth. The **umbra** is the region of total darkness (like night), and the **penumbra** is where the light is partially blocked.



Lunar eclipses

The earth stops light hitting the Moon.



Key Words

Make sure you can write a definition for these key terms.

artificial satellite · asteroid · asteroid belt · astronomer · axis · comet · constellation · day · dwarf planet · ellipse · galaxy · gas giant · hemisphere · lunar eclipse · meteor · meteorite · Milky Way · Moon · natural satellite · night · partial solar eclipse · penumbra · phases of the Moon · season · Solar System · star · terrestrial · total solar eclipse · umbra · Universe · year