

# Glossary

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## A

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**acids** dissolve in water to produce solutions with a pH of less than 7

**acid rain** rain which has been made more acidic by pollutant gases

**activation energy** the energy needed for a chemical reaction to happen

**addition polymer** a very long molecule resulting from polymerisation, e.g. polythene

**aggregate** gravel added to cement and sand to make concrete

**alcohols** family of organic compounds with the functional group  $\text{-OH}$

**alkali metals** the metals in Group 1 of the periodic table

**alkalis** compounds which produce hydroxide ions in water

**alkanes** a family of hydrocarbons with all single carbon-carbon covalent bonds and general formula  $\text{C}_n\text{H}_{2n+2}$

**alkenes** a family of hydrocarbons with one double carbon-carbon bond and general formula  $\text{C}_n\text{H}_{2n}$

**allotropes** different forms of the same element

**alloy** a mixture of a metal with one or more other metals or non-metals to change the properties of the metal

**alpha particles** radioactive particles which are helium nuclei – helium atoms without the electrons (they have a positive charge)

**amino acids** small molecules from which proteins are built

**ammeter** meter used in an electric circuit for measuring current

**anion** ion with a negative charge; they move to the anode during electrolysis

**anode** electrode in electrolysis with a positive charge

**aquifer** underground layer of permeable rock or loose materials (gravel or silt) where groundwater is stored

**atom** the basic 'building block' of an element, the smallest part of an element that can take part in a chemical reaction

**atom economy** a measure of the amount of starting materials that become useful products

**atomic number** the number of protons in the nucleus of an atom

**Avogadro's constant** the number of atoms, molecules or ions in one mole of a given substance, and is  $6.02 \times 10^{23}$  per mole

## B

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**balanced symbol equation** chemical equation written in chemical symbols showing the number of atoms on each side of the equation balance

**barium chloride** chemical used to test for sulfates in aqueous solutions

**base** reacts with an acid to form a salt

**battery** two or more electrochemical cells joined together

**bioleaching** process that uses bacteria to leach metal compounds from rocks

**biological catalyst** molecules in cells of living organisms that speed up chemical reactions

**boiling point** temperature at which the bulk of a liquid turns to vapour

**buckminsterfullerene** a very stable spherical structure of 60 carbon atoms joined by covalent bonds (an allotrope of carbon)

## C

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**carbon** an element present in all living things and forms a huge range of compounds with other elements

**carbon-14** radioactive isotope of carbon

**carbon dioxide ( $\text{CO}_2$ )** a greenhouse gas which is emitted into the atmosphere as a product of combustion

**carbon footprint** the total amount of carbon dioxide and other greenhouse gases emitted over the full life cycle of a product, service or event.

**carboxylic acids** family of organic compounds with the functional group  $\text{-COOH}$

**catalyst** a chemical that speeds up a reaction but is not used up by the reaction

**cathode** the negative electrode in electrolysis

**cell** an electrochemical cell is a unit that uses a chemical reaction to provide electricity

**charge(s)** a property of matter, charge exists in two forms, positive and negative, which attract each other

**chemical properties** the characteristic chemical reactions of substances

**chlorination** addition of chlorine to water supplies to kill micro-organisms

**chromatography** a method for separating substances, used to identify compounds and check for purity

**close-packed atoms** structure of many metals

**collision frequency** the number of collisions between particles that happen in one unit of time

**composites** are made of two materials, a matrix or binder surrounding and binding together fibres or fragments of the other material, which is called the reinforcement

**combustion** exothermic reaction of a substance with oxygen

**compound** two or more elements which are chemically joined together, e.g.  $H_2O$

**concentration** the amount of chemical dissolved in a certain volume of solution

**condensation polymer** these are made of units of two different monomers, with the loss of a small molecule (e.g. water) in the process. For example, polyester

**conductors** materials which transfer thermal energy easily; electrical conductors allow electricity to flow through them

**conservation of energy** principle stating that energy cannot be created or destroyed

**conservation of mass** the total mass of reactants equals the total mass of products formed in a chemical reaction

**covalent bonds** bonds between atoms where a pair of electrons is shared

**cracking** the process of breaking down large hydrocarbons into smaller molecules

**current** flow of electrons in an electric circuit

**curved line** line of changing gradient

## D

**decay** to rot or decompose

**delocalised electrons** electrons which are free to move from atom to atom in a giant structure or a molecule

**density** the density of a substance is its mass divided by its volume

**diesel oil** fuel for diesel engines, traditionally obtained from crude oil but other forms such as biodiesel have been developed

**direct current** an electric current that flows in one direction only

**displacement reaction** chemical reaction where an element takes the place of or 'pushes out' another element from a compound

**distillation** the process of evaporation followed by condensation

**DNA** molecule found in the nucleus of cells and contains a genetic code for making proteins

**DNA bases** four bases that are found in DNA; they make up the base sequence and are given the letters A, T, G and C

**dot and cross diagram** a diagram representing the number of electrons in the outer shell of atoms or ions

## E

**electrical conductivity** a measurement of the ability to conduct electricity

**electrical conductors** materials that let electricity pass through them

**electrode** ions are discharged at the electrodes during electrolysis

**electrolysis** the process of passing direct current through a melted ionic compound or a solution of an ionic compound so ions are discharged and the compound is broken down

**electrolyte** a liquid or solution that conducts electricity and breaks down during electrolysis

**electromagnetic spectrum** electromagnetic waves ordered according to wavelength and frequency, ranging from radio waves to gamma rays

**electronic structure** the arrangement of electrons in the sequence that they occupy the shells or energy levels, e.g. the 11 electrons of sodium are arranged 2,8,1

**electrons** small negatively charged particles within an atom that are outside the nucleus

**electrostatic attraction** attraction between opposite charges, e.g. between  $Na^+$  and  $Cl^-$

**elements** substances made out of only one type of atom with the same number of protons in the nucleus

**empirical formula** simplest ratio of atoms or ions in a compound

**endothermic reaction** chemical reaction which takes in thermal energy

**energy** the ability to 'do work'

**enzymes** biological catalysts that increase the speed of chemical reactions

**equilibrium** when the forwards and backwards reactions are occurring at the same rate in a closed system

**estimate** calculate approximately the value of something

**evaporation** when a liquid changes to a gas, it evaporates

**exhaust gases** gases discharged into the atmosphere from an engine as a result of combustion of fuels

**exothermic reaction** chemical reaction in which thermal energy is given out

**explosion** a sudden, loud, violent release of energy by a chemical reaction

**extrapolation** making an estimate by continuing a trend or graph line beyond the range of results

## F

**fermentation** a process where aqueous solutions of ethanol are produced when sugar solutions are fermented using yeast

**fertiliser** chemical or substance put on soil to improve the growth of crop plants

**filtration** the process of using a porous material to remove solids from water or solutions

**flame emission spectroscopy** an instrumental method used to analyse solutions for metal ions

**flame test** test where a chemical put into a flame produces a characteristic colour – tests for metal ions

**formulation** a mixture that has been designed as a useful product

**fractional distillation** crude oil is separated into fractions using this process of distillation where a mixture of liquids is vaporised and compounds with different boiling points condense at different temperatures

**force** a push or pull which is able to change the velocity or shape of a body

**fossil fuels** fuels which are the fossilised remains of plants or animals, such as coal, oil and gas

**fuel cell** electrical cells supplied by an external source of fuel and oxygen. The fuel is oxidised electrochemically within the fuel cell to produce a potential difference

**fullerenes** cage-like carbon molecules containing many carbon atoms, e.g. buckyballs

**functional group** a group that characterises a series of organic compounds. The functional group of an alkene is C=C

## G

**gene** section of DNA that codes for a particular characteristic

**giant covalent structure** a large regular arrangement of atoms all joined together by covalent bonds

**giant ionic lattice** the regular three-dimensional arrangement of ions in an ionic compound, also called a giant ionic structure

**gradient** rate of change of two quantities on a graph; change in  $y$  divided by change in  $x$

**graphite** a type of carbon made of layers of atoms

**greenhouse gas** any of the gases whose absorption of solar radiation is responsible for the greenhouse effect, e.g. carbon dioxide, methane

**group** within the periodic table the vertical columns are called groups

**Group 1** the elements in Group 1 of the periodic table, the alkali metals

**Group 7** the elements in Group 7 of the periodic table, the halogens

## H

**Haber process** industrial process for making ammonia

**haemoglobin** chemical found in red blood cells which carries oxygen

**half equation** a redox reaction is made up of two half equations, one in which electrons are lost and one in which electrons are gained.

**halogens** reactive non-metals in Group 7 of the periodic table, e.g. chlorine

**hardness** resistance of a solid material to cutting, indentation or scratching

**homologous series** a series of organic compounds that have the same general formula, i.e. the general formula of alkanes is  $C_nH_{2n+2}$

**hydrocarbons** compounds containing only hydrogen and carbon

## I

**incomplete combustion** takes place when there is not enough oxygen present for complete combustion

**indicator** used to show pH of a solution or when the end point of a titration is reached

**insoluble salt** salt which is not soluble in water

**intermolecular force** force between molecules

**interpolation** making an estimate of a value from values on either side of the point

**ionic bond** the chemical bond between ions of opposite charges

**ionic equation** an equation showing changes to the ions involved in a reaction

**ionises** adds or removes electrons from an atom leaving it charged

**ions** charged particles (can be positive or negative)

**isotopes** atoms with the same number of protons but different numbers of neutrons

## J

**joule** unit of work done and energy

## K

**kilogram (kg)** unit of mass

**kinetic energy** the energy that moving objects have

## L

**Le Châtelier's principle** if a system is at equilibrium and a change is made to any of the conditions, then the system responds to counteract the change

**life cycle assessments (LCAs)** are carried out to assess the environmental impact of products in each of the stages involved in their manufacture, use and disposal

**limewater** a solution of calcium hydroxide in water – the colourless solution turns milky in the presence of carbon dioxide

**limiting reactant** chemical used up in a reaction that limits the amount of product formed

**line spectrum** a spectrum produced by gaseous atoms showing individual lines at particular wavelengths that is unique for each element

**lustrous** shiny

**lysis** to split apart

## M

**magnitude** size of something

**mass** the amount of matter in something; it is measured in kilograms (kg)

**mass number** the sum of the number of protons and neutrons in a nucleus

**melting point** the temperature at which a solid turns into a liquid

**metal halide** a compound of a halogen and a metal, e.g. potassium bromide

**metallic bonding** the bonding between atoms in a metal due to delocalised electrons

**metallic properties** the physical and chemical properties specific to a metal, such as lustre, electrical conductivity and the ability to form positive ions

**metalloids** elements with properties of both metals and non-metals; in the periodic table they are between the metals and non-metals

**metals** elements that are usually solid, lustrous, conduct electricity and form ions by losing electrons

**minerals** natural solid materials with a fixed chemical composition and structure, rocks are made of collections of minerals

**mobile phase** in chromatography this is the phase that moves

**mole** a unit for a standard amount of a substance. One mole of any substance contains the same

number of particles, atoms, molecules or ions as one mole of any other substance

**molecular formula** the formula of a chemical using chemical symbols, e.g. methane has the molecular formula  $\text{CH}_4$

**molecule** two or more atoms covalently bonded to form the smallest unit of an element or compound, e.g.  $\text{O}_2$ ,  $\text{H}_2\text{O}$

**molten** a substance in its liquid state, often referring to a substance which is solid at ordinary temperatures, such as rock, ores, metals or salts, when heated to temperatures above its melting point

## N

**nanometre (nm)** unit used to measure very small things ( $10^{-9}$  m or one billionth of a metre)

**nanoparticles** very small particles on the nanoscale (1 to 100 nm)

**nanotube** carbon atoms formed into a nanoparticle with a tube-like structure

**negative ion** an ion with a negative charge, such as when atoms gain electrons

**neutral** a neutral solution has a pH of 7

**neutralisation** the reaction that takes place when an acid and base react to produce a salt and water

**neutron** particle which does not have a charge found in the nucleus of an atom

**non-metals** elements that are solids, liquids or gases that do not conduct electricity and bond covalently or form negative ions by their atoms gaining electrons

**non-renewable** something which is used up at a faster rate than it can be replaced e.g. fossil fuels

**nucleus** central part of an atom that contains protons and neutrons

## O

**optimum conditions** the conditions, such as temperature and pressure, that give the products of a chemical process at the lowest cost

**order of magnitude** values that differ by one order of magnitude are 10 times larger or smaller than each other

**oxidation** when a reactant gains oxygen or loses electrons

## P

**particulates** small particles in the air often caused by burning fuels

**percentage yield (of a reaction)** compares the mass of product obtained (the actual yield) to the mass we

expect to make (the maximum theoretical mass) as a percentage

**period** a row in the periodic table

**periodic table** a table of all the chemical elements in order of their atomic numbers

**petrol** volatile mixture of mainly hydrocarbons used as a fuel

**pharmaceuticals** medical drugs

**physical property** property that can be measured without changing the chemical composition of a substance, e.g. hardness

**phytomining** process that uses plants to extract metals

**pollutants** substances that can cause damage to the environment

**pollute** put unwanted or harmful substances into the environment

**pollution** contamination of the environment as a result of human activities

**polymer** very large molecule formed from many similar smaller molecules (monomers) linked together

**positive ion** an ion with a positive charge, such as when atoms lose electrons

**potable water** water that is safe to drink

**precipitate** solid formed in a solution by a chemical reaction

**precipitation reaction** chemical reaction in which a solid is formed when two solutions are mixed, e.g. in chemical tests for ions

**product** substance produced by a chemical reaction (shown on the right-hand side of the chemical equation)

**protons** positively charged particles found in the nucleus of an atom

**pure** a pure substance is a single element or compound that is not mixed with any other substance

## R

**random** having no regular pattern

**rate of reaction** the speed with which a chemical reaction takes place, measured by the amount of a reactant used or amount of product formed in a given time

**reactants** chemicals that react together in a chemical reaction (shown on the left-hand side of the chemical equation)

**recharging** battery or cell being charged with a flow of electric current

**reduction** when a reactant loses oxygen or gains electrons

**refine** the refining process turns crude oil into usable forms such as petrol

**relative atomic mass** the mass of an atom compared to 1/12 of the mass of a carbon-12 atom

**relative formula mass** the sum of the relative atomic masses in a compound

**renewable energy** energy from a resource that is rapidly replaced

**renewable resource** any resource that can be replenished at the same rate that it is used, e.g. biofuels

**reservoir** a water resource where large volumes of water are held

**reversible reaction** a chemical reaction where the reactants form products that, in turn, react together to give the reactants back

**R<sub>f</sub>** in chromatography is the distance a substance moved divided by the distance the solvent moved

## S

**sacrificial protection** using a more reactive metal to protect another metal

**saturated hydrocarbon** a hydrocarbon containing the maximum number of hydrogen atoms and only single carbon-carbon bonds; alkanes are saturated hydrocarbons

**sea water** water from the sea that contains high levels of dissolved salts making it undrinkable

**sedimentation** a process during water purification where small solid particles are allowed to settle

**silver nitrate** a chemical used for testing halide ions in water

**single covalent bond** chemical bond between atoms where each atom shares one pair of electrons

**solar energy** energy from the Sun

**soluble** a soluble substance can dissolve in a liquid, e.g. sugar is soluble in water

**solution** when a solute dissolves in a solvent, a solution forms

**solvent** the liquid used to dissolve a solute

**spectrum** the distribution of colours according to frequency or wavelength when white light is dispersed, also used for other things arranged in order of magnitude of a physical property

**stable electronic structure** the electronic structure of a noble gas, with two electrons in the first shell and eight electrons in every other outer shell, e.g. He 2; Ne 2,8; Ar 2,8,8; Kr 2,8,18,8

**standard form** a way of writing a large number with one number before the decimal point, multiplied by a power of 10, e.g.  $1\,200 = 1.2 \times 10^3$

**stationary phase** the phase in chromatography that does not move; in paper chromatography it is the paper

**straight line** line of constant gradient

**strength (of an acid)** strong acids ionise completely in water; weak acids partially ionise

**sub-atomic particles** particles that make up an atom, e.g. protons, neutrons and electrons

**sublimation** change of state of a substance from a solid directly to a gas; e.g. iodine

## T

**titration** a method to measure the volumes of acid and alkali that react with each other

**theoretical yield** the mass of product that we would expect to make from a reaction calculated from the chemical equation

**thermal decomposition** the breaking down of a compound into two or more products on heating

**thermal energy** energy that can be transferred as heat

**toxic** a toxic substance is one which is poisonous and causes harm to living organisms

**transition element** an element in the middle section of the periodic table, between the block containing Groups 1 and 2 and the block containing Group 3 to Group 0

## U

**unsaturated hydrocarbon** a hydrocarbon containing fewer than the maximum number of hydrogen atoms possible, and so at least one double bond.

## V

**vacuum** space containing no particles of matter

**voltage (also called the potential difference)** the difference in electrical potential between two points or objects

**voltmeter** instrument used to measure voltage (potential difference)

**volt (V)** unit used to measure voltage

## W

**water conservation** reducing water consumption through planned choice, e.g. hosepipe bans and water metering

**water resources** places from where water is extracted or where it is stored, e.g. aquifers, reservoirs or lakes

**wavelength** distance between two wave peaks or the distance between identical points in adjacent cycles of a wave