Glossary

A

Activation energy The minimum energy that a particle needs in order to react; the energy (enthalpy) difference between the reactants and the transition state.

Aldehyde An organic compound with the general formula RCHO.

Alkaline earth metals The metals in Group 2 of the periodic table.

Alkane A hydrocarbon with C—C and C—H single bonds only, with the general formula C_nH_{2n+2}.

Allotropes Pure elements which can exist in different physical forms in which their atoms are arranged differently. For example, diamond, graphite and buckminsterfullerene are allotropes of carbon.

Anaerobic respiration The process by which energy is released and new compounds formed in living things in the absence of oxygen.

Atom economy This describes the efficiency of a chemical reaction by comparing the total number of atoms in the product with the total number of atoms in the starting materials.
It is defined by: $\%\,\text{atom economy} = \frac{\text{mass of desired product}}{\text{total mass of reactants}} \times 100\%$

Atomic orbital A region of space around an atomic nucleus where there is a high probability of finding an electron.

Avogadro constant The total number of particles in a mole of substance. Also called the **Avogadro number**. It is numerically equal to 6.022×10^{23}.

B

Bond dissociation enthalpy The enthalpy change required to break a covalent bond with all species in the gaseous state.

C

Calorimeter An instrument for measuring the heat changes that accompany chemical reactions.

Catalyst A substance that alters the rate of a chemical reaction but is not used up in the reaction.

Catalytic cracking The breaking, with the aid of a catalyst, of long-chain alkane molecules (obtained from crude oil) into shorter chain hydrocarbons (some of which are alkenes).

Carbocation An organic ion in which one of the carbon atoms has a positive charge.

Carbon-neutral A process, or series of processes, in which as much carbon dioxide is absorbed from the air as is given out.

Chemical feedstock The starting materials in an industrial chemical process.

Co-ordinate bonding Covalent bonding in which both the electrons in the bond come from one of the atoms in the bond. (Also called dative covalent bonding.)

Covalent bonding Describes a chemical bond in a pair of electrons are shared between two atoms.

D

Dative covalent bonding Covalent bonding in which both the electrons in the bond come from one of the atoms in the bond. (Also called coordinate bonding.)

Delocalised Describes electrons that are spread over several atoms and help to bond them together.

Dipole–dipole force An intermolecular force that results from the attraction between molecules with permanent dipoles.

Displacement reaction A chemical reaction in which one atom or group of atoms replaces another in a compound, for example, $Zn + CuO \rightarrow ZnO + Cu$.

Displayed formula The formula of a compound drawn out so that each atom and each bond is shown.

Disproportionation Describes a redox reaction in which the oxidation number of some atoms of a particular element increases and that of other atoms of the same element decreases.

Dynamic equilibrium A situation in which the composition of a constant concentration reaction mixture does not change because both forward and backward reactions are proceeding at the same rate.

E

Electron density The probability of electrons being found in a particular volume of space.

Electron pair repulsion theory A theory which explains the shapes of simple molecules by assuming that pairs of electrons around a central atom repel each other and thus take up positions as far away as possible from each other in space.

Electronegativity The power of an atom to attract the electrons in a covalent bond.

Electrophile An electron-deficient atom, ion or molecule that takes part in an organic reaction by attacking areas of high electron density in another reactant.

Electrophilic addition A reaction in which a carbon–carbon double bond is saturated, by the carbon–carbon double bond attacking an electrophile.

Electrostatic forces The forces of attraction and repulsion between electrically charged particles.

Elimination A reaction in which an atom or group of atoms is removed from a reactant.

Empirical formula The simplest whole number ratio of atoms of each element in a compound.

Endothermic Describes a reaction in which heat is taken in as the reactants change to products; the temperature thus drops.

Enthalpy change A measure of heat energy given out or taken in when a chemical or physical change occurs at constant pressure.

Enthalpy diagrams Diagrams in which the enthalpies (energies) of the reactants and products of a chemical reaction are plotted on a vertical scale to show their relative levels.

Equilibrium mixture The mixture of reactants and products formed when a reversible reaction is allowed to proceed in a closed container until no further change occurs. The forward and backward reactions are still proceeding but at the same rate.

Exothermic Describes a reaction in which heat is given out as the reactants change to products; the temperature thus rises.

F

Fingerprint region The area of an infra-red spectrum below about 1500 cm^{-1}. It is caused by complex vibrations of the whole molecule and is characteristic of a particular molecule.

Fraction A mixture of hydrocarbons collected over a particular range of boiling points during the fractional distillation of crude oil.

Free radical A chemical species with an unpaired electron – usually highly reactive.

Functional group An atom or group of atoms in an organic molecule which is responsible for the characteristic reactions of that molecule.

G

Group A vertical column of elements in the periodic table. The elements have similar properties because they have the same outer electron arrangement.

H

Half equation An equation for a redox reaction which considers just one of the species involved and shows explicitly the electrons transferred to or from it.

Homologous series A set of organic compounds with the same functional group. The compounds differ in the length of their hydrocarbon chains.

Hydrogen bonding A type of intermolecular force in which a hydrogen atom ($H^{\delta+}$) interacts with a more electronegative atom with a δ− charge.

I

Incomplete combustion A combustion reaction in which there is insufficient oxygen for all the carbon in the fuel to burn to carbon dioxide. Carbon monoxide and/or carbon (soot) are formed.

Ionic bonding Describes a chemical bond in which an electron or electrons are transferred from one atom to another, resulting in the formation of oppositely charged ions with electrostatic forces of attraction between them.

Ionisation energy The energy required to remove a mole of electrons from a mole of isolated gaseous atoms or ions.

Isomer One of two (or more) compounds with the same molecular formula but different arrangement of atoms in space.

K

Ketone An organic compound with the general formula R_2CO in which there is a C=O double bond.

L

Lattice A regular three-dimensional arrangement of atoms, ions or molecules.

Leaving group In an organic substitution reaction, the leaving group is an atom or group of atoms that is ejected from the starting material, normally taking with it an electron pair and forming a negative ion.

Lone pair A pair of electrons in the outer shell of an atom that is not involved in bonding.

M

Maxwell–Boltzmann distribution The distribution of energies (and therefore speeds) of the molecules in a gas or liquid.

Mean bond enthalpy The average value of the bond dissociation enthalpy for a given type of bond taken from a range of different compounds.

Metallic bonding Describes a chemical bond in which outer electrons are delocalised within the lattice of metal ions.

Mole A quantity of a substance that contains the Avogadro number (6.022×10^{23}) of particles (e.g., atoms, molecules or ions).

Molecular formula A formula that tells us the actual numbers of atoms of each different element that make up a molecule of a compound.

Molecular ion In mass spectrometry this is a molecule of the sample which has been ionised but which has not broken up during its flight through the instrument.

Monomer A small molecule that combines with many other monomers to form a polymer.

N

Nucleons Protons and neutrons – the sub-atomic particles found in the nuclei of atoms.

Nucleophile An ion or group of atoms with a negative charge or a partially negatively-charged area that takes part in an organic reaction by attacking an electron-deficient area in another reactant.

Nucleophilic substitution An organic reaction in which a molecule with a partially positively charged carbon atom is attacked by a reagent with a negative charge or partially negatively charged area (a nucleophile). It results in the replacement of one of the groups or atoms on the original molecule by the nucleophile.

Nucleus The tiny, positively charged centre of at atom composed of protons and neutrons.

O

Oxidation A reaction in which an atom or group of atoms loses electrons.

Oxidation state The number of electrons lost or gained by an atom in a compound compared to the uncombined atom. It forms the basis of a way of keeping track of redox (electron transfer) reactions. Also called oxidation number.

Oxidising agent A reagent that oxidises (removes electrons from) another species.

P

Percentage yield In a chemical reaction this is the actual amount of product produced divided by the theoretical amount (predicted from the chemical equation) expressed as a percentage.

Period A horizontal row of elements in the periodic table. There are trends in the properties of the elements as we cross a period.

Periodicity The regular recurrence of the properties of elements when they are arranged in atomic number order as in the periodic table.

Polar Describes a molecule in which the charge is not symmetrically distributed so that one area is slightly positively charged and another slightly negatively charged.

Positive inductive effect Describes the tendency of some atoms or groups of atoms to release electrons via a covalent bond.

Proton number The number of protons in the nucleus of an atom; the same as the atomic number.

R

Redox reaction Short for reduction–oxidation reaction, it describes reactions in which electrons are transferred from one species to another.

Reducing agent A reagent that reduces (adds electrons to) another species.

Reduction A reaction in which an atom or group of atoms gain electrons.

Relative atomic mass, A_r

$$A_r = \frac{\text{average mass of an atom}}{\frac{1}{12}\text{th mass of 1 atom of } {}^{12}\text{C}}$$

Relative formula mass, M_r

$$M_r = \frac{\text{average mass of an entity}}{\frac{1}{12}\text{th mass of 1 atom of } {}^{12}\text{C}}$$

Relative molecular mass M_r

$$M_r = \frac{\text{average mass of a molecule}}{\frac{1}{12}\text{th mass of 1 atom of } {}^{12}\text{C}}$$

S

Saturated hydrocarbon A compound containing only hydrogen and carbon with only C—C and C—H single bonds, i.e. one to which no more hydrogen can be added.

Specific heat capacity *c* The amount of heat needed to raise the temperature of 1 g of substance by 1 K.

Spectator ions Ions that are unchanged during a chemical reaction, that is, they take no part in the reaction.

Standard molar enthalpy change of combustion $\Delta_c H^{\ominus}$ The enthalpy change when 1 mole of a substance I completely burned in oxygen with all reactants and products in their standard states (298 K and 100 kPa).

Standard molar enthalpy change of formation $\Delta_f H^{\ominus}$ The enthalpy change when 1 mole of substance is formed from its elements with all reactants and products in their standard states (298 K and 100 kPa).

Stereoisomer Isomers with the same molecular formula and the same structure, but a different position of atoms in space.

Stoichiometry Describes the simple whole number ratios in which chemical species react.

Strong nuclear force The force that holds protons and neutrons together within the nucleus of the atom.

Structural formula A way of writing the formula of an organic compound in which bonds are not shown but each carbon atom is written separately with the atoms or groups of atoms attached to it.

Structural isomer Isomers with the same molecular formula but a different structure.

T

Thermochemical cycle A sequence of chemical reactions (with their enthalpy changes) that convert a reactant into a product. The total enthalpy change of the sequence of reactions will be the same as that for the conversion of the reactant to the product directly (or by any other route).

V

van der Waals force A type of intermolecular force of attraction that is caused by instantaneous dipoles and acts between all atoms and molecules.