

GCE



Revised GCE  
Support Material  
**Chemistry**

Clarification of terms

AS and A2 Effective from September 2016





## Acceptable Definitions

The current specification has several definitions. It is not the function of the specification to actually define every term that is mentioned.

Most examinations ask for some explanation of the terms used in the specification. When such a question is asked the term is usually listed in bold type.

In order to improve the answers to such questions a list of definitions has been produced using all of the terms in the specification. The list was made using current text books. It may be that some definitions are not commonly found in text books either because an explanation is used or, sometimes, that the definition is not featured.

It should be borne in mind that QCA has no influence in the production of definitions. Some examination boards either produce their own sponsored text book or they recommend a series of text books which include definitions.

The list of definitions produced is an indication of what might be expected in an examination. Some definitions are short and some are long. It is not expected that every word in a definition be reproduced exactly in an examination. At all times examiners will exercise discretion in what marks to award for the definitions supplied by candidates.

It is not expected that the definitions supplied will have errors within them and it is not intended that there will be debate on the definitions supplied. However, if there are errors or questions to be asked please contact:

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## AS1

Specification Reference	Concept/Term	Essential points
1.1.1	Molecular ion	Two or more atoms covalently bonded with an overall charge
1.1.4	Avogadro constant (Avogadro's constant)	Number of atoms in 12.000g of carbon-12.
1.1.4	Mole	The amount of substance which contains the Avogadro constant of atoms, molecules or groups of ions.
1.1.4	Molar mass	The mass of one mole of a substance.
1.1.7	Anhydrous (salt)	A salt which contains no water of crystallisation.
1.1.7	Hydrated (salt)	A salt which contains water of crystallisation.
1.1.7	Water of crystallisation	Water chemically bonded within a crystal structure.
1.2.2	Atomic number	The number of protons in (the nucleus of) an atom.
1.2.2	Mass number	The total number of protons and neutrons in (the nucleus of) an atom.
1.2.3	Relative atomic mass (RAM)	The average (weighted mean) mass of an atom of an element relative to one-twelfth of the mass of an atom of carbon-12.
1.2.3	Relative isotopic mass (RIM)	The mass of an atom of an isotope of an element relative to one-twelfth of the mass of an atom of carbon-12.
1.2.4	Isotopes	Atoms which have the same atomic number but a different mass number (contain the same number of protons but a different number of neutrons).
1.2.5	Relative formula mass (RFM)	The average (weighted mean) mass of a formula unit relative to one-twelfth of the mass of an atom of carbon-12.
1.2.5	Relative molecular mass (RMM)	The average (weighted mean) mass of a molecule relative to one-twelfth of the mass of an atom of carbon-12.
1.2.11	First ionisation energy	The energy required to convert one mole of gaseous atoms into gaseous ions with a single positive charge.
1.2.11	Second ionisation energy	The energy required to convert one mole of gaseous ions with a single positive charge into gaseous ions with a double positive charge.
1.2.11	Third ionisation energy	The energy required to convert one mole of gaseous ions with a double positive charge into gaseous ions with a triple positive charge.
1.3.3	Covalent bond	The electrostatic attraction between a shared pair of electrons and the nuclei of bonded atoms.
1.3.5	Co-ordinate (Dative) bond	A shared pair of electrons between two atoms. One atom provides both electrons.

Specification Reference	Concept/Term	Essential points
1.3.7	Octet rule	When reacting, an atom tends to gain, lose or share electrons to achieve eight in its outer shell.
1.3.8	Electronegativity	The extent to which an atom attracts the bonding electrons in a covalent bond.
1.3.9	Polar bond	A covalent bond in which there is unequal sharing of the bonding electrons.
1.3.10	Delocalised electrons	Outer electrons do not have fixed positions but move freely.
1.4.1	Intermolecular	Between neighbouring molecules (as opposed to intramolecular).
1.4.1	van der Waals' forces	The attraction between instantaneous and induced dipoles on neighbouring molecules.
1.4.1	Permanent dipole-dipole attraction	Attraction between the positive end, $\delta^+$ , of the permanent dipole on a molecule with the negative end, $\delta^-$ , of the permanent dipole of a neighbouring molecule.
1.4.1	Hydrogen bond	The attraction between a lone pair of electrons on a very electronegative atom (i.e. N,O, F) in one molecule and a hydrogen atom in a neighbouring molecule, in which the hydrogen atom is covalently bonded to a very electronegative atom (N,O,F).
1.7.2	Redox	Oxidation and reduction occur in the same reaction.
1.7.2	Oxidation	Loss of electrons/Increase in oxidation state.
1.7.2	Reduction	Gain of electrons/Decrease in oxidation state.
1.7.3	Oxidising agent	Electron acceptor
1.7.3	Reducing agent	Electron donor
1.7.4	Disproportionation	Oxidation and reduction of the same element in the same reaction.
1.9.1	Strong acid/base	Fully dissociates in solution.
1.9.1	Weak acid base	Partially dissociates in solution.
1.9.7	Molarity	Concentration in mol dm <sup>-3</sup> expressed using M.
1.9.7	Concentration	Number of moles or mass present in a stated volume.
1.9.8	Standard solution	A solution for which the concentration is known.

## AS2

Specification Reference	Concept/Term	Essential points
2.1.1	Empirical formula	A formula which shows the simplest whole number ratio of atoms of each element in a compound.
2.1.1	Molecular formula	A formula which shows the actual number of atoms of each element in a molecule.
2.1.3	Molar gas volume	The volume of one mole of gas under specified conditions of temperature and pressure e.g. 24 dm <sup>3</sup> at 20 °C (293K) and one atmosphere pressure.
2.1.4	Percentage yield	$\frac{\text{actual yield}}{\text{theoretical yield}} \times 100$
2.1.6	Atom economy	$\frac{\text{mass of desired product}}{\text{total mass of products}} \times 100$
2.2.1	Homologous series	Compounds which have the same general formula, similar chemical properties, show a gradation in physical properties and successive members differ by a CH <sub>2</sub> unit.
2.2.1	Functional group	Reactive group within a compound.
2.2.1	Structural isomers	Molecules which have the same molecular formula but a different structural formula.
2.2.1	Geometric isomers	Molecules with the same structural formula, but different arrangement of atoms due to the presence of one or more C=C bond.
2.3.1	Saturated hydrocarbon	Contains no C=C or C≡C bond.
2.3.1	Hydrocarbon	Contains hydrogen and carbon only.
2.3.8	Substitution	Replacing one atom or group with a different atom or group.
2.3.9	Homolytic fission	Bond breaking in which one of the shared electrons goes to each atom.
2.3.9, 2.4.7	Heterolytic fission	Bond breaking in which both electrons in the shared pair go to a single atom.
2.3.9	Radical	A particle with an unpaired electron.
2.4.1	Unsaturated hydrocarbon	Contains at least one C=C or C≡C bond.
2.4.3	Sigma bond	A covalent bond formed by the linear overlap of atomic orbitals.
2.4.3	Pi bond	A covalent bond formed by the sideways overlap of p orbitals.
2.4.3	Bond length	The distance between the nuclei of two covalently bonded atoms.

Specification Reference	Concept/Term	Essential points
2.4.5	Hydrogenation	Addition of a hydrogen molecule across a C=C.
2.4.7	Electrophile	An ion or molecule that attacks regions of high electron density.
2.4.9	Primary carbocation	A carbocation which has one carbon atom directly bonded to the positively charged carbon.
2.4.9	Secondary carbocation	A carbocation which has two carbon atoms directly bonded to the positively charged carbon.
2.4.9	Tertiary carbocation	A carbocation which has three carbon atoms directly bonded to the positively charged carbon.
2.4.10	Polymerisation	Joining together of many small molecules (monomers) to form a large molecule.
2.4.10	Monomers	Many small molecules which join together to form a polymer.
2.4.10	Polymer	A large molecule formed when monomers join together.
2.5.3	Primary halogenoalkane	A halogenoalkane which has one carbon atom directly bonded to the carbon atom that is bonded to the halogen. (Exceptions are halomethanes.)
2.5.3	Secondary halogenoalkane	A halogenoalkane which has two carbon atoms directly bonded to the carbon atom that is bonded to the halogen.
2.5.3	Tertiary halogenoalkane	A halogenoalkane which has three carbon atoms directly bonded to the carbon atom that is bonded to the halogen.
2.5.4	Reflux	Repeated boiling and condensing of a (reaction) mixture.
2.5.5	Hydrolysis	Breaking up molecules by reaction with water.
2.5.6	Nucleophile	An ion or molecule, with a lone pair of electrons, that attacks regions of low electron density.
2.5.8	Elimination	A reaction in which a small molecule is removed from a larger molecule.
2.6.1	Miscibility	Liquids which mix in all proportions i.e. form a single layer.
2.6.2	Primary alcohol	An alcohol which has one carbon atom directly bonded to the carbon atom that is bonded to the –OH group. (Exception is methanol.)
2.6.2	Secondary alcohol	An alcohol which has two carbon atoms directly bonded to the carbon atom that is bonded to the –OH group.
2.6.2	Tertiary alcohol	An alcohol which has three carbons atoms directly bonded to the carbon atom that is bonded to the –OH group.
2.7.1	Ground state (infrared spectroscopy)	A molecular vibration which is in the lowest possible energy state

Specification Reference	Concept/Term	Essential points
2.7.3	Wavenumber	The reciprocal of the wavelength and it is measured in $\text{cm}^{-1}$ .
2.8.1	Endothermic	A reaction in which the enthalpy of the products is greater than the enthalpy of the reactants.
2.8.1	Exothermic	A reaction in which the enthalpy of the products is less than the enthalpy of the reactants.
2.8.2	Standard conditions	298K and 100kPa.
2.8.3	Standard enthalpy change	Change in heat energy at constant pressure, measured at standard conditions.
2.8.5	Standard enthalpy of combustion	The enthalpy change when one mole of a substance is completely burnt in oxygen under standard conditions.
2.8.5	Standard enthalpy of formation	The enthalpy change when one mole of a compound is formed from its elements under standard conditions.
2.8.5	Standard enthalpy of neutralisation	The enthalpy change when one mole of water is produced in a neutralisation reaction under standard conditions.
2.8.8	Conservation of energy	Energy cannot be created or destroyed but it can change from one form to another.
2.8.8	Hess's Law	The enthalpy change for a reaction is independent of the route taken, provided the initial and final conditions are the same.
2.8.11	Average bond enthalpy	The energy required to break one mole of a given bond averaged over many compounds.
2.9.1	Reaction rate	The change of the concentration (amount) of a reactant or product with respect to time.
2.9.1	Catalyst	A substance which increases the rate of a chemical reaction but does not get used up.
2.9.2	Activation energy	The minimum amount of energy required for a reaction to occur.
2.10.1	Reversible	A reaction which goes in both the forward and backward directions.
2.10.1	Dynamic (equilibria)	Rate of forward reaction is equal to the rate of the backward reaction.
2.10.1	Equilibrium	A reversible reaction in which the amount of each reactant / product remains constant.

Specification Reference	Concept/Term	Essential points
2.10.1	Homogeneous	A reaction in which all the reactants and products are in the same physical state.
2.10.2	Heterogeneous (equilibria)	A reaction in which all the reactants and products are not in the same physical state.
2.10.4	$K_c$	$K_c = \frac{[C]^c[D]^d}{[A]^a[B]^b}$ <p>for a reaction in the format  <math>aA + bB \rightleftharpoons cC + dD</math></p>
2.10.5	Heterogeneous (catalyst)	The catalyst is in a different phase from the reactants.
2.11.1	s-block element	An element which has an atom with highest energy/outer electron in an s-subshell (orbital).
2.11.8	Solubility	The maximum mass of solute that will dissolve in 100 g of solvent at a stated temperature.

## A21

Specification Reference	Concept/Term	Essential points
4.1.1	Lattice enthalpy	The enthalpy change when one mole of an ionic compound is converted to gaseous ions.
4.1.2	Enthalpy of atomisation	The enthalpy change when one mole of gaseous atoms is formed from the element in its standard state.
4.1.2	First electron affinity	The enthalpy change when one mole of gaseous atoms is converted into gaseous ions with a single negative charge.
4.1.3	Enthalpy of solution	The enthalpy change when one mole of a solute dissolves in water.
4.1.3	Enthalpy of hydration	The enthalpy change when one mole of gaseous ions is converted to one mole of aqueous ions.
4.2.2 4.2.6	Feasible	A reaction for which $\Delta G < 0$ .
4.2.3	Entropy	A measure of disorder (randomness).
4.2.5	Free energy change ( $\Delta G$ )	$\Delta G = \Delta H - T\Delta S$
4.3.2	Rate of reaction	The change of the concentration (amount) of a reactant or product with respect to time
4.3.2	Order of reaction (with respect to a reactant)	The power to which the concentration of a reactant is raised in the rate equation.
4.3.2	Order of reaction (overall)	The sum of the powers to which the concentration terms are raised in the rate equation.
4.3.2	Rate constant	The proportionality constant which links the rate of the reaction to the concentrations in the rate equation.
4.3.6	Rate determining step	The slowest step in the mechanism of a reaction.
4.5.1	Brønsted acid	Proton donor.
4.5.1	Brønsted base	Proton acceptor.
4.5.2	$K_w$	$K_w = [H^+][OH^-]$
4.5.2	$K_a$	$K_a = \frac{[H^+][A^-]}{[HA]}$
4.5.2	pH	$pH = -\log_{10}[H^+]$
4.5.2	$pK_w$	$pK_w = -\log_{10}K_w$
4.5.4	Buffer solution	A solution which resists changes in pH on addition of small amounts of acid or alkali.

Specification Reference	Concept/Term	Essential points
4.5.5	Monobasic acid	Donates one proton per molecule.
4.6.2	Asymmetric (chiral) centre	An atom which has four different atoms or groups attached.
4.6.4	Optical isomers	Molecules which exist as non-superimposable mirror images.
4.6.5	Optically active	A sample which rotates the plane of plane polarised light.
4.6.5	Racemic mixture	A 50:50 mixture of two optical isomers.
4.9.2	Monoester	An ester which contains only one ester group.
4.9.7	Transesterification	A reaction where the alkyl group of an ester is exchanged with the alkyl group of an alcohol.
4.9.7	Biodiesel	A fuel, similar to diesel, which is made from vegetable sources. e.g. from the reaction of rape seed oil with methanol.
4.10.1	Delocalisation (arenes)	The $\pi$ electrons are spread over several atoms.

## A22

Specification Reference	Concept/Term	Essential points
5.1.1	Base peak	Peak of greatest abundance in a mass spectrum.
5.1.1	Molecular ion peak	A peak produced by an ion formed by the removal of one electron from a molecule.
5.1.1	M+1 peak	A peak produced by a molecular ion with an increased mass due to the presence of one carbon-13 atom.
5.1.1	Fragmentation ion	A positively charged ion produced when the molecular ion breaks apart.
5.2.1	Low resolution nmr	A spectrum which does not show the spin-spin splitting pattern.
5.2.1	High resolution nmr	A spectrum which does show the spin-spin splitting pattern.
5.2.6	Doublet	A signal which appears as a pair of lines of equal intensity
5.2.6	Triplet	A signal which appears as three lines in the approximate intensity ratio (1:2:1)
5.2.6	Quartet	A signal which appears as four lines in the approximate intensity ratio (1:3:3:1)
5.3.4	Back titration	Method where an excess of a reagent is reacted with a sample. The unreacted reagent is then determined by titration.
5.4.1	R <sub>f</sub> values	Retardation factor, this is calculated using the expression: $R_f = \frac{\text{Distance moved by spot}}{\text{Distance moved by solvent}}$
5.4.2	Retention time	The time taken from injection until a component reaches the detector.
5.5.1	Transition metal	An element which forms at least one stable ion with a partially filled d-subshell.
5.5.3	Complex	A central metal atom or ion with ligands bonded by co-ordinate bonds.
5.5.4	Ligand	An ion or molecule with a lone pair of electrons which forms a co-ordinate bond with a central metal atom or ion in a complex.
5.5.5	Co-ordination number	The number of co-ordinate bonds to a central metal atom or ion in a complex.
5.5.7	Monodentate	A ligand which uses only one lone pair of electrons to form a co-ordinate bond with a central metal atom or ion in a complex.

Specification Reference	Concept/Term	Essential points
5.5.7	Bidentate	A ligand which uses two lone pairs of electrons to form two co-ordinate bonds with a central metal atom or ion in a complex.
5.5.7	Polydentate	A ligand which uses many lone pairs of electrons to form more than two co-ordinate bonds with a central metal atom or ion in a complex.
5.6.1	Standard electrode potential	The potential difference measured when a half-cell is connected to the standard hydrogen electrode under standard conditions.
5.6.2	e.m.f.	The potential difference measured when two half-cells are connected.
5.7.1	Primary amine	Only one carbon atom directly bonded to the nitrogen atom and therefore has the (-NH <sub>2</sub> ) group.
5.7.1	Secondary amine	Two carbon atoms directly bonded to the $\begin{array}{c}   \\ \text{—NH} \end{array}$ nitrogen atom i.e. —NH
5.7.1	Tertiary amine	Three carbon atoms directly bonded to the $\begin{array}{c}   \\ \text{—N} \\   \end{array}$ nitrogen atom i.e. —N
5.7.8	Coupling	A reaction in which two benzene rings are linked together through an azo (-N=N-) group.
5.8.3	Dehydration of amides	A reaction which involves the elimination of water from the amide.
5.9.3	Zwitterions	Ions which have a permanent positive and negative charge but which are neutral overall.
5.9.6	Primary structure (protein)	Sequence of amino acids joined by peptide links in the chain.
5.9.6	Secondary structure (protein)	The twisting/coiling of the chain to form a $\beta$ -pleated sheet/ $\alpha$ -helix by intramolecular hydrogen bonding.
5.9.6	Tertiary structure (protein)	The bending/folding of the secondary structure to give a precise 3D shape held together by hydrogen bonding/disulfide bridges/ionic interactions/van der Waals' forces.
5.9.7	Enzyme	A protein which is a biological catalyst.
5.9.7	Active site	The site on the surface of the enzyme into which the substrate fits.
5.9.7	Induced fit	The substrate induces a change of shape of the active site of the

<b>Specification Reference</b>	<b>Concept/Term</b>	<b>Essential points</b>
		enzyme.
<b>5.10.1</b>	Condensation polymers	Polymers formed by the elimination of small molecules such as water or hydrogen chloride when monomers bond together.
<b>5.10.4</b>	Biodegradable polymer	A polymer which can be hydrolysed by the action of microorganisms.
<b>5.11.5</b>	DNA replication	The process by which a double stranded DNA molecule is copied to produce two identical DNA molecules.
<b>5.11.8</b>	GLC-MS	A gas liquid chromatograph attached to a mass spectrometer.
<b>5.11.10</b>	Sequestering	The formation of a complex so that an ion is no longer available for reactions.



