AQA AS-LEVEL CHEMISTRY

SUMMARY OF CONTENT NEEDED FOR PAPER 1

Topic 1 – Atomic Structure and the Periodic Table (Paper 1 only)

Topic 2 – Amount of Substance (both Papers)

Topic 3 – Structure, Bonding and the Periodic Table (both Papers unless stated)

Topic 4 – Energetics (both Papers)

Topic 5 – How Far How Fast? (both Papers unless stated)

Topic 6 – Redox Reactions and Group Chemistry (Paper 1 only)

Topic 1 – Atomic Structure and the Periodic Table (Paper 1 only)

* I can appreciate that knowledge and understanding of atomic structure has evolved over time
* I can describe the relative charge and relative mass of protons, neutrons and electrons
* I can describe an atom as consisting of a nucleus containing protons and neutrons surrounded by electrons
* I can define mass number (*A*) and atomic (proton) number (*Z*)
* I can determine the number of fundamental particles in atoms and ions using mass number, atomic number and charge
* I can explain the existence of isotopes
* I can explain that the mass of atoms and molecules can be measured to a high degree of accuracy in a mass spectrometer
* I can explain how the mass spectrometer gives accurate information about relative isotopic mass and also about the relative abundance of isotopes
* I can use simple mass spectra of elements to identify elements and to calculate relative atomic mass from isotopic abundance, limited to mononuclear ions
* I can use mass spectra of molecules to determine relative molecular mass
* I can explain the principles of operation of a simple time of flight (TOF) mass spectrometer, limited to electrospray ionisation, acceleration to give all ions constant kinetic energy, ion drift, ion detection and data analysis
* I can write electron configurations of atoms and ions up to *Z* = 36 in terms of shells and sub-shells (orbitals) s, p and d
* I can explain that the chemical properties of elements depend on their atomic structure and in particular on the arrangement of electrons around the nucleus
* I can explain that the arrangement of electrons in orbitals is linked to the way in which elements are organised in the Periodic Table
* I can classify an element as s, p, d or f block according to its position in the Periodic Table, which is determined by its proton number
* I can define first ionization energy
* I can write equations for first and successive ionization energies
* I can *e*xplain how first and successive ionisation energies in Period 3 (Na–Ar) and in Group 2 (Be-Ba) give evidence for electron configuration in sub-shells and in shells.
* I can describe and explain the trends in atomic radius and first ionisation energy of the elements Na–Ar

Topic 2 – Amount of Substance (both Papers)

* I can describe the Avogadro constant as the number of particles in a mole and I can carry out calculations using the Avogadro constant
* I can use moles to describe the amount of electrons, atoms, molecules and ions in a formulas and in equations
* I can describe the concentration of a substance in solution, measured in mol dm–3
* I can carry out calculations using mass of substance, *M*r, and amount in moles
* I can carry out calculations using concentration, volume and amount of substance in a solution
* I can state the ideal gas equation *pV* = *nRT* with the variables in SI units
* I can use the ideal gas equation in calculations
* I can write balanced equations for reactions studied
* I can balance equations for unfamiliar reactions when reactants and products are specified
* I can use balanced equations to calculate masses, volumes of gases, and concentrations and volumes for reactions in solutions
* I can determine the number of moles of water of crystallisation in a hydrated salt by titration
* I can define empirical formula as the simplest whole number ratio of atoms of each element in a compound
* I can define molecular formula as the actual number of atoms of each element in a compound
* I can describe the relationship between empirical formula and molecular formula
* I can calculate empirical formula from data giving composition by mass or percentage by mass
* I can calculate molecular formula from the empirical formula and relative molecular mass
* I can define percentage atom economy as: molecular mass of desired product

sum of molecular masses of all reactants × 100

* I can explain the economic, ethical and environmental advantages for society and for industry of developing chemical processes with a high atom economy
* I can use balanced equations to calculate percentage atom economies
* I can use balanced equations to calculate percentage yields
* I can make up a volumetric solution and carry out a simple acid–base titration (Required Practical 1)

Topic 3 – Structure, Bonding and the Periodic Table (both Papers unless stated)

* I can describe ionic bonding involves electrostatic attraction between oppositely charged ions in a lattice
* I can recall the formulas of the compound ions sulfate, hydroxide, nitrate, carbonate and ammonium
* I can predict the charge on a simple ion using the position of the element in the Periodic Table
* I can construct formulas for ionic compounds
* I can describe the structure of sodium chloride as an example of an ionic structure
* I can describe metallic bonding as the attraction between delocalized electrons and positive ions arranged in a lattice
* I can describe the structure of sodium chloride as an example of an ionic structure
* I can describe the structure of magnesium as an example of a metallic structure
* I can relate the melting point and conductivity of materials to the type of structure and the bonding present
* I can explain the energy changes associated with changes of state
* I can draw diagrams to represent these structures involving specified numbers of particles
* I can describe a single covalent bond contains a shared pair of electrons, and multiple bonds as containing multiple pairs of electrons
* I can describe a co-ordinate (dative covalent) bond as a shared pair of electrons with both electrons supplied by one atom
* I can represent a covalent bond using a line and a co-ordinate bond using an arrow
* I can describe bonding pairs and lone (non-bonding) pairs of electrons as charge clouds that repel each other
* I can state that pairs of electrons in the outer shell of atoms arrange themselves as far apart as possible to minimise repulsion, that lone pair–lone pair repulsion is greater than lone pair–bond pair repulsion, which is greater than bond pair–bond pair repulsion
* I can state the effect of electron pair repulsion on bond angles
* I can explain the shapes of, and bond angles in, simple molecules and ions with up to six electron pairs (including lone pairs of electrons) surrounding the central atom
* I can describe electronegativity as the power of an atom to attract the pair of electrons in a covalent bond
* I can explain that the electron distribution in a covalent bond between elements with different electronegativities will be unsymmetrical, and that this produces a polar covalent bond, which may cause a molecule to have a permanent dipole
* I can use partial charges to show that a bond is polar
* I can explain why some molecules with polar bonds do not have a permanent dipole
* I can describe permanent dipole–dipole forces, induced dipole–dipole (van der Waals, dispersion, London) forces and hydrogen bonding as forces between molecules
* I can explain how the melting and boiling points of molecular substances are influenced by the strength of these intermolecular forces
* I can explain the importance of hydrogen bonding in the low density of ice and the anomalous boiling points of compounds
* I can explain the existence of these forces between familiar and unfamiliar molecules
* I can explain how melting and boiling points are influenced by these intermolecular forces
* I can describe macromolecular (giant covalent) structures using diamond and graphite as examples
* I can describe molecular structures using ice and iodine as examples
* I can relate the melting point and conductivity of materials to the type of structure and the bonding present
* I can describe the trends in melting point of the elements Na–Ar, and explain the melting point of the elements in terms of their structure and bonding (paper 1 only)

Topic 4 – Energetics (both Papers)

**for skills development**

* I can describe reactions can be endothermic or exothermic
* I can define enthalpy change (Δ*H*) as the heat energy change measured under conditions of constant pressure
* I can describe standard enthalpy changes as referring to standard conditions ie 100 kPa and a stated temperature (eg Δ*H*298 Ɵ)
* I can define standard enthalpy of combustion (Δc*H*Ɵ) and standard enthalpy of formation (Δf*H*Ɵ
* I can describe the heat change, *q*, in a reaction as given by the equation *q* = *mc*Δ*T* where *m* is the mass of the substance that has a temperature change Δ*T* and a specific heat capacity *c*
* I can use this equation to calculate the molar enthalpy change for a reaction
* I can use this equation in related calculations
* I can define Hess’ Law and use it to perform calculations, including calculation of enthalpy changes for reactions from enthalpies of combustion or from enthalpies of formation
* I can define the term mean bond enthalpy
* I can use mean bond enthalpies to calculate an approximate value of Δ*H* for reactions in the gaseous phase
* I can explain why values from mean bond enthalpy calculations differ from those determined using Hess’s law

Topic 5 – How Far How Fast? (both Papers unless stated)

**Content Opportunities for skills development**

* I can define the term rate of reaction (Paper 2 only)
* I can explain why most collisions to not lead to a reaction (Paper 2 only)
* I can explain that reactions can only occur when collisions take place between particles having sufficient energy, and that this energy is called the activation energy (Paper 2 only)
* I can define the term activation energy (Paper 2 only)
* I can describe the qualitative effect of changes in concentration, and a change in the pressure of a gas, on collision frequency and the rate of a reaction (Paper 2 only)
* I can interpret a Maxwell–Boltzmann distribution of molecular energies in gases (Paper 2 only)
* I can draw and interpret distribution curves for different temperatures (Paper 2 only)
* I can explain the qualitative effect of temperature changes on the rate of reaction (Paper 2 only)
* I can construct an expression for *K*c for a homogeneous system in equilibrium from the equation for a reversible reaction, representing the concentration, in mol dm–3, of a species X involved in the expression for *K*c as [X]
* I can calculate a value for *K*c from the equilibrium concentrations for a homogeneous system at constant temperature
* I can perform calculations involving *K*c
* I can state that the value of the equilibrium constant is not affected either by changes in concentration or addition of a catalyst
* I can predict the qualitative effects of changes of temperature on the value of *K*c
* I can use Le Chatelier’s principle to predict qualitatively the effect of changes in temperature, pressure and concentration on the position of equilibrium
* I can explain why, for a reversible reaction used in an industrial process, a compromise temperature and pressure may be used

Topic 6 – Redox Reactions and Group Chemistry (Paper 1 only)

* I can explain that redox reactions involve a transfer of electrons from the reducing agent to the oxidising agent
* I can define oxidation is the process of electron loss and oxidizing agents as electron acceptors
* I can define reduction as the process of electron gain and reducing agents as electron donors
* I can work out the oxidation state of an element in a compound or ion from the formula
* I can use the change in the oxidation state of an element in a compound or ion to identify the element that has been oxidised or reduced in a given reaction
* I can write separate half-equations for oxidation or reduction processes in redox reactions
* I can combine half-equations to give an overall equation for any redox reaction
* I can state that the elements in Group 2 are called the alkaline earth metals
* I can state and explain the trends in atomic radius, first ionisation energy of the elements Mg–Ba
* I can state and explain the trends in melting point of the elements Mg–Ba in terms of their structure and bonding
* I can write equations for reactions of the elements Mg–Ba with water
* I can describe the relative solubilities of the hydroxides and sulfates of the elements Mg–Ba in water; Mg(OH)2 is sparingly soluble; BaSO4 is insoluble
* I can explain how the trends in the solubilities of the hydroxides and the sulfates of these elements are linked to their use; Mg(OH)2 in medicine, Ca(OH)2 in agriculture, MgSO4 and BaSO4 in medicine
* I can explain why BaCl2 solution is used to test for sulfate ions and why it is acidified
* I can describe the use of CaO or CaCO3 to remove SO2 from flue gases
* I can describe the use of magnesium in the extraction of titanium from TiCl4
* I can describe the halogens in Group 7 as very reactive non-metals
* I can explain the trend in electronegativity in the halogens
* I can explain the trend in boiling point of the halogens in terms of their structure and bonding
* I can describe the trend in oxidising ability of the halogens down the group, including displacement reactions of halide ions in aqueous solution
* I can describe the trend in reducing ability of the halide ions, including the reactions of solid sodium halides with concentrated sulfuric acid
* I can describe the use of acidified silver nitrate solution to identify and distinguish between halide ions and explain why the silver nitrate solution is acidified
* I can explain the trend in solubility of the silver halides in ammonia and explain why ammonia solution is added after acidified silver nitrate
* I can describe the reaction of chlorine with water to form chloride ions and chlorate(I) ions
* I can describe the reaction of chlorine with water to form chloride ions and oxygen
* I can appreciate that society assesses the advantages and disadvantages when deciding if chemicals should be added to water supplies
* I can describe the use of chlorine in water treatment
* I can appreciate that the benefits to health of water treatment by chlorine outweigh its toxic effects
* I can describe reaction of chlorine with cold, dilute, aqueous NaOH and uses of the solution formed