2.1. Atoms and Reactions

2.1.1 Atomic structure and isotopes

(a) isotopes as atoms of the same element with different numbers of neutrons and different masses					
(b) atomic structure in terms of the numbers of protons, neutrons and electrons for atoms and ions, given the atomic number, mass number and any ionic charge					
(c) explanation of the terms relative isotopic mass (mass compared with 1/12th mass of carbon-12) and relative atomic mass (weighted mean mass compared with 1/12th mass of carbon-12), based on the mass of a ^{12}C atom, the standard for atomic masses					
(d) use of mass spectrometry in: **(i)** the determination of relative isotopic masses and relative abundances of the isotope, **(ii)** calculation of the relative atomic mass of an element from the relative abundances of its isotopes					
(e) use of the terms relative molecular mass, Mr, and relative formula mass and their calculation from relative atomic masses.					

2.1.2 Compounds, formulae and equations

(a) the writing of formulae of ionic compounds from ionic charges, including: **(i)** prediction of ionic charge from the position of an element in the periodic table **(ii)** recall of the names and formulae for the following ions: NO^{3-}, CO_3^{2-}, SO_4^{2-}, OH^-, NH_4^+, Zn^{2+} and Ag^+					
(b) construction of balanced chemical equations (including ionic equations), including state symbols, for reactions studied and for unfamiliar reactions given appropriate information.					

2.1.3 Amounts of substance

(a) explanation and use of the terms: **(i)** *amount of substance* **(ii)** *mole* (symbol 'mol'), as the unit for amount of substance **(iii)** the *Avogadro constant*, N_A (the number of particles per mole, 6.02×10^{23} mol^{-1}) **(iv)** *molar mass* (mass per mole, units g mol^{-1}), **(v)** *molar gas volume* (gas volume per mole, units dm^3 mol^{-1})					
(b) use of the terms: **(i)** *empirical formula* (the simplest whole number ratio of atoms of each element present in a compound) **(ii)** *molecular formula* (the number and type of atoms of each element in a molecule)					
(c) calculations of empirical and molecular formulae, from composition by mass or percentage compositions by mass and relative molecular mass					
(d) the terms *anhydrous*, *hydrated* and *water of crystallisation* and calculation of the formula of a hydrated salt from given percentage composition, mass composition or based on experimental results					
(e) calculations, using amount of substance in mol, involving: **(i)** mass **(ii)** gas volume **(iii)** solution volume and concentration					
(f) the ideal gas equation: $pV = nRT$					
(g) use of stoichiometric relationships in calculations					
(h) calculations to determine: **(i)** the percentage yield of a reaction or related quantities **(ii)** the atom economy of a reaction					
(i) the techniques and procedures required during experiments requiring the measurement of mass, volumes of solutions and gas volumes					

(j) the benefits for sustainability of developing chemical processes with a high atom economy.					

2.1.4 Acids

(a) the formulae of the common acids (HCl, H_2SO_4, HNO_3 and CH_3COOH) and the common alkalis ($NaOH$, KOH and NH_3) and explanation that acids release H^+ ions in aqueous solution and alkalis release OH^- ions in aqueous solution					
(b) qualitative explanation of strong and weak acids in terms of relative dissociations					
(c) neutralisation as the reaction of: **(i)** H^+ and OH^- to form H_2O **(ii)** acids with bases, including carbonates, metal oxides and alkalis (water-soluble bases), to form salts, including full equations					
(d) the techniques and procedures used when preparing a standard solution of required concentration and carrying out acid–base titrations					
(e) structured and non-structured titration calculations, based on experimental results of familiar and non-familiar acids and bases.					
(f) describe the redox reactions of metals with dilute hydrochloric and dilute sulfuric acids					
(g) interpret and make predictions from redox equations in terms of oxidation numbers and electron loss/gain					

2.1.5 Redox

(a) rules for assigning and calculating oxidation number for atoms in elements, compounds and ions					
(b) writing formulae using oxidation numbers					
(c) use of a Roman numeral to indicate the magnitude of the oxidation number when an element may have compounds/ions with different oxidation numbers					
(d) oxidation and reduction in terms of: **(i)** electron transfer **(ii)** changes in oxidation number					
(e) redox reactions of metals with acids to form salts, including full equations **(see also 2.1.4 c)**					
(f) interpretation of redox equations in **(e)**, and unfamiliar redox reactions, to make predictions in terms of oxidation numbers and electron loss/ gain.					
(g) interpret and make predictions from redox equations in terms of oxidation numbers and electron loss/gain					