GCSE Pearson Edexcel Chemistry specification
Please note: EDEXCEL IGCSE is different so please use this
How to use:
The first second and third columns are to track your progress
Highlight where your strengths and weaknesses are
Remember this is all they can test you on in the exams!
Paper 1 - topics 1-5
Paper 2 - topics 1, 6, 7, 8, 9
Taken from
https://qualifications.pearson.com/content/dam/pdf/GCSE/Science/2016/Specification/gcse-chemistry-spec.pdf
Practicals are listed at the end (may be asked in exams)
Highlighted = higher tier only
Those that are ***italic*** for chemistry separate (not combined science)

Topic 1 key concepts

Topic	1st	2nd	3rd	Comments
1.1 Describe how the Dalton model of an atom has changed over time because of the discovery of subatomic particles				
1.2 Describe the structure of an atom as a nucleus containing protons and neutrons, surrounded by electrons in shells				
1.3 Recall the relative charge and relative mass of: a a proton b a neutron c an electron				
1.4 Explain why atoms contain equal numbers of protons and electrons				
1.5 Describe the nucleus of an atom as very small compared to the overall size of the atom				
1.6 Recall that most of the mass of an atom is concentrated in the nucleus				
1.7 Recall the meaning of the term mass number of an atom				
1.8 Describe atoms of a given element as having the same number of protons in the nucleus and that this number is unique to that element				
1.9 Describe isotopes as different atoms of the same element containing the same number of protons but different numbers of neutrons in their nuclei				
1.10 Calculate the numbers of protons, neutrons and electrons in atoms given the atomic number and mass number				
1.11 Explain how the existence of isotopes results in relative atomic masses of some elements not being whole numbers				
1.12 **Calculate the relative atomic mass of**				

an element from the relative masses and abundances of its isotopes				
1.13 Describe how Dmitri Mendeleev arranged the elements, known at that time, in a periodic table by using properties of these elements and their compounds				
1.14 Describe how Dmitri Mendeleev used his table to predict the existence and properties of some elements not then discovered				
1.15 Explain that Dmitri Mendeleev thought he had arranged elements in order of increasing relative atomic mass but this was not always true because of the relative abundance of isotopes of some pairs of elements in the periodic table				
1.16 Explain the meaning of atomic number of an element in terms of position in the periodic table and number of protons in the nucleus				
1.17 Describe that in the periodic table a elements are arranged in order of increasing atomic number, in rows called periods b elements with similar properties are placed in the same vertical columns called groups				
1.18 Identify elements as metals or non-metals according to their position in the periodic table, explaining this division in terms of the atomic structures of the elements				

1.19 Predict the electronic configurations of the first 20 elements in the periodic table as diagrams and in the form, for example 2.8.1				
1.20 Explain how the electronic configuration of an element is related to its position in the periodic table				
1.21 Explain how ionic bonds are formed by the transfer of electrons between atoms to produce cations and anions, including the use of dot and cross diagrams				
1.22 Recall that an ion is an atom or group of atoms with a positive or negative charge				
1.23 Calculate the numbers of protons, neutrons and electrons in simple ions given the atomic number and mass number				
1.24 Explain the formation of ions in ionic compounds from their atoms, limited to compounds of elements in groups 1, 2, 6 and 7				
1.25 Explain the use of the endings –ide and –ate in the names of compounds				
1.26 Deduce the formulae of ionic compounds (including oxides, hydroxides, halides, nitrates, carbonates and sulfates) given the formulae of the constituent ions				
1.27 Explain the structure of an ionic compound as a lattice structure a consisting of a regular arrangement of				

ions b held together by strong electrostatic forces (ionic bonds) between oppositely-charged ions				
1.28 Explain how a covalent bond is formed when a pair of electrons is shared between two atoms				
1.29 Recall that covalent bonding results in the formation of molecules				
1.30 Recall the typical size (order of magnitude) of atoms and small molecules				
1.31 Explain the formation of simple molecular, covalent substances, using dot and cross diagrams, including: a hydrogen b hydrogen chloride c water d methane e oxygen f carbon dioxide				
1.32 Explain why elements and compounds can be classified as: a ionic b simple molecular (covalent) c giant covalent d metallic and how the structure and bonding of these types of substances results in different physical properties, including relative melting point and boiling point, relative solubility in water and ability to conduct electricity (as solids and in solution)				
1.33 Explain the properties of ionic compounds limited to:				

a high melting points and boiling points, in terms of forces between ions b whether or not they conduct electricity as solids, when molten and in aqueous solution				
1.34 Explain the properties of typical covalent, simple molecular compounds limited to: a low melting points and boiling points, in terms of forces between molecules (intermolecular forces) b poor conduction of electricity				
1.35 Recall that graphite and diamond are different forms of carbon and that they are examples of giant covalent substances				
1.36 Describe the structures of graphite and diamond				
1.37 Explain, in terms of structure and bonding, why graphite is used to make electrodes and as a lubricant, whereas diamond is used in cutting tools				
1.38 Explain the properties of fullerenes including C60 and graphene in terms of their structures and bonding				
1.39 Describe, using poly(ethene) as the example, that simple polymers consist of large molecules containing chains of carbon atoms				

1.40 Explain the properties of metals, including malleability and the ability to conduct electricity				
1.41 Describe the limitations of particular representations and models, to include dot and cross, ball and stick models and two- and three-dimensional representations				
1.42 Describe most metals as shiny solids which have high melting points, high density and are good conductors of electricity whereas most non-metals have low boiling points and are poor conductors of electricity				
1.43 Calculate: a relative formula mass given relative atomic masses b percentage by mass of an element in a compound given relative atomic masses				
1.44 Calculate the formulae of simple compounds from reacting masses or percentage composition and understand that these are empirical formulae				
1.45 Deduce: a the empirical formula of a compound from the formula of its molecule b the molecular formula of a compound from its empirical formula and its relative molecular mass				
1.46 Describe an experiment to determine the empirical formula of a simple compound such as magnesium oxide				

1.47 Explain the law of conservation of mass applied to: a a closed system including a precipitation reaction in a closed flask b a non-enclosed system including a reaction in an open flask that takes in or gives out a gas				
1.48 Calculate masses of reactants and products from balanced equations, given the mass of one substance				
1.49 Calculate the concentration of solutions in g dm–3				
1.50 **Recall that one mole of particles of a substance is defined As:** **a the Avogadro constant number of particles (6.02 × 1023 atoms, molecules, formulae or ions) of that substance** **b a mass of 'relative particle mass' g**				
1.51 **Calculate the number of:** **a moles of particles of a substance in a given mass of that substance and vice versa** **b particles of a substance in a given number of moles of that substance and vice versa** **c particles of a substance in a given mass of that substance and vice versa**				

1.52 **Explain why, in a reaction, the mass of product formed is controlled by the mass of the reactant which is not in excess**				
1.53 **Deduce the stoichiometry of a reaction from the masses of the reactants and products**				

Topic 2 states of matter and mixtures

Topic	1st	2nd	3rd	Comments
2.1 Describe the arrangement, movement and the relative energy of particles in each of the three states of matter: solid, liquid and gas				
2.2 Recall the names used for the interconversions between the three states of matter, recognising that these are physical changes: contrasted with chemical reactions that result in chemical changes				
2.3 Explain the changes in arrangement, movement and energy of particles during these interconversions				
2.4 Predict the physical state of a substance under specified conditions, given suitable data				
2.5 Explain the difference between the use of ‘pure’ in chemistry compared with its everyday use and the differences in chemistry between a pure substance and a mixture				
2.6 Interpret melting point data to distinguish between pure substances which have a sharp melting point and mixtures which melt over a range of temperatures				

2.7 Explain the types of mixtures that can be separated by using the following experimental techniques: a simple distillation b fractional distillation c filtration d crystallisation e paper chromatography				
2.8 Describe an appropriate experimental technique to separate a mixture, knowing the properties of the components of the mixture				
2.9 Describe paper chromatography as the separation of mixtures of soluble substances by running a solvent (mobile phase) through the mixture on the paper (the paper contains the stationary phase), which causes the substances to move at different rates over the paper				
2.10 Interpret a paper chromatogram: a to distinguish between pure and impure substances b to identify substances by comparison with known substances c to identify substances by calculation and use of Rf values				
2.11 *Core Practical: Investigate the composition of inks using simple distillation and paper chromatography*				
2.12 Describe how: a waste and ground water can be made potable, including the need for sedimentation, filtration and chlorination b sea water can be made potable by using distillation c water used in analysis must not contain any dissolved salts				

Topic 3 chemical changes

Topic	1st	2nd	3rd	Comments
3.1 Recall that acids in solution are sources of hydrogen ions and alkalis in solution are sources of hydroxide ions				
3.2 Recall that a neutral solution has a pH of 7 and that acidic solutions have lower pH values and alkaline solutions higher pH values				
3.3 Recall the effect of acids and alkalis on indicators, including litmus, methyl orange and phenolphthalein				
3.4 **Recall that the higher the concentration of hydrogen ions in an acidic solution, the lower the pH; and the higher the concentration of hydroxide ions in an alkaline solution, the higher the pH** 3.5 **Recall that as hydrogen ion concentration in a solution increases by a factor of 10, the pH of the solution decreases by 1**				
3.6 *Core Practical: Investigate the change in pH on adding powdered calcium hydroxide* or *calcium oxide to a fixed volume of dilute hydrochloric acid*				
3.7 **Explain the terms dilute and concentrated, with respect to amount of substances in solution**				
3.8 **Explain the terms weak and strong acids, with respect to the degree of dissociation into ions**				
3.9 Recall that a base is any substance that reacts with an acid to form a salt and water only				
3.10 Recall that alkalis are soluble bases				
3.11 Explain the general reactions of aqueous solutions of acids with:				

a metals b metal oxides c metal hydroxides d metal carbonates to produce salts				
3.12 Describe the chemical test for: a hydrogen b carbon dioxide (using limewater)				
3.13 Describe a neutralisation reaction as a reaction between an acid and a base				
3.14 Explain an acid-alkali neutralisation as a reaction in which hydrogen ions (H+) from the acid react with hydroxide ions (OH–) from the alkali to form water				
3.15 Explain why, if soluble salts are prepared from an acid and an insoluble reactant: a excess of the reactant is added b the excess reactant is removed c the solution remaining is only salt and water				
3.16 Explain why, if soluble salts are prepared from an acid and a soluble reactant: a titration must be used b the acid and the soluble reactant are then mixed in the correct proportions c the solution remaining, after reaction, is only salt and water				
3.17 *Core Practical: Investigate the preparation of pure, dry hydrated copper sulfate crystals starting from copper oxide including the use of a water bath*				
3.18 Describe how to carry out an acid-alkali titration, using burette, pipette and a suitable indicator, to prepare a pure, dry salt				

3.19 Recall the general rules which describe the solubility of common types of substances in water: a all common sodium, potassium and ammonium salts are soluble b all nitrates are soluble c common chlorides are soluble except those of silver and lead d common sulfates are soluble except those of lead, barium and calcium e common carbonates and hydroxides are insoluble except those of sodium, potassium and ammonium				
3.20 Predict, using solubility rules, whether or not a precipitate will be formed when named solutions are mixed together, naming the precipitate if any				
3.21 Describe the method used to prepare a pure, dry sample of an insoluble salt				
3.22 Recall that electrolytes are ionic compounds in the molten state or dissolved in water				
3.23 Describe electrolysis as a process in which electrical energy, from a direct current supply, decomposes electrolytes				
3.24 Explain the movement of ions during electrolysis, in which: a positively charged cations migrate to the negatively charged cathode b negatively charged anions migrate to the positively charged anode				
3.25 Explain the formation of the products in the electrolysis, using inert electrodes, of some electrolytes, including:				

a copper chloride solution b sodium chloride solution c sodium sulfate solution d water acidified with sulfuric acid e molten lead bromide (demonstration)				
3.26 Predict the products of electrolysis of other binary, ionic compounds in the molten state				
3.27 **Write half equations for reactions occurring at the anode and cathode in electrolysis**				
3.28 **Explain oxidation and reduction in terms of loss or gain of electrons**				
3.29 **Recall that reduction occurs at the cathode and that oxidation occurs at the anode in electrolysis reactions**				
3.30 Explain the formation of the products in the electrolysis of copper sulfate solution, using copper electrodes, and how this electrolysis can be used to purify copper				
3.31 *Core Practical: Investigate the electrolysis of copper sulfate solution with inert electrodes and copper electrodes*				

Topic 4 extracting metals and equilibria

Topic	1st	2nd	3rd	Comments
4.1 Deduce the relative reactivity of some metals, by their reactions with water, acids and salt solutions				
4.2 **Explain displacement reactions as redox reactions, in terms of gain or loss of electrons**				
4.3 Explain the reactivity series of metals				

(potassium, sodium, calcium, magnesium, aluminium, (carbon), zinc, iron, (hydrogen), copper, silver, gold) in terms of the reactivity of the metals with water and dilute acids and that these reactions show the relative tendency of metal atoms to form cations				
4.4 Recall that: a most metals are extracted from ores found in the Earth's crust b unreactive metals are found in the Earth's crust as the uncombined elements				
4.5 Explain oxidation as the gain of oxygen and reduction as the loss of oxygen				
4.6 Recall that the extraction of metals involves reduction of ores				
4.7 Explain why the method used to extract a metal from its ore is related to its position in the reactivity series and the cost of the extraction process, illustrated by a heating with carbon (including iron) b electrolysis (including aluminium) (knowledge of the blast furnace is not required)				
4.8 **Evaluate alternative biological methods of metal extraction (bacterial and phytoextraction)**				
4.9 Explain how a metal's relative resistance to oxidation is related to its position in the reactivity series				
4.10 Evaluate the advantages of recycling metals, including economic implications and how recycling can preserve both the environment and the				

supply of valuable raw materials				
4.11 Describe that a life-cycle assessment for a product involves consideration of the effect on the environment of obtaining the raw materials, manufacturing the product, using the product and disposing of the product when it is no longer useful				
4.12 Evaluate data from a life cycle assessment of a product				
4.13 Recall that chemical reactions are reversible, the use of the symbol ⇌ in equations and that the direction of some reversible reactions can be altered by changing the reaction conditions				
4.14 Explain what is meant by dynamic equilibrium				
4.15 Describe the formation of ammonia as a reversible reaction between nitrogen (extracted from the air) and hydrogen (obtained from natural gas) and that it can reach a dynamic equilibrium				
4.16 Recall the conditions for the Haber process as: a temperature 450 °C b pressure 200 atmospheres c iron catalyst				
4.17 **Predict how the position of a dynamic equilibrium is affected by changes in:** **a temperature** **b pressure** **c concentration**				

Topic 5 separate chemistry

Topic	1st	2nd	3rd	Comments
5.1C Recall that most metals are transition metals and that their typical properties include: *a high melting point* *b high density* *c the formation of coloured compounds* *d catalytic activity of the metals and their compounds as exemplified by iron*				
5.2C Recall that the oxidation of metals results in corrosion				
5.3C Explain how rusting of iron can be prevented by: *a exclusion of oxygen* *b exclusion of water* *c sacrificial protection*				
5.4C Explain how electroplating can be used to improve the appearance and/or the resistance to corrosion of metal objects				
5.5C Explain, using models, why converting pure metals into alloys often increases the strength of the product				
5.6C Explain why iron is alloyed with other metals to produce alloy steels				
5.7C Explain how the uses of metals are related to their properties (and vice versa), including aluminium, copper and gold and their alloys including magnalium and brass				

5.8C ***Calculate the concentration of solutions in mol dm–3 and convert concentration in g dm–3 into mol dm–3 and vice versa***				
5.10C ***Carry out simple calculations using the results of titrations to calculate an unknown concentration of a solution or an unknown volume of solution required***				
5.11C Calculate the percentage yield of a reaction from the actual yield and the theoretical yield				
5.12C Describe that the actual yield of a reaction is usually less than the theoretical yield and that the causes of this include: *a incomplete reactions* *b practical losses during the experiment* *c competing, unwanted reactions (side reactions)*				
5.13C Recall the atom economy of a reaction forming a desired product				
5.14C Calculate the atom economy of a reaction forming a desired product				
5.15C ***Explain why a particular reaction pathway is chosen to produce a specified product, given appropriate data such as atom economy, yield, rate, equilibrium position and usefulness of by-products***				
5.16C ***Describe the molar volume, of any gas at room temperature and pressure, as the volume occupied by one mole of molecules of any gas at room temperature***				

and pressure ***(The molar volume will be provided as 24 dm3 or*** ***24000 cm3 in calculations where it is required)***				
5.17C ***Use the molar volume and balanced equations in calculations involving the masses of solids and volumes of gases***				
5.18C ***Use Avogadro's law to calculate volumes of gases involved in a gaseous reaction, given the relevant equation***				
5.19C Describe the Haber process as a reversible reaction between nitrogen and hydrogen to form ammonia				
5.20C ***Predict how the rate of attainment of equilibrium is affected by:*** ***a changes in temperature*** ***b changes in pressure*** ***c changes in concentration*** ***d use of a catalyst***				
5.21C ***Explain how, in industrial reactions, including the Haber process, conditions used are related to:*** ***a the availability and cost of raw materials and energy supplies*** ***b the control of temperature, pressure and catalyst*** ***used produce an acceptable yield in an acceptable*** ***time***				
5.22C Recall that fertilisers may contain nitrogen, phosphorus and potassium compounds to promote plant growth				

5.23C Describe how ammonia reacts with nitric acid to produce a salt that is used as a fertiliser				
5.24C Describe and compare: *a the laboratory preparation of ammonium sulfate from* *ammonia solution and dilute sulfuric acid on a small scale* *b the industrial production of ammonium sulfate, used as a* *fertiliser, in which several stages are required to produce* *ammonia and sulfuric acid from their raw materials and the* *production is carried out on a much larger scale (details of* *the industrial production of sulfuric acid are not required)*				
5.25C Recall that a chemical cell produces a voltage until one of the reactants is used up				
5.26C Recall that in a hydrogen–oxygen fuel cell hydrogen and oxygen are used to produce a voltage and water is the only product				
5.27C Evaluate the strengths and weaknesses of fuel cells for given uses				

Topic 6 groups of the periodic table

Topic	**1st**	**2nd**	**3rd**	**Comments**
6.1 Explain why some elements can be classified as alkali metals (group 1), halogens (group 7) or noble gases (group 0), based on their position in the periodic table				
6.2 Recall that alkali metals:				

a are soft b have relatively low melting points				
6.3 Describe the reactions of lithium, sodium and potassium with water				
6.4 Describe the pattern in reactivity of the alkali metals, lithium, sodium and potassium, with water; and use this pattern to predict the reactivity of other alkali metals				
6.5 Explain this pattern in reactivity in terms of electronic configurations				
6.6 Recall the colours and physical states of chlorine, bromine and iodine at room temperature				
6.7 Describe the pattern in the physical properties of the halogens, chlorine, bromine and iodine, and use this pattern to predict the physical properties of other halogens				
6.8 Describe the chemical test for chlorine				
6.9 Describe the reactions of the halogens, chlorine, bromine and iodine, with metals to form metal halides, and use this pattern to predict the reactions of other halogens				
6.10 Recall that the halogens, chlorine, bromine and iodine, form hydrogen halides which dissolve in water to form acidic solutions, and use this pattern to predict the reactions of other halogens				
6.11 Describe the relative reactivity of the halogens chlorine, bromine and iodine, as shown by their displacement reactions with halide ions in aqueous solution, and use this pattern to predict the reactions of astatine				

6.12 **Explain why these displacement reactions are redox reactions in terms of gain and loss of electrons, identifying which of the substances are oxidised and which are reduced**				
6.13 Explain the relative reactivity of the halogens in terms of electronic configurations				
6.14 Explain why the noble gases are chemically inert, compared with the other elements, in terms of their electronic configurations				
6.15 Explain how the uses of noble gases depend on their inertness, low density and/or non-flammability				
6.16 Describe the pattern in the physical properties of some noble gases and use this pattern to predict the physical properties of other noble gases				

Topic 7 Rates of reaction

Topic	1st	2nd	3rd	Comments
7.2 Suggest practical methods for determining the rate of a given reaction				
7.3 Explain how reactions occur when particles collide and that rates of reaction are increased when the frequency and/or energy of collisions is increased				
7.4 Explain the effects on rates of reaction of changes in temperature, concentration, surface area to volume ratio of a				

solid and pressure (on reactions involving gases) in terms of frequency and/or energy of collisions between particles				
7.5 Interpret graphs of mass, volume or concentration of reactant or product against time				
7.6 Describe a catalyst as a substance that speeds up the rate of a reaction without altering the products of the reaction, being itself unchanged chemically and in mass at the end of the reaction				
7.7 Explain how the addition of a catalyst increases the rate of a reaction in terms of activation energy				
7.8 Recall that enzymes are biological catalysts and that enzymes are used in the production of alcoholic drinks				
7.9 Recall that changes in heat energy accompany the following Changes: a salts dissolving in water b neutralisation reactions c displacement reactions d precipitation reactions and that, when these reactions take place in solution, temperature changes can be measured to reflect the heat changes				
7.10 Describe an exothermic change or reaction as one in which heat energy is given out				
7.11 Describe an endothermic change or reaction as one in which heat energy is taken in				
7.12 Recall that the breaking of bonds is endothermic and the making of bonds is				

exothermic				
7.13 Recall that the overall heat energy change for a reaction is: a exothermic if more heat energy is released in forming bonds in the products than is required in breaking bonds in the reactants b endothermic if less heat energy is released in forming bonds in the products than is required in breaking bonds in the reactants				
7.14 **Calculate the energy change in a reaction given the energies of bonds (in kJ mol–1)**				
7.15 Explain the term activation energy				
7.16 Draw and label reaction profiles for endothermic and exothermic reactions, identifying activation energy				

Topic 8 fuels and earth science

Topic	1st	2nd	3rd	Comments
8.1 Recall that hydrocarbons are compounds that contain carbon and hydrogen only				
8.2 Describe crude oil as: a a complex mixture of hydrocarbons b containing molecules in which carbon atoms are in chains or rings (names, formulae and structures of specific ring molecules not required) c an important source of useful substances (fuels and				

feedstock for the petrochemical industry) d a finite resource				
8.3 Describe and explain the separation of crude oil into simpler, more useful mixtures by the process of fractional distillation				
8.4 Recall the names and uses of the following fractions: a gases, used in domestic heating and cooking b petrol, used as fuel for cars c kerosene, used as fuel for aircraft d diesel oil, used as fuel for some cars and trains e fuel oil, used as fuel for large ships and in some power stations f bitumen, used to surface roads and roofs				
8.5 Explain how hydrocarbons in different fractions differ from each other in: a the number of carbon and hydrogen atoms their molecules contain b boiling points c ease of ignition d viscosity and are mostly members of the alkane homologous series				
8.6 Explain an homologous series as a series of compounds which: a have the same general formula b differ by CH2 in molecular formulae from neighbouring compounds c show a gradual variation in physical properties, as exemplified by their boiling points d have similar chemical properties				
8.7 Describe the complete combustion of hydrocarbon fuels as a reaction in which:				

a carbon dioxide and water are produced b energy is given out				
8.8 Explain why the incomplete combustion of hydrocarbons can produce carbon and carbon monoxide				
8.9 Explain how carbon monoxide behaves as a toxic gas				
8.10 Describe the problems caused by incomplete combustion producing carbon monoxide and soot in appliances that use carbon compounds as fuels				
8.11 Explain how impurities in some hydrocarbon fuels result in the production of sulfur dioxide				
8.12 Explain some problems associated with acid rain caused when sulfur dioxide dissolves in rain water				
8.13 Explain why, when fuels are burned in engines, oxygen and nitrogen can react together at high temperatures to produce oxides of nitrogen, which are pollutants				
8.14 Evaluate the advantages and disadvantages of using hydrogen, rather than petrol, as a fuel in cars				
8.15 Recall that petrol, kerosene and diesel oil are non-renewable fossil fuels obtained from crude oil and methane is a non-renewable fossil fuel found in natural gas				
8.16 Explain how cracking involves the breaking down of larger, saturated hydrocarbon molecules (alkanes) into smaller, more useful ones, some of which are unsaturated (alkenes)				

8.17 Explain why cracking is necessary				
8.18 Recall that the gases produced by volcanic activity formed the Earth's early atmosphere				
8.19 Describe that the Earth's early atmosphere was thought to Contain: a little or no oxygen b a large amount of carbon dioxide c water vapour d small amounts of other gases and interpret evidence relating to this				
8.20 Explain how condensation of water vapour formed oceans				
8.21 Explain how the amount of carbon dioxide in the atmosphere was decreased when carbon dioxide dissolved as the oceans formed				
8.22 Explain how the growth of primitive plants used carbon dioxide and released oxygen by photosynthesis and consequently the amount of oxygen in the atmosphere gradually increased				
8.23 Describe the chemical test for oxygen				
8.24 Describe how various gases in the atmosphere, including carbon dioxide, methane and water vapour, absorb heat radiated from the Earth, subsequently releasing energy which keeps the Earth warm: this is known as the greenhouse effect				
8.25 Evaluate the evidence for human activity causing climate change, considering:				

a the correlation between the change in atmospheric carbon dioxide concentration, the consumption of fossil fuels and temperature change b the uncertainties caused by the location where these measurements are taken and historical accuracy				
8.26 Describe: a the composition of today's atmosphere b the potential effects on the climate of increased levels of carbon dioxide and methane generated by human activity, including burning fossil fuels and livestock farming c that these effects may be mitigated: consider scale, risk and environmental implications				

Topic 9 quantitative analysis

Topic	1st	2nd	3rd	Comments
9.1C Explain why the test for any ion must be unique				
9.2C Describe flame tests to identify the following ions in solids: a lithium ion, Li+ (red) b sodium ion, Na+ (yellow) c potassium ion, K+ (lilac) d calcium ion, Ca2+ (orange-red) e copper ion, Cu2+ (blue-green)				
9.3C Describe tests to identify the following ions in solids or solutions as appropriate: a aluminium ion, Al3+ b calcium ion, Ca2+				

c copper ion, Cu^{2+} d iron(II) ion, Fe^{2+} e iron(III) ion, Fe^{3+} f ammonium ion, NH_4^+ using sodium hydroxide solution				
9.4C Describe the chemical test for ammonia				
9.5C Describe tests to identify the following ions in solids or solutions as appropriate: a carbonate ion, CO_3^{2-}, using dilute acid and identifying the carbon dioxide evolved b sulfate ion, SO_4^{2-} , using dilute hydrochloric acid and barium chloride solution c chloride ion, Cl^-, bromide ion, Br^-, iodide ion, I^-, using dilute nitric acid and silver nitrate solution				
9.7C Identify the ions in unknown salts, using results of the tests above				
9.8C Describe that instrumental methods of analysis are available and that these may improve sensitivity, accuracy and speed of tests				
9.9C Evaluate data from a flame photometer: a to determine the concentration of ions in dilute solution using a calibration curve b to identify metal ions by comparing the data with reference Data (no knowledge of the instrument or how it works is required)				
9.10C Recall the formulae of molecules of the alkanes, methane, ethane, propane and butane, and draw the structures of these molecules, showing all covalent bonds				
9.11C Explain why the alkanes are saturated				

hydrocarbons				
9.12C Recall the formulae of molecules of the alkenes, ethene, propene, butene, and draw the structures of these molecules, showing all covalent bonds (but-1-ene and but-2-ene only)				
9.13C Explain why the alkenes are unsaturated hydrocarbons, describing that their molecules contain the functional group C=C				
9.14C Recall the addition reaction of ethene with bromine, showing the structures of reactants and products, and extend this to other alkenes				
9.15C Explain how bromine water is used to distinguish between alkanes and alkenes				
9.16C Describe how the complete combustion of alkanes and alkenes involves the oxidation of the hydrocarbons to produce carbon dioxide and water				
9.17C Recall that a polymer is a substance of high average relative molecular mass made up of small repeating units				
9.18C Describe: a how ethene molecules can combine together in a polymerisation reaction b that the addition polymer formed is called poly(ethene) (conditions and mechanisms not required)				
9.19C Describe how other addition polymers can be made by combining together other monomer molecules containing C=C,				

to include poly(propene), poly(chloroethene) (PVC) and poly(tetrafluoroethene) (PTFE) (conditions and mechanisms not required)				
9.20C Deduce the structure of a monomer from the structure of an addition polymer and vice versa				
9.21C Explain how the uses of polymers are related to their properties and vice versa: including poly(ethene), poly(propene), poly(chloroethene) (PVC) and poly(tetrafluoroethene) (PTFE)				
9.22C **Explain:** **a why polyesters are condensation polymers** **b how a polyester is formed when a monomer molecule** **containing two carboxylic acid groups is reacted with a** **monomer molecule containing two alcohol groups** **c how a molecule of water is formed each time an ester link is formed**				
9.23C Describe some problems associated with polymers including The: a availability of starting materials b persistence in landfill sites, due to non-biodegradability c gases produced during disposal by combustion d requirement to sort polymers so that they can be melted and reformed into a new product				
9.24C Evaluate the advantages and disadvantages of recycling polymers, including economic implications, availability				

of starting materials and environmental impact				
9.25C Recall that: a DNA is a polymer made from four different monomers called nucleotides (names of nucleotides not required) b starch is a polymer based on sugars c proteins are polymers based on amino acids				
9.26C Recall the formulae of molecules of the alcohols, methanol, ethanol, propanol (propan-1-ol only) and butanol (butan-1-ol only), and draw the structures of these molecules, showing all covalent bonds				
9.27C Recall that the functional group in alcohols is –OH and that alcohols can be dehydrated to form alkenes				
9.29C Recall the formulae of molecules of the carboxylic acids, methanoic, ethanoic, propanoic and butanoic acids, and draw the structures of these molecules, showing all covalent bonds				
9.30C Recall that the functional group in carboxylic acids is –COOH and that solutions of carboxylic acids have typical acidic properties				
9.31C Recall that ethanol can be oxidised to produce ethanoic acid and extend this to other alcohols (reagents not required)				
9.32C Recall members of a given homologous series have similar reactions because their molecules contain the same functional				

group and use this to predict the products of other members of these series				
9.33C Describe the production of ethanol by fermentation of carbohydrates in aqueous solution, using yeast to provide enzymes				
9.34C Explain how to obtain a concentrated solution of ethanol by fractional distillation of the fermentation mixture				
9.35C Compare the size of nanoparticles with the sizes of atoms and molecules				
9.36C Describe how the properties of nanoparticulate materials are related to their uses including surface area to volume ratio of the particles they contain, including sunscreens				
9.37C Explain the possible risks associated with some nanoparticulate materials				
9.38C Compare, using data, the physical properties of glass and clay ceramics, polymers, composites and metals				
9.39C Explain why the properties of a material make it suitable for a given use and use data to select materials appropriate for specific uses				

Practicals

(see also practicals you have done in class for technique and reading data)

2.11 *Investigate the composition of inks using simple distillation and paper chromatography*

3.6 *Investigate the change in pH on adding powdered calcium hydroxide or calcium*

oxide to a fixed volume of dilute hydrochloric acid

3.17 *Investigate the preparation of pure, dry hydrated copper sulfate crystals starting from copper oxide including the use of a water bath*

3.31 *Investigate the electrolysis of copper sulfate solution with inert electrodes and copper electrodes*

5.9C Carry out an accurate acid-alkali titration, using burette, pipette and a suitable indicator

7.1 *Investigate the effects of changing the conditions of a reaction on the rates of chemical reactions by:*

a measuring the production of a gas (in the reaction between hydrochloric acid and marble chips)
b observing a colour change (in the reaction between sodium thiosulfate and hydrochloric acid)

9.6C Identify the ions in unknown salts, using the tests for the specified cations and anions in 9.2C, 9.3C, 9.4C, 9.5C

9.28C Investigate the temperature rise produced in a known mass of water by the combustion of the alcohols ethanol, propanol, butanol and pentanol

Students should:		Maths skills
0.1	Recall the formulae of elements, simple compounds and ions	
0.2	Write word equations	
0.3	Write balanced chemical equations, including the use of the state symbols (s), (l), (g) and (aq)	1c
0.4	**Write balanced ionic equations**	1c
0.5	Describe the use of hazard symbols on containers a to indicate the dangers associated with the contents b to inform people about safe-working precautions with these substances in the laboratory	
0.6	Evaluate the risks in a practical procedure and suggest suitable precautions for a range of practicals including those mentioned in the specification	

Note

Understand teh differences in terminology
For example
Recall = be able to say/memorise
Explain = how something happens
Describe = what is happening