Year 10 Topics

In year 10 we teach the following modules over the course of the year. Each module draws on prior learning from previous years and builds on understanding from the KS2 programme of study. Each module develops and deepens the Core knowledge that will underpin all areas of the curriculum at KS3 and KS4.

Topic	Rationale	Knowledge acquisition	Key vocabulary	Skills and enrichment
Atomic structure and the periodic table	The periodic table provides chemists with a structured organisation of the known chemical elements from which they can make sense of their physical and chemical properties	Atoms, elements, compounds, mixtures	Atoms, elements, compounds, mixtures	Separation techniques, Filtration, distillation, Crystallisation. Safe use of a range of equipment to separate chemical mixtures. Numeracy.
		Separating mixtures – distillation – Liebig Condenser, boiling points	Separation techniques, Filtration, distillation, Crystallisation.	
		Separating mixtures – salt and sand – sea water practical – filtration (portion for evaporation)	Evaporation	
		Sea water practical continued, distillation	Distillation, Liebig Condenser	
		History of the atom, structure of the atom, masses and charges of PEN	protons, neutrons and electrons	
		Calculate number of protons, neutrons and electrons in atoms and ions definition and recognition of isotopes	protons, neutrons and electrons isotopes	
Atomic structure and the periodic table	The historical development of the periodic table and models of atomic structure provide good examples of how scientific ideas and explanations develop over time as new evidence emerges.	History of the atom, structure of the atom, masses and charges of PEN		This historical context provides an opportunity for students to show an understanding of why and describe how scientific methods and theories develop over time.
		Calculate number of protons, neutrons and electrons in atoms and ions definition and recognition of isotopes		
		Electronic structure, drawing electron configurations	Electron configurations, shielding.	
		History of the periodic table timeline of development up to modern periodic table Newlands and Mendeleev		
		The modern periodic table, groups, periods, metals, non-metals, transition metals, group 0		
		Group 7 – the Halogens – electronic structure and reactions		
		Explaining trends in Group 7 – link to electronic structure		
		History of the atom, structure of the atom, masses and charges of PEN		

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Bonding, Structures and Properties	Chemical bonds are the glue that hold substances together. The attraction of one atom to another determines a substances chemical reactivity and its physical properties. Understanding how these can be determined by considering the atoms involved within the substance can be used to advance our understanding of materials science and where research may go in the immediate future.	1. Structure of the atom (revision)	Proton, Neutron, Electron, Negligible	Opportunities for learners to demonstrate their research skills – for an individual transition element. This could be presented as an extended piece of prose (literacy) or 2 minute oral presentation (oracy) Some opportunities for learners to develop their practical skills, especially those of qualitative observation. Learners could analyse the use and appropriateness of a range of materials for specific purposes. Further research opportunities exist for learners to demonstrate the new and diverse use of nanoparticles.
		2. Formation of ions and ionic bonding	Ion, positive, negative, cation, anion, transfer, noble gas, configuration, ionic	
		3. Ionic compounds and properties of giant ionic lattices	Giant, lattice, 3D, ions, conductivity, brittle, soluble, electrostatic	
		4. Covalent bonding dot and cross diagrams	Venn diagram, covalent, share	
		5. Simple covalent molecules and polymers	Polymer, manufactured, covalent, molecule, monomer, polymerisation, thermosetting, thermosoftening, intermolecular	
		6. Giant covalent structures, to include diamond and graphite	Brilliant, strong, hard, lubricant,	
		7. Nanoparticles, to include graphene, fullerenes and nanotubes	Pure, element, lubricant, delocalised, covalent	
		8. Metallic bonding and the properties of metals	Delocalised, electrostatic, electron, conduction	

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4.3.1 Quantitative Chemistry	Chemists use quantitative analysis to determine the formulae of compounds and the equations for reactions. Given this information, analysts can then use quantitative methods to determine the purity of chemical samples and to monitor the yield from chemical reactions. Identifying different types of chemical reactions allows chemists to make sense of how different chemicals react together, to establish patterns and to make predictions about the behaviour of other chemicals. Chemical equations provide a means of representing chemical reactions and are a key way for chemists to communicate chemical ideas.	What is relative atomic and relative formula mass?	Mass number, formula mass, formula, equation, reactants, products	Independence: Identify a chemical reaction that has a high atom economy and research the positives to industry of producing a high yield of useful product. Independence: Identify a chemical reaction that has a low atom economy and research the negatives to industry of producing a low yield of useful product and ways the reactions has been improved to increase the yield of useful product. Problem solving: Finding x in hydrated magnesium sulphate Practical skills: Titrate HCl with NaOH using an indicator of methyl orange. Use the titre results and know volumes of NaOH and concentration, to calculate the concentration of the HCl. **REQUIRED PRACTICAL – TITRATION**
		Why do we need to know percentage yield and atom economy?	Completion, reversible, yield, reactant, product, theoretical, atom economy	
		What are moles and how do we calculate them?	Moles, mol, substance, Avogadro	
		How can we apply moles to work out reacting masses?	Balanced, equation, moles, masses, grams	
		How can we apply moles to balance equations?	Balancing, equation, converting, reactants, products	
		How can we apply moles to work out limiting factors?	Limiting reagents, reactants, quantity	
		How can we use moles to work out the number of moles of gas?	Volume, temperature, pressure, volumes, gaseous	
		How do we calculate the concentration of solutions?	Solutions, concentration, volume, solute	

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Chemical Changes	Understanding of chemical changes began when people began experimenting with chemical reactions in a systematic way and organising their results logically. Knowing about these different chemical changes meant that scientists could begin to predict exactly what new substances would be formed and use this knowledge to develop a wide range of different materials and processes	How does the pH scale work?	pH, hydrogen ions, concentration, neutralisation reaction,	Practical: (chemistry only) determination of the reacting volumes of solutions of a strong acid and a strong alkali by titration. **REQUIRED PRACTICAL SEPARATES ONLY TITRATION** Numeracy: practice order of magnitude calculations Research: research the extraction of aluminium and explain why the process is energy intensive Practical: investigate what happens when aqueous solutions are electrolysed using inert electrodes. This should be an investigation involving developing a hypothesis. **REQUIRED PRATICAL ELECTROLYSIS**
		How can we accurately calculate the amount of acid needed to neutralise and alkali? (**SEPARATES ONLY)**	Burette, pipette, indicator, endpoint, titrations, concentration	
		What is the difference between a strong and weak acid?	ionisation, strong and weak acids, neutrality, relative acidity, dilute and concentrated	
		What is electrolysis?	Ionic compound, electrolysis, electrolytes, ions, discharge, electrodes, half equations, molten, aqueous.	
		How do we represent the process at each electrode?	Electrode, half equations, oxidation, reduction	

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4.5 Energy changes	Energy changes are an important part of chemical reactions. The interaction of particles often involves transfers of energy due to the breaking and formation of bonds. Reactions in which energy is released to the surroundings are exothermic reactions, while those that take in thermal energy are endothermic. These interactions between particles can produce heating or cooling effects that are used in a range of everyday applications. Separate Some interactions between ions in an electrolyte result in the production of electricity. Cells and batteries use these chemical reactions to provide electricity. Electricity can also be used to decompose ionic substances and is a useful means of producing elements that are too expensive to extract any other way.	Energy transfer during exothermic and endothermic reactions	Exothermic Endothermic.	Practical skills development - An opportunity to measure temperature changes when substances react or dissolve in water. analysis – Draw simple reaction profiles (energy level diagrams) for exothermic and endothermic Analysis - Use reaction profiles to identify reactions as exothermic or endothermic. Numeracy skills - Calculate the energy transferred in chemical reactions. Extended writing: write instructions to another student how to calculate the energy transferred in a chemical reaction. Analysis - Be able to interpret data in terms of the relative reactivity of different metals and to evaluate the use of cells. Evaluate - Research and evaluate uses of cells and batteries. Practical skills development Construct simple cells using combinations of metal strips .
		Using energy transfer reactions	activation energy energy level	
		Reaction profiles for exothermic and endothermic reactions	reaction profiles	
		Bond energy calculations (HT only)	Energy change	
		Cells and batteries	Energy transferred Chemical reaction. Cells and batteries Voltage. Electrode and electrolyte. Alkaline batteries	
		Fuel cells	Fuel cells Oxidation oxidised electrochemically half equations Electrode	

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Rate and extent of chemical change	Chemical reactions can occur at vastly different rates. Whilst the reactivity of chemicals is a significant factor in how fast chemical reactions proceed, there are many variables that can be manipulated in order to speed them up or slow them down. Chemical reactions may also be reversible and therefore the effect of different variables needs to be established in order to identify how to maximise the yield of desired product. In industry, chemists and chemical engineers determine the effect of different variables on reaction rate and yield of product. Whilst there may be compromises to be made, they carry out optimisation processes to ensure that enough product is produced within a sufficient time, and in an energy-efficient way.	9. How to determine the rate of a chemical reaction	Product, reactant, rate, mean, tangent, gradient, slope	• Wide range of opportunities for learners to demonstrate their graphing skills. All learners need to practice and demonstrate the ability to draw a suitable tangent on a graph with a curved line of best fit. • Essential opportunities for learners to develop their practical skills, especially those of quantitative observation when measuring data associated with rate of reaction determination. • Learners need to employ the use of suitable units when measuring and collecting data. • There is a need for learners to develop their mathematical mastery to determine the gradient of a straight line. • Learners will also need to be able to determine the intercept on a linear graph.
		10. Collision theory and factors affecting the rate of reaction	Collision, particle, energy, activation, rate, concentration, pressure, sufficient, catalyst, temperature, surface area, state	
		11. Required Practical – Rates of Reaction – The Thiosulfate Cross	Dependent, independent, control, variable, rate, concentration, hydrochloric, thiosulphate. Erlenmeyer , obscure, hypothesis, conclusion	
		12. Reversible reactions, to include the reaction of anhydrous copper sulfate with water	Reactant, product, forward, backward, reversible, equilibrium, rate, anhydrous, hydrated	
		13. Equilibria and factors affecting the equilibrium position	Equilibrium, dynamic, pressure, temperature, catalyst, shift, forward, backward	
		14. The Haber Process; a case study	Le Chatelier (HT), equilibrium, position, shift, rate, pressure, catalyst, temperature, compromise, condition, qualitative(HT)	

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4.7 Organic Chemistry - Separates Only Content	The chemistry of carbon compounds is so important that it forms a separate branch of chemistry. A great variety of carbon compounds is possible because carbon atoms can form chains and rings linked by C-C bonds. This branch of chemistry gets its name from the fact that the main sources of organic compounds are living, or once-living materials from plants and animals. These sources include fossil fuels which are a major source of feedstock for the petrochemical industry. Chemists are able to take organic molecules and modify them in many ways to make new and useful materials such as polymers, pharmaceuticals, perfumes and flavourings, dyes and detergents.	Polymerisation of alkenes and properties of polymers	Homologous series, alkene, unsaturated, polymerisation, thermosetting, thermo-softening, monomer, polymer, repeat unit, polymer structure	Analysis: Recognise substances that are alkenes from their names or from given formulae in these forms Problem solving: Model polymerisation using molecular model kits. Independence: Research uses of simple polymers. Evaluation: Look at the suitability of different types of polymers for their function Independence: Research uses of common alcohols. Practical skill: investigating the reactions of alcohols. Evaluation: comparison and evaluation of the environmental impacts of production of ethanol from steam hydration of ethane and fermentation of glucose with yeast. Practical skill: investigating the reactions of carboxylic acids.
		Reactions of alkenes	Functional group, combustion, complete, incomplete, addition reactions	
		Alcohols, acids and esters functional groups and properties	Functional group, carboxylic acid, ester, ethyl ethanoate, strong and weak acids	
		Alcohols, acids and esters reactions	Combustion, oxidising agent, fermentation, glucose, yeast	
		Condensation polymers	Condensation polymerisation, monomers, repeat units	
		Amino acids	Amino acids, polypeptides, proteins	
		Natural Polymers and DNA	Deoxyribonucleic acid, polymer chains, nucleotides, double helix	

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4.8.1 Purity, Formulations and Chromatography 4.8.2 Identification of common gases	Analysts have developed a range of qualitative tests to detect specific chemicals in order to determine the purity of substances and the presence of gases. Purity of samples can be checked using chromatography.	What is the difference between pure and impure substances and how can you distinguish between the two?	Pure, substance, melting point, boiling point, distinguish, impure	Independence: research the melting points and boiling points of common pure substances and compounds. Suggest reasons for different data being available on the internet. Independence: research the composition of the following formulations: • Fuel • Cleaning agents • Paints • Medicines Practical skills: Investigate how paper chromatography can be used to separate and tell the difference between coloured substances, including the calculation of Rf values **REQUIRED PRACTICAL - CHROMATOGRAPHY** Analysis: analyse the composition of various tubes of gas by carrying out simple gas tests
		What is a formulation and why are they useful?	Mixture, product, purpose, fertilisers,	
		How do we separate mixtures using simple paper chromatography?	Separation, identification, stationary, mobile, phase, retention factor, soluble, solvent, solute, solution dissolve, chromatograms	
		How do identify common atmospheric gases?	Hydrogen, oxygen, carbon dioxide, chlorine, splint, burning, glowing, lime water, calcium hydroxide, cloudy, precipitate, litmus paper, bleach	
4.8.3 Identification of ions by chemical and spectroscopic means	Chemical tests are based on reactions that produce a gas with distinctive properties, or a colour change or an insoluble solid that appears as a	How can we use flame tests to identify positive ions?	Flame tests, metals, species, ions	Practical skills: use flame tests to identify positive metal ions and to investigate the masking effect of mixtures in the Bunsen flame **REQUIRED PRACTICAL – IDENTIFYING IONS**

	precipitate. Instrumental methods provide fast, sensitive and accurate means of analysing chemicals, and are particularly useful when the amount of chemical being analysed is small. Forensic scientists and drug control scientists rely on such instrumental methods in their work.	How can we use sodium hydroxide to identify positive ions?	Solutions, coloured, white precipitates	Practical skills: make precipitates of metal hydroxides to identify positive ions, investigate the difficult in distinguishing magnesium, calcium and aluminium as they produce a white precipitate **REQUIRED PRACTICAL – IDENTIFYING IONS**
		How can we identify negative ions?	Carbonates, halides, sulfates	Practical skills: produce carbon dioxide gas a test for carbonates, use barium chloride to identify sulphates, use acidified silver nitrate to identify precipitates of halides, highlighting the difficulty of identify halides individually without direct **comparison REQUIRED PRACTICAL – IDENTIFYING IONS**
		Are there advantages to using instrumental methods over chemical methods?	Identification, instrumental, accurate, sensitive, rapid	Independence: Students could research the use of different spectroscopic techniques
		What is flame emission spectroscopy?	Flame emission spectroscopy, spectroscope, spectrum, concentrations, metal ions	Practical skills: observe flame spectra using a hand-held spectroscope Analysis: analyse emission spectra using data in chart or tabular form.