# Curriculum Map Year 11 Combined Science – Chemistry

| Topic Name | | Scientific Skills | Essential Knowledge<br>(misconceptions or really tricky bits are highlighted in red) | Prior Learning (KS3 or Y10) | Assessment |
|---|---|---|---|---|---|
| **REACTION RATES** | *Autumn HT1 (approx.9 lessons)* | **Demonstrating that I can:**<br>• Measure the rate of a reaction using a range of methods and collect reliable data.<br>• Evaluate practical work and comment on ways to reduce error<br>• Explain how to increase reliability of data<br>• Plot a graph and interpret the results eliminating any anomalous results.<br>• Calculate the mean rate of reaction with correct units<br>• Measure the gradient of a line<br><br>**HT**<br>• plot the tangent to a curve and calculate rate using the gradient of the tangent. | **In this topic I will know:**<br>• How Collison Theory explains why the rate of a reaction changes<br>• Methods of altering the rate of a reaction.<br>• Why increasing temperature has a greater impact on reaction rate than changing concentration or surface area.<br>• Methods of measuring a rate of reaction by measuring loss of reactant or gain of product over time. Justify the choice of method<br>• The meaning of the term activation energy.<br>• How catalysts speed up rates of reaction by lowering activation energy.<br>• Be able to draw a reaction profile with and without a catalyst.<br>• About a range of catalysts (link to biology with enzymes being biological catalysts) | **Before I start this topic, I need to know:**<br>• The difference between a chemical reaction and physical change.<br>• How to write word equations<br>• A range of types of chemical reaction e.g. neutralisation, combustion<br>• That all matter is made of particles called atoms. The difference between elements and compounds, atoms and elements.<br>• The terms reactant and product.<br>• Basic apparatus and practical techniques | **Knowledge and skills will be assessed by:**<br>Calculate the mean rate of a reaction from given information about the quantity of a reactant used or the quantity of a product formed and the time taken<br>Identify catalysts in reactions from their effect on the rate of reaction<br>Predict and explain using collision theory the effects of changing temperature on the rate of a reaction<br>Predict and explain using collision theory the effects of changing concentration on the rate of a reaction explain the effects of changes in the size of pieces of a reacting solid in terms of surface area to volume ratio<br>Interpret graphs showing the quantity of product formed or quantity of reactant used up against time<br>Required practical: Investigate how changes in concentration affect the rates of reactions by a method involving the production of a gas and a method involving a colour change. |
| | | | • recall a source for the nitrogen and a source for the hydrogen used in the Haber process.<br>HT<br>• interpret graphs of reaction conditions versus rate in the Haber process<br>• apply the principles of dynamic equilibrium in Reversible reactions and dynamic equilibrium to the Haber process<br>• explain the trade-off between rate of production and position of equilibrium<br>• explain how the commercially used conditions for the Haber process are related to the availability and cost of raw materials and energy supplies, control of equilibrium position and rate. | | interpret graphs of reaction conditions versus rate in the Haber process<br>explain the trade-off between rate of production and position of equilibrium.<br>End of topic assessment |
| **CHEMICAL ANALYSIS** | *Autumn HT1 (approx.6 lessons)* | **Demonstrating that I can:**<br>• Recognise and use expressions in decimal form.<br>• Use ratios, fractions and percentages.<br>• Make estimates of the results of simple calculations.<br>• provide answers to an appropriate number of significant figures. | **In this topic I will know:**<br>• use melting point and boiling point data to distinguish pure from impure substances.<br>• identify formulations.<br>• explain how paper chromatography separates mixtures.<br>• suggest how chromatographic methods can be used for distinguishing pure substances from impure substances.<br>• interpret chromatograms and determine Rf values from chromatograms.<br>• The gas tests for hydrogen, oxygen, carbon dioxide and chlorine<br>• Identify an unknown species from the results of the tests for metal ions / metal hydroxides / carbonates / halides / sulfates.<br>• write word and balanced equations for the reactions. | **Before I start this topic, I need to know:**<br>• Mixtures may be separated due to differences in their physical properties. The method chosen to separate a mixture depends on which physical properties of the individual substances are different.<br>• The chemical tests for Hydrogen, oxygen, carbon dioxide | **Knowledge and skills will be assessed by:**<br>Required practical: Investigate how paper chromatography can be used in forensic science to identify an ink mixture used in a forgery.<br>explain how paper chromatography separates mixtures.<br>Calculate Rf values.<br>Required practical: use of chemical tests to identify the ions in unknown single ionic compounds.<br>End of topic assessment |

| | | | | | |
|---|---|---|---|---|---|
| | | | • state advantages of instrumental methods compared with the chemical tests.<br>• interpret an instrumental result given appropriate data in chart or tabular form. | | |
| **QUANTITATIVE CHEMISTRY** | *Autumn HT2*<br><br>*(approx.11 lessons* | **Demonstrating that I can:**<br>• Rearrange equations and use them correctly.<br>• Round up or down to 2dp or 3sf correctly.<br>• How to convert units by scaling up or down e.g. g to kg or $cm^3$ to $dm^3$<br>• Use ratios, fractions and percentages.<br><br>• <u>HT</u><br>• Work with standard form (Avogadro's number) | **In this topic I will know how to:**<br>• Find the relative atomic mass of an element from the Periodic Table.<br>• Calculate the relative formula mass of a compound.<br>• Calculate the % of an element in a compound.<br>• Describe what the concentration of a solution is<br>• Calculate the concentration of a solution in $g/dm^3$ or the mass of solute with a given concentration.<br><br>**<u>HT</u>**<br>• Balance a symbol equation<br>• Calculate the number of moles of a substance from a given mass or volume of gas<br>• Understand how to find mole ratios from a balanced symbol equation<br>• Calculate the mass of reactant or product in a reaction using the mole ratios<br>• Identify the limiting reagent in a chemical reaction<br>• Calculate the number of particles in a solution with a given concentration and volume | **Before I start this topic, I need to know:**<br>• How to locate an atomic or mass number on the Periodic Table<br>• The difference between elements and compounds, atoms and elements.<br>• How to write basic chemical formulae like $H_2O$ and know how many atoms and elements are in the molecule.<br>• Particle theory<br>• The term solution (aq) and be able to describe a solution in terms of particles, dissolving, soluble and insoluble.<br>• Be able to understand the terms volume and mass and understand how to measure them in the lab. | **Knowledge and skills will be assessed by:**<br><br>Assessment booklet<br>State that mass is conserved and explain why, including describing balanced equations in terms of conservation of mass.<br>Describe what the relative formula mass (Mr) of a compound is and calculate the relative formula mass of a compound, given its formula.<br>Calculate the mass of solute in a given volume of solution of known concentration in terms of mass per given volume of solution.<br>HT<br>Explain the effect of limiting the quantity of a reactant on the amount of products in terms of moles or masses in grams<br>Explain how the mass of a solute and the volume of a solution is related to the concentration of the solution. |
| | | | • calculate the percentage yield of a product from the actual yield of a reaction.<br>• calculate the atom economy of a reaction to form a desired product from the balanced equation.<br>• describe how to carry out titrations using strong acids and strong alkalis only (sulfuric, hydrochloric and nitric acids only) to find the reacting volumes accurately.<br><br>HT<br>• calculate the theoretical mass of a product from a given mass of reactant and the balanced equation for the reaction.<br>• explain why a particular reaction pathway is chosen to produce a specified product.<br>• explain how the concentration of a solution in mol/dm3 is related to the mass of the solute and the volume of the solution.<br>• calculate the chemical quantities in titrations involving concentrations in $mol/dm^3$ and in $g/dm^3$<br>• calculate the volume of a gas at room temperature and pressure from its mass and relative formula mass.<br>• calculate volumes of gaseous reactants and products from a balanced equation and a given volume of a gaseous reactant or product | | calculate the percentage yield of a product from the actual yield of a reaction.<br>calculate the theoretical mass of a product from a given mass of reactant and the balanced equation for the reaction.<br>calculate the atom economy of a reaction to form a desired product from the balanced equation.<br>calculate the volume of a gas at room temperature and pressure from its mass and relative formula mass.<br>Required practical: determination of the reacting volumes of solutions of a strong acid and a strong alkali by titration. (HT only) determination of the concentration of one of the solutions in mol/dm3 and g/dm3 from the reacting volumes and the known concentration of the other solution.<br>End of topic assessment |

| | | | | | |
|---|---|---|---|---|---|
| **Chemical Changes 1** | *Spring HT3 (approx.8 lessons* | **Demonstrating that I can:**<br>• mix reagents to explore chemical changes and/or products.<br>• safely use appropriate heating devices and techniques including use of a Bunsen burner and a water bath or electric heater.<br>• use appropriate apparatus and techniques for conducting chemical reactions, including appropriate reagents.<br>• safely use of a range of equipment to purify and/or separate chemical mixtures including evaporation, filtration, crystallisation.<br>• safely use and careful handle liquids and solids, including careful mixing of reagents under controlled conditions.<br><br>HT<br>• Make order of magnitude calculations. | **In this topic I must know how to:**<br>• explain reduction and oxidation in terms of loss or gain of oxygen.<br>• Work out an order of reactivity of metals based on experimental results.<br>• interpret or evaluate specific metal extraction processes identifying the substances which are oxidised or reduced.<br>• predict products from given reactants.<br>• use the formulae of common ions to deduce the formulae of salts.<br>• describe the use of universal indicator or a wide range indicator to measure the approximate pH of a solution.<br>• use the pH scale to identify acidic or alkaline solutions.<br><br>**HT**<br>• write ionic equations for displacement reactions.<br>• identify in a reaction, symbol equation or half equation which species are oxidised, and which are reduced.<br>• explain what redox reactions are.<br>• use and explain the terms dilute and concentrated (in terms of amount of substance), and weak and strong (in terms of the degree of ionisation) in relation to acids | Before I start this topic, I must know:<br>• Most metals are found combined with other elements, as a compound, in ores. The more reactive a metal, the more difficult it is to separate it from its compound. Carbon displaces less reactive metals, while electrolysis is needed for more reactive metals<br>• Metals react with oxygen to form oxides.<br>• Metals can be arranged as a reactivity series in order of how readily they react with other substances. Some metals react with acids to produce salts and hydrogen.<br>• The pH of a solution depends on the strength of the acid: strong acids have lower pH values than weak acids.<br>• Mixing an acid and alkali produces a chemical reaction, neutralisation, forming a chemical called a salt and water.<br>• Acids have a pH below 7, neutral solutions have a pH of 7, alkalis have a pH above 7.<br>• Acids and alkalis can be corrosive or irritant and require safe handling. | **Knowledge and skills will be assessed by:**<br><br>Assessment booklet<br>Plan an investigation to find the order of reactivity of three metals using the temperature change when each metal reacts with hydrochloric acid.<br>Name common salts<br>Use the formulae of common ions to deduce the formulae of salts.<br>Use the pH scale to identify acidic or alkaline solutions.<br><br>Required practical activity: preparation of a pure, dry sample of a soluble salt from an insoluble oxide or carbonate, using a Bunsen burner to heat dilute acid and a water bath or electric heater to evaporate the solution.<br><br>HT<br>identify in a reaction which species are oxidised, and which are reduced.<br>Write ionic equations for displacement reactions.<br>use and explain the terms dilute and concentrated (in terms of amount of substance), and weak and strong (in terms of the degree of ionisation) in relation to acids.<br>End of topic assessment |
| | | | • recall the names of the salts produced when phosphate rock is treated with nitric acid, sulfuric acid and phosphoric acid.<br>• compare the industrial production of fertilisers with laboratory preparations of the same compounds | • Haber process | compare the industrial production of fertilisers with laboratory preparations |
| **Chemical Changes 2** | *Spring HT4 (approx.6 lessons* | **Demonstrating that I can:**<br>• use of appropriate apparatus and techniques for conducting and monitoring chemical reactions.<br>• use of appropriate apparatus and techniques to draw, set up and use electrochemical cells for separation and production of elements and compounds.<br>• use scientific theories and explanations to develop hypotheses.<br>• plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data or explore phenomena.<br>• apply a knowledge of a range of techniques, instruments, apparatus and materials to select those appropriate to the experiment.<br>• carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy | **In this topic I must know how to:**<br>• predict the products of the electrolysis of ionic compounds in the molten state.<br>• explain why a mixture is used in the extraction of Aluminium from its ore and why the positive electrode must be continually replaced.<br>• predict the products of the electrolysis of aqueous solutions containing an ionic compound.<br><br>**HT**<br>• Represent reactions at electrodes as half equations | **Before I start this topic, I must know:**<br>• An ore is a naturally occurring rock containing sufficient minerals for extraction.<br>• Extraction is the separation of a metal from a metal compound.<br>• Recycling is the processing of a material so that it can be used again.<br>• Electrolysis is using electricity to split up a compound into its elements. | **Knowledge and skills will be assessed by:**<br><br>Assessment booklet<br>predict the products of the electrolysis of ionic compounds in the molten state.<br>explain why a mixture is used in the extraction of Aluminium from its ore and why the positive electrode must be continually replaced.<br>predict the products of the electrolysis of aqueous solutions containing an ionic compound.<br>Required practical activity: investigate what happens when aqueous solutions are electrolysed using inert electrodes.<br><br>HT<br>Represent reactions at electrodes as half equations.<br><br>End of topic assessment |

| | | | | | |
|---|---|---|---|---|---|
| | | of measurements and health and safety considerations.<br>• make and record observations and measurements using a range of apparatus and methods. | | | |
| **Reflection and preparation for examinations** | *Summer HT5* | | | | |
| **Examination period** | *Summer HT6* | | | | |