| ***CHEMISTRY***<br>***Energy Changes*** | ***Students will Know and Remember…*** | ***So that they can…*** |
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| Define exothermic and endothermic reactions | Exothermic reactions release energy in the form of heat<br>Endothermic reactions take in energy from their surroundings | How to accurately measure temperature changes<br>How to correctly read a thermometer |
| Identify whether a reaction is exothermic or endothermic (RP4) | Identify whether a reaction is exothermic or endothermic from temperature change data | How to accurately measure temperature changes<br>How to correctly read a thermometer |
| State a use of an exothermic reaction and an endothermic reaction. | Exothermic reactions are used in applications where heating is required. Endothermic reactions can be used when cooling is required. | How to accurately measure temperature changes<br>How to correctly read a thermometer |
| Define activation energy.<br>Sketch a generic reaction profile diagram for an exothermic or endothermic reaction. | Energy levels of reactants and products in exothermic/endothermic reactions<br>Reactions have an activation energy<br>An energy change takes place during reactions | Draw reaction profiles including correctly labelled axes.<br>Identify the activation energy and enthalpy change on a reaction profile. |
| Calculate energy/enthalpy changes using bond energy values | Breaking bonds is an endothermic process<br>Making bonds is an exothermic process<br>We can calculate energy changes quantitatively using bond enthalpy values | Bond energy calculations<br>Second law of thermodynamics – Energy cannot be created or destroyed, only transferred.<br>Heat energy is lost to the environment, warming the surroundings. |
| **SEPARATE CHEMISTRY ONLY**<br>Describe a simple cell.<br>Describe a battery<br>Give an example of a non-rechargeable battery | Batteries are comprised of a collection of cells<br>Alkaline batteries and zinc-carbon batteries are non-rechargeable.<br>Lithium batteries are rechargeable. | Building a simple cell using two different metals and a metal salt solution<br>Using a voltmeter to measure potential difference<br>How to produce a series circuit |
| **SEPARATE CHEMISTRY ONLY**<br>Describe a hydrogen fuel cell. State some uses for hydrogen fuel cells.<br>State that hydrogen fuel cells could be an alternative to rechargeable cells and batteries | Hydrogen fuel cells have several advantages over Internal Combustion Engines.<br>Fuel cells are particularly useful in space due to their properties and waste products. | Hydrogen fuel cells are being developed which could potentially be a viable alternative to Petrol/Diesel or electric cars.<br>Barriers to adoption of hydrogen as a fuel including safety and distribution. |

| ***CHEMISTRY***<br>***Chemical Calculations*** | ***Students will know and remember…*** | ***So that they can…*** |
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| Define the conservation of mass | Mass is always conserved in chemical reactions e.g. the total | Identify the number and type of each atom in a chemical formulae |

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| Interpret chemical formulae | mass of the products must equal the total mass of the reactants | |
| Demonstrate the conservation of mass<br>Explain why mass may not appear to be conserved | Mass is always conserved in chemical reactions e.g. the total mass of the products must equal the total mass of the reactants.<br>Reactions which produce a gas may appear to lose mass, but the total mass remains the same | How to use a top pan balance to accurately measure mass<br>Heating to constant mass to accurately measure mass change |
| Identify the relative atomic mass of elements<br>Calculate relative formula mass for compounds | The relative atomic mass represents the number of protons and neutrons in the nucleus of an atom<br>The relative formula mass of a compound is the sum of the relative atomic masses | Calculate the relative formula mass of compounds including those with brackets<br>How the concept of RAM was developed including the use of Hydrogen, Oxygen and now Carbon as a comparison |
| Calculate the number of moles in a known mass of chemicals | Calculate the number of moles given Mass and Mr.<br>Know the value of Avogadro's constant and what it represents | Mole calculations and the use of formula triangles to support rearranging equations with three terms |
| Calculate the mass of product that will be produced in a chemical reaction | Calculate the mass of product expected using the balanced chemical equation and the masses of the reactants | How to carry out reacting mass calculations |
| Explain why chemical equations must be balanced.<br>Identify the limiting reactant in a chemical reaction. | Limiting reactants determine the amount of products that can be produced<br>Reactions stop when the limiting reactant runs out | Balancing chemical equations<br>Chemical equations must be balanced due to the conservation of mass |
| State the definition of theoretical yield, actual yield, and percentage yield.<br>Calculate percentage yields | Calculate the theoretical yield of a reaction<br>Calculate the percentage yield of a reaction using actual and theoretical yields | Percentage yield is used in industry to determine the efficiency of a chemical process<br>High percentage yields mean less valuable resources and reactants are wasted |
| State a definition of atom economy | Calculate the atom economy of a reaction | Atom economy is important to "green chemistry" and the desire to reduce sometimes harmful waste products in industry. |
| Explain how concentration of a solution can be changed.<br>Calculate the mass of solute (in g) in a solution when given the concentration in g/dm3 and volume in dm3 or cm3. | Calculate the concentration of a solution in g/dm3 and mol/dm3<br>Calculate concentrations of diluted solutions | Increasing the volume of a solution by X decreases the concentration by X<br>How to carry out a dilution of a solution to give a known concentration |
| **SEPARATE CHEMISTRY ONLY**<br><br>Calculate a titre.<br>Describe how an indicator can be used to determine the end point. | Titrations are used to identify the concentration of a solution via neutralisation.<br>Indicators are used to identify the end point of a reaction. | Understand the titrimetric method and its uses in identifying the concentration of an unknown solution. Titrations are often used in toxicology and forensic science. |

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| Explain how accuracy can be improved in a titration. | | |
| **SEPARATE CHEMISTRY ONLY**<br><br>Accurately read the volume on a burette to 1 decimal place.<br>Identify concordant results | How to carry out a titration accurately | Understand the titration procedure/method and its applications.<br>Explain how to accurately record the end point of a titration.<br>Recording concordant results |
| **SEPARATE CHEMISTRY ONLY**<br><br>Calculate the concentration of a solution using a titration<br>Calculate the amount of acid or alkali needed in a neutralisation reaction. | Calculate the concentration of a solution in mol/dm3 when given the amount of solute in moles and volume of solution in dm3. | Titrimetric method<br>Difference between accuracy and precision<br>Repeatability and concordant results |
| **SEPARATE CHEMISTRY ONLY**<br><br>Calculate the amount in moles of gas in a given volume at room temperature and pressure. | Calculate the volume of an ideal gas given the number of moles | Ideal gas calculations<br>Converting from cm3 to dm3 and m3 |

| ***CHEMISTRY***<br>***Rates & Equilibrium*** | ***Students will know and remember…*** | ***So that they can…*** |
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| Define rate of reaction<br>Calculate the mean rate of a reaction | Rates of reaction can be given in a variety of units depending on the variable being measured.<br>Calculate the mean rate of reaction using change in variable over time | Using gas syringes and measuring cylinders to measure the volume of gas produced<br>Use a top pan balance to accurately record the mass change |
| Plot a graph that allows the calculation of the rate at a specific time | How to accurately plot a scatter graph using data<br>Use the gradient of the tangent to a curve to calculate the rate of reaction at a given time | Calculating the gradient of a tangent<br>Plotting a scatter graph<br>Drawing a correct line of best fit<br>Identifying anomalies |
| Use collision theory to explain how changing conditions affects the rate of reaction | Reaction rate is determined by the number of successful collisions per second<br>Four main factors can influence the frequency of successful collisions | How to use particle diagrams to explain the impact of changing condition on the rate of reaction<br>Particle model – Solids, liquids and gases |
| Explain how temperature affects the rate of a reaction using collision theory | Increasing temperature means particles have more energy, are moving faster and therefore there is an increased frequency of successful collisions | Using a thermometer to accurately record starting temperatures.<br>How to design a method to investigate the effect of temperature on reaction rate. |
| Explain how concentration and pressure affect the rate of a reaction using collision theory | Increasing concentration means there are more particles in the same volume. Increasing pressure means the same number of particles in a smaller volume. Both of which increase the frequency of successful collisions. | How to design a method to investigate the effect of concentration and pressure on reaction rate. Correct use of gas syringes and measuring cylinders. |

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| Explain how catalysts speed up a reaction<br>Explain the effect of increased surface area using collision theory | Catalysts provide an alternative reaction pathway with a lower activation energy.<br>Increased surface area results in more particles being exposed to collisions. | Use of catalysts in industry to reduce production costs by speeding up reactions.<br>Advantages of using a catalyst over increasing other factors.<br>Examples of catalysts in industry and why catalysts often have a large surface area. |
| Explain how reactions can be reversible<br>Identify reversible reactions from the chemical equation | Chemical reactions can be reversible.<br>Reversible reactions are identified using the ⇋ symbol<br>Understand that reversible physical changes such as melting are not reversible chemical reactions | Produce balanced symbol equations using the ⇋ symbol |
| Explain why the energy change in a reversible reaction is exothermic in one direction and endothermic in the reverse direction<br>Make predictive observations of familiar reversible reactions when information is supplied. | Identify which direction of a reversible reaction is exothermic and which is endothermic using the sign of the overall enthalpy change as written. | Write balanced equations for reversible reactions using the ⇋ symbol |
| **SEPARATE CHEMISTRY ONLY**<br><br>Describe the conditions needed to achieve dynamic equilibrium<br>Describe how the rate of the forward and reverse reactions compare at equilibrium<br>Define Le Chatelier's Principle | Dynamic equilibria can only occur in a closed system.<br>Equilibrium is reached when the rate of the forward and reverse reactions are equal.<br>The concentrations of reactants an products are not changing at equilibrium. | Le Chatelier was a French Scientist who produced the Principle named after him which states that a system at equilibrium will shift to oppose any applied change. |
| **SEPARATE CHEMISTRY ONLY**<br><br>Explain how changing the conditions for a system at equilibrium affects the position of the equilibria<br>Predict the effect on yield of changing the conditions of a reaction at equilibrium | The position of an equilibrium will shift to reduce the effect of any imposed change.<br>By changing the conditions of an equilibrium we can shift the position of equilibrium to favour one direction and increase the yield of the desired product. | The Haber-Bosch process is one of the most valuable commercial equilibria reactions. It was invented by Fritz Haber and the fertiliser it produces has enabled us as a society to produce enough food to sustain a much higher population. |

| ***CHEMISTRY***<br><br>***Crude Oil & Fuels*** | ***Students will know and remember…*** | ***So that they can…*** |
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| Explain the properties of hydrocarbons | Define the term hydrocarbon<br><br>Describe how hydrocarbons are formed<br><br>Explain why hydrocarbons are a finite resource<br><br>Name and draw the common alkanes and alkenes<br><br>Identify the properties of the different hydrocarbons<br><br>Explain how the properties of hydrocarbons are affected by the length of the hydrocarbons | |
| Explain how Crude oil is processed | Define the term fraction<br><br>Describe the process of fractional distillation<br><br>Explain how the fractions of crude oil are used<br><br>Evaluate the availability of each fraction against the demand for that fraction<br><br>Define the term cracking<br><br>Describe methods used to crack hydrocarbons<br><br>Identify the products of the cracking process<br><br>Define the term alkene<br><br>Draw and name alkenes containing up to 5 carbon atoms<br><br>Describe the test for saturation<br><br>Name the reactions that alkenes undergo | |

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| Describe combustion reactions involving hydrocarbons | Define the terms combustion and incomplete combustion<br><br>Identify the products of the combustion and incomplete combustion reactions<br><br>Explain why combustion reactions are exothermic<br><br>Describe the chemical tests for water and carbon dioxide<br><br>Describe how to determine the energy released in a reaction<br><br>Explain why incomplete combustion reactions can be dangerous. | Evaluate a calorimetry reaction<br><br>Create equations for complete and incomplete combustion reactions |