

Subject	Y11 Chemistry Threshold Concepts – Autumn Term	How to support students' learning
Quantitative chemistry	Conservation of mass and balanced chemical equations • The law of conservation of mass states that no atoms are lost or made during a chemical reaction so the mass of the products equals the mass of the reactants. • Chemical reactions can be represented by symbol equations which are balanced in terms of the numbers of atoms of each element involved on both sides of the equation. Relative formula mass • The relative formula mass (M_r) of a compound is the sum of the relative atomic masses of the atoms in the numbers shown in the formula. • In a balanced chemical equation, the sum of the relative formula masses of the reactants in the quantities shown equals the sum of the relative formula masses of the products in the quantities shown. Mass changes when a reactant or product is a gas • Some reactions may appear to involve a change in mass but this can usually be explained because a reactant or product is a gas and its mass has not been taken into account. For example: when a metal reacts with oxygen the mass of the oxide produced is greater than the mass of the metal or in thermal decompositions of metal carbonates carbon dioxide	Encourage your child to visit BBC bitesize to learn how to calculate relative formula mass Calculating relative formula masses - Formula mass and mole calculations - GCSE Chemistry (Single Science) Revision - Other - BBC Bitesize

	is produced and escapes into the atmosphere leaving the metal oxide as the only solid product. Chemical measurements - Whenever a measurement is made there is always some uncertainty about the result obtained. Moles (HT only) - Chemical amounts are measured in moles. The symbol for the unit mole is mol. - The mass of one mole of a substance in grams is numerically equal to its relative formula mass. - One mole of a substance contains the same number of the stated particles, atoms, molecules or ions as one mole of any other substance. - The number of atoms, molecules or ions in a mole of a given substance is the Avogadro constant. The value of the Avogadro constant is 6.02×10^{23} per mole. - The relative formula mass of a substance can be used to calculate the number of moles in a given mass of that substance and vice versa. Amounts of substances in equations (HT only) - The masses of reactants and products can be calculated from balanced symbol equations.	Encourage your child to watch this video on calculating moles calculating moles aqa cognito - Google Search
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- The balancing numbers in a symbol equation can be calculated from the masses of reactants and products by converting the masses in grams to amounts in moles and converting the numbers of moles to simple whole number ratios.

Limiting reactants (HT only)

- In a chemical reaction involving two reactants, it is common to use an excess of one of the reactants to ensure that all of the other reactant is used. The reactant that is completely used up is called the limiting reactant because it limits the amount of products.

Concentration of solutions

- Many chemical reactions take place in solutions. The concentration of a solution can be measured in mass per given volume of solution, eg grams per dm^3 (g/dm^3).
- The mass of solute in a given volume of solution of known concentration can be calculated in terms of mass per given volume of solution

Yield and atom economy of chemical reactions (chemistry only)

- Even though no atoms are gained or lost in a chemical reaction, it is not always possible to obtain the calculated amount of a product because:

Encourage your child to visit BBC bitesize to learn about limiting reactants [Limiting reactants - \(higher tier\) - Quantitative chemistry - \(CCEA\) - GCSE Chemistry \(Single Science\) Revision - CCEA - BBC Bitesize](#)

Encourage your child to watch this video on atom economy [GCSE Chemistry - Atom Economy #31 - YouTube](#)

	- the reaction may not go to completion because it is reversible - some of the product may be lost when it is separated from the reaction mixture - some of the reactants may react in ways different to the expected reaction. • The amount of a product obtained is known as the yield. When compared with the maximum theoretical amount as a percentage, it is called the percentage yield. % Yield = <u>Mass of product actually made</u> <i>Maximum theoretical mass of product</i> × 100 • The atom economy (atom utilisation) is a measure of the amount of starting materials that end up as useful products. It is important for sustainable development and for economic reasons to use reactions with high atom economy. • The percentage atom economy of a reaction is calculated using the balanced equation for the reaction as follows: <u>Relative formula mass of desired product from equation</u>	Encourage your child to visit BBC bitesize to read about percentage yield Percentage yield - Atom economy, percentage yield and gas calculations - AQA - GCSE Chemistry (Single Science) Revision - AQA - BBC Bitesize
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	<i>Sum of relative formula masses of all reactants from equation</i> × 100 Using concentrations of solutions in mol/dm³ (chemistry only) • The concentration of a solution can be measured in mol/dm³. • The amount in moles of solute or the mass in grams of solute in a given volume of solution can be calculated from its concentration in mol/dm³. • If the volumes of two solutions that react completely are known and the concentration of one solution is known, the concentration of the other solution can be calculated. Use of amount of substance in relation to volumes of gases (chemistry only) (HT only) • Equal amounts in moles of gases occupy the same volume under the same conditions of temperature and pressure. • The volume of one mole of any gas at room temperature and pressure (20°C and 1 atmosphere pressure) is 24 dm³. • The volumes of gaseous reactants and products can be calculated from the balanced equation for the reaction.	Encourage your child to watch this video on how to calculate the concentration of a solution GCSE Chemistry - How to Calculate Concentration in grams per decimetre cubed #30 - YouTube
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Electrolysis	• When an ionic substance is melted or dissolved in water, the ions are free to move about within the liquid or solution. • Passing an electric current through ionic substances that are molten, for example lead bromide, or in solution breaks them down into elements. This process is called electrolysis and the substance that is broken down is called the electrolyte. • During electrolysis, positively charged ions move to the negative electrode, and negatively charged ions move to the positive electrode. • Electrolysis is used to electroplate objects. This may be for a variety of reasons and includes copper plating and silver plating. • At the negative electrode, positively charged ions gain electrons (reduction) and at the positive electrode, negatively charged ions lose electrons (oxidation). • If there is a mixture of ions, the products formed depend on the reactivity of the elements involved • Reactions at electrodes can be represented by half equations HT only • Aluminium is manufactured by the electrolysis of a molten mixture of aluminium oxide and cryolite.	Encourage your child to visit BBC bitesize to read about the process of electrolysis Electrolysis of molten salts - Electrolysis - AQA - GCSE Chemistry (Single Science) Revision - AQA - BBC Bitesize Encourage your child to watch this video on electrolysis of aqueous solutions GCSE Chemistry - Electrolysis Part 3 - Aqueous Solutions #42 - YouTube Encourage your child to watch this video on obtaining aluminium from bauxite Electrolysis Of Aluminium Oxide GCSE Chemistry (9-1) kayscience.com - YouTube
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	- Aluminium forms at the negative electrode and oxygen at the positive electrode. The positive electrode is made of carbon, which reacts with - the oxygen to produce carbon dioxide. - The electrolysis of sodium chloride solution produces hydrogen and chlorine. Sodium hydroxide solution is also produced. These are important reagents for the chemical industry, eg sodium hydroxide for the production of soap and chlorine for the production of bleach and plastics. Triple only Chemical cells and fuel cells Cells and batteries Interpret data for relative reactivity of different metals and evaluate the use of cells Fuel cells Evaluate the use of hydrogen fuel cells in comparison with rechargeable cells and batteries Write the half equations for the electrode reactions in the hydrogen fuel cell	Encourage your child to visit this website to learn about hydrogen fuel cells GCSE CHEMISTRY - What is a Hydrogen Fuel Cell? - What are the Advantages of a Hydrogen Fuel Cell? - What are the Disadvantages of a Hydrogen Fuel Cell? - GCSE SCIENCE.
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Subject	Year 11 Chemistry Threshold Concepts – Spring Term	How to support students' learning
Equilibrium	Dynamic Equilibrium - When a reversible reaction occurs in apparatus which prevents the escape of reactants and products, equilibrium is reached when the forward and reverse reactions occur at exactly the same rate. Changing the Conditions of Equilibrium - The relative amounts of all the reactants and products at equilibrium depend on the conditions of the reaction. - If a system is at equilibrium and a change is made to any of the conditions, then the system responds to counteract the change. - The effects of changing conditions on a system at equilibrium can be predicted using Le Chatelier's Principle. - The relative amounts of all the reactants and products at equilibrium depend on the conditions of the reaction. - If a system is at equilibrium and a change is made to any of the conditions, then the system responds to counteract the change.	Encourage your child to visit BBC bitesize to learn what dynamic equilibrium is and what can affect it Changing the position of equilibrium - Higher - Reversible reactions - AQA - GCSE Combined Science Revision - AQA Trilogy - BBC Bitesize

	• <i>The effects of changing conditions on a system at equilibrium can be predicted using Le Chatelier's Principle.</i> <i>The Effect of Temperature</i> <i>If the temperature of a system at equilibrium is increased:</i> • <i>the relative amount of products at equilibrium increases for an endothermic reaction</i> • <i>the relative amount of products at equilibrium decreases for an exothermic reaction.</i> <i>If the temperature of a system at equilibrium is decreased:</i> • <i>the relative amount of products at equilibrium decreases for an endothermic reaction</i> • <i>the relative amount of products at equilibrium increases for an exothermic reaction.</i> <i>The Effect of Concentration</i> • <i>If the concentration of one of the reactants or products is changed, the system is no longer at equilibrium and the concentrations of all the substances will change until equilibrium is reached again.</i>	Encourage your child to watch this video on reversible reactions and the factors affecting equilibrium GCSE Chemistry - Reversible Reactions and Equilibrium #49 - YouTube
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- *If the concentration of a reactant is increased, more products will be formed until equilibrium is reached again.*
- *If the concentration of a product is decreased, more reactants will react until equilibrium is reached again.*

The Effect of Pressure

For gaseous reactions at equilibrium:

- *an increase in pressure causes the equilibrium position to shift towards the side with the smaller number of molecules as shown by the symbol equation for that reaction*
- *a decrease in pressure causes the equilibrium position to shift towards the side with the larger number of molecules as shown by the symbol equation for that reaction.*

The Haber Process (triple only)

- *used to produce nitrogen-based fertilisers.*
- *The raw materials for the Haber process are nitrogen and hydrogen.*
- *The purified gases are passed over a catalyst of iron at a high temperature (about 450°C) and a high pressure (about 200*
- *atmospheres). Some of the hydrogen and nitrogen reacts to form ammonia. The reaction is reversible so some of the ammonia produced breaks down into nitrogen and hydrogen*

Encourage your child to watch this video on the Haber process [GCSE Chemistry - The Haber Process Explained #76 - YouTube](#)

Organic chemistry	- On cooling, the ammonia liquefies and is removed. The remaining hydrogen and nitrogen are recycled. <u>Triple only topic</u> Alcohols - Alcohols contain the functional group –OH. Methanol, ethanol and propanol are the first three members of a homologous series of alcohols. Candidates should be able to recognise alcohols from their names or formulae, but do not need to know the names of individual alcohols, other than methanol, ethanol and propanol. - Methanol, ethanol and propanol dissolve in water to form a neutral solution, react with sodium to produce hydrogen, burn in air, are used as fuels and solvents, and ethanol is the main alcohol in alcoholic drinks. Candidates are not expected to write balanced chemical equations for the reactions of alcohols other than combustion reactions.	Encourage your child to visit BBC bitesize to learn about alcohols and carboxylic acids Alkenes - More organic chemistry - AQA - GCSE Chemistry (Single Science) Revision - AQA - BBC Bitesize
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- Ethanol can be oxidised to ethanoic acid, either by chemical oxidising agents or by microbial action. Ethanoic acid is the main acid in vinegar.
- Candidates should be aware that vinegar is an aqueous solution that contains ethanoic acid.

Carboxylic acids

- Ethanoic acid is a member of the carboxylic acids, which have the functional group -COOH .

Candidates should be able to recognise carboxylic acids from their names or formulae, but do not need to know the names of individual carboxylic acids, other than methanoic acid, ethanoic acid and propanoic acid.

- Carboxylic acids dissolve in water to produce acidic solutions react with carbonates to produce carbon dioxide react with alcohols in the presence of an acid catalyst to produce esters
- **do not ionise completely when dissolved in water and so are weak acids (HT only)**
- **aqueous solutions of weak acids have a higher pH value than aqueous solutions of strong acids with the same concentration. (HT only)**

	Addition Polymers - recognise addition polymers and monomers from diagrams in the forms shown and from the presence of the functional group $C=C$ in the monomers - draw diagrams to represent the formation of a polymer from a given alkene monomer - relate the repeating unit to the monomer. Condensation Polymers (HT only) explain the basic principles of condensation polymerisation that requires two different functional groups in the monomers and the repeating units in the polymers. When these types of monomers react they join together, usually losing small molecules such as water Amino Acids (HT only) Amino acids have two different functional groups in a molecule. Amino acids react by condensation polymerisation to produce polypeptides Different amino acids can be combined in the same chain to produce proteins.	Encourage your child to watch this video on addition polymers GCSE Chemistry - Addition Polymers & Polymerisation #56 - YouTube Encourage your child to watch this video on condensation polymers GCSE Chemistry - Condensation Polymers (Polyesters) #60 - YouTube Encourage your child to read the information on this website on amino acids Amino Acids (GCSE Chemistry) - Study Mind
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	DNA (deoxyribonucleic acid) and other naturally occurring polymers • DNA (deoxyribonucleic acid) is a large molecule essential for life. • DNA encodes genetic instructions for the development and functioning of living organisms and viruses. • Most DNA molecules are two polymer chains, made from four different monomers called nucleotides, in the form of a double helix. • Other naturally occurring polymers important for life include proteins, starch and cellulose.	Encourage your child to watch this video on naturally occurring polymers GCSE Chemistry - Naturally Occurring Polymers - Polypeptides, DNA, and Carbohydrates #61 - YouTube
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