AQA Chemistry GCSE Student Progress

Unit 4.3 - Quantitative Chemistry

4.3.1. Chemical Measurements, Conservation of Mass and the Quantitative Interpretation of Chemical Equations

4.3.1.1. Conservation of Mass and Balanced Chemical Equations

a	I know that 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.			
b	I know that 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.			
c	I can use multipliers in equations in normal script before a formula and in subscript within a formula.			

4.3.1.2. Relative Formula Mass

a	I know that the relative formula mass (Mr) of a compound is the sum of the relative atomic masses of the atoms in the numbers shown in the formula.			
b	I know that, 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.			

4.3.1.3. Mass Changes when a Reactant or Product is a Gas

a	I know that 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.			
b	I can explain any observed changes in mass in non-enclosed systems during a chemical reaction given the balanced symbol equation for the reaction and explain these changes in terms of the particle model.			

4.3.1.4. Chemical Measurements

a	I can explain why, whenever a measurement is made, there is always some uncertainty about the result obtained.			
b	I can represent the distribution of results and make estimations of uncertainty and use the range of a set of measurements about the mean as a measure of uncertainty (e.g. range bars on graphs).			

4.3.2. Use of Amount of Substance in Relation to Masses of Pure Substances

4.3.2.1. Moles (HT Only)

a	I know that chemical amounts are measured in moles and that the symbol for the unit mole is mol.			
b	I know that the mass of one mole of a substance in grams is numerically equal to its relative formula mass.			
c	I know that 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 x 1023 per mole.			
d	I know that one mole of a substance contains the same number of the stated particles, atoms, molecules or ions as one mole of any other substance.			
e	I can use the relative formula mass of a substance to calculate the number of moles in a given mass of that substance and vice versa.			

4.3.2.2. Amounts of Substances in Equations (HT Only)

a	I know that the masses of reactants and products can be calculated from balanced symbol equations.			
b	I know that chemical equations can be interpreted in terms of moles. For example: $Mg + 2HCI \longrightarrow MgCI_2 + H_2$ shows that one mole of magnesium reacts with two moles of hydrochloric acid to produce one mole of magnesium chloride and one mole of hydrogen gas.			
c	I can calculate the masses of reactants and products from the balanced symbol equation and the mass of a given reactant or product.			

4.3.2.3. Using Moles to Balance Equations (HT Only)

a	I know that 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.			
b	I can balance an equation given the masses of reactants and products.			

4.3.2.4. Limiting Reactants (HT Only)

a	I know that, 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, and that the reactant that is completely used up is called the limiting reactant because it limits the amount of products.			
b	I can explain the effect of a limiting quantity of a reactant on the amount of products it is possible to obtain in terms of amounts in moles or masses in grams.			

4.3.2.5. Concentration of Solutions

a	I know that many chemical reactions take place in solutions and that the concentration of a solution can be measured in mass per given volume of solution, e.g. grams per dm^3 (g/dm^3).			
b	I can calculate the mass of solute in a given volume of solution of known concentration in terms of mass per given volume of solution.			
c	I can explain how the mass of a solute and the volume of a solution is related to the concentration of the solution (HT only)			

4.3.3. Yield and Atom Economy of Chemical Reactions (Chemistry Only)

4.3.3.1. Percentage Yield (Chemistry Only)

a	I know that, 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: • 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.			
b	I know that the amount of a product obtained from a chemical reaction is known as the yield.			
c	I know that, when compared with the maximum theoretical amount as a percentage, it is called the percentage yield.			
d	I can calculate the percentage yield of a product from the actual yield of a reaction, using the equation: % Yield = (Mass of product actually made / Maximum theoretical mass of product) x100			
e	I can calculate the theoretical mass of a product from a given mass of reactant and the balanced equation for the reaction (HT Only).			

4.3.3.2. Atom Economy (Chemistry Only)

a	I know that atom economy (atom utilisation) is a measure of the amount of starting materials that end up as useful products.			
b	I know that atom economy is important for sustainable development and for economic reasons to use reactions with high atom economy.			
c	I can calculate the percentage atom economy of a reaction is calculated using the balanced equation for the reaction as follows: $\text{Atom economy} = \dfrac{\text{Relative formula mass of desired product from equation x100}}{\text{Sum of relative formula masses of all reactants from equation}}$			
d	I can explain why a particular reaction pathway is chosen to produce a specified product given appropriate data such as atom economy (if not calculated), yield, rate, equilibrium position and usefulness of by-products (HT Only).			

4.3.4. Using Concentration of Solutions in mol/dm³ (Chemistry Only) (HT Only)

a	I know that the concentration of a solution can be measured in mol/dm^3.			
b	I know that 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/dm^3.			
c	I know that 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.			
d	I can explain how the concentration of a solution in mol/dm^3 is related to the mass of the solute and the volume of the solution.			

4.3.5. Use of Amount of Substance in Relation to Volumes of Gases (Chemistry Only) (HT Only)

a	I know that equal amounts in moles of gases occupy the same volume under the same conditions of temperature and pressure.			
b	I know that the volume of one mole of any gas at room temperature and pressure (20^oC and 1 atmosphere pressure) is 24 dm^3.			
c	I can calculate the volume of a gas at room temperature and pressure from its mass and relative formula mass.			
d	I can calculate volumes of gaseous reactants and products from a balanced equation and a given volume of a gaseous reactant or product.			