Topic 1: Quantitative chemistry (12.5 hours)

1.1 The mole concept and Avogadro's constant

2 hours

TOK: Assigning numbers to the masses of the chemical elements allowed chemistry to develop into a physical science and use mathematics to express relationships between reactants and products.

	Assessment statement	Obj	Teacher's notes
1.1.1	Apply the mole concept to substances.	2	The mole concept applies to all kinds of particles: atoms, molecules, ions, electrons, formula units, and so on. The amount of substance is measured in moles (mol). The approximate value of Avogadro's constant (L), 6.02×10^{23} mol^{-1}, should be known. **TOK:** Chemistry deals with enormous differences in scale. The magnitude of Avogadro's constant is beyond the scale of our everyday experience.
1.1.2	Determine the number of particles and the amount of substance (in moles).	3	Convert between the amount of substance (in moles) and the number of atoms, molecules, ions, electrons and formula units.

1.2 Formulas

3 hours

	Assessment statement	Obj	Teacher's notes
1.2.1	Define the terms *relative atomic mass* (A_r) and *relative molecular mass* (M_r).	1	
1.2.2	Calculate the mass of one mole of a species from its formula.	2	The term molar mass (in g mol^{-1}) will be used.
1.2.3	Solve problems involving the relationship between the amount of substance in moles, mass and molar mass.	3	
1.2.4	Distinguish between the terms *empirical formula* and *molecular formula.*	2	
1.2.5	Determine the empirical formula from the percentage composition or from other experimental data.	3	**Aim 7:** Virtual experiments can be used to demonstrate this.

1.2.6	Determine the molecular formula when given both the empirical formula and experimental data.	3	

1.3 Chemical equations
1 hour

	Assessment statement	Obj	Teacher's notes
1.3.1	Deduce chemical equations when all reactants and products are given.	3	Students should be aware of the difference between coefficients and subscripts.
1.3.2	Identify the mole ratio of any two species in a chemical equation.	2	
1.3.3	Apply the state symbols (s), (l), (g) and (aq).	2	**TOK:** When are these symbols necessary in aiding understanding and when are they redundant?

1.4 Mass and gaseous volume relationships in chemical reactions
4.5 hours

	Assessment statement	Obj	Teacher's notes
1.4.1	Calculate theoretical yields from chemical equations.	2	Given a chemical equation and the mass or amount (in moles) of one species, calculate the mass or amount of another species.
1.4.2	Determine the limiting reactant and the reactant in excess when quantities of reacting substances are given.	3	**Aim 7:** Virtual experiments can be used here.
1.4.3	Solve problems involving theoretical, experimental and percentage yield.	3	
1.4.4	Apply Avogadro's law to calculate reacting volumes of gases.	2	
1.4.5	Apply the concept of molar volume at standard temperature and pressure in calculations.	2	The molar volume of an ideal gas under standard conditions is 2.24×10^{-2} m^3 mol^{-1} (22.4 dm^3 mol^{-1}).
1.4.6	Solve problems involving	3	**Aim 7:** Simulations can be used to demonstrate this.

	the relationship between temperature, pressure and volume for a fixed mass of an ideal gas.		
1.4.7	Solve problems using the ideal gas equation, $PV = nRT$	3	**TOK:** The distinction between the Celsius and Kelvin scales as an example of an artificial and natural scale could be discussed.
1.4.8	Analyse graphs relating to the ideal gas equation.	3	

1.5 Solutions

2 hours

	Assessment statement	Obj	Teacher's notes
1.5.1	Distinguish between the terms *solute*, *solvent*, *solution* and *concentration* (g dm^{-3} and mol dm^{-3}).	2	Concentration in mol dm^{-3} is often represented by square brackets around the substance under consideration, for example, [HCl].
1.5.2	Solve problems involving concentration, amount of solute and volume of solution.	3	