OCR A GCSE Chemistry

Topic 3: Chemical reactions

Introducing chemical reactions

Notes

C3.1a use chemical symbols to write the formulae of elements and simple covalent and ionic compounds

- For simple ionic – just balance the charges of the ions involved
- For simple covalent – imagine what the ion would be, e.g. H_2O balances – because the ions would be $2H^+$ and O^{2-} (and ++ cancels out with - -)

C3.1b use the names and symbols of common elements and compounds and the principle of conservation of mass to write formulae and balanced chemical equations and (HT only) half equations

- to write a balanced chemical equation: count up how many atoms of each element you have on both sides of the equation
- use large numbers e.g. $3H_2O$ to balance the equation so that there is the same amount of each element on each side

C3.1c use the names and symbols of common elements from a supplied periodic table to write formulae and balanced chemical equations where appropriate

C3.1d use the formula of common ions to deduce the formula of a compound

- Ions of elements are atoms of those elements that have either lost or gained one or more electrons
  - Atoms form ions in order to have a stable arrangement of electrons – i.e. one similar to that of a noble gas, with 8 electrons in its outer shell
  - For example, group 1 ions have a 1+ charge to gain the arrangement of a group 8 / group 0 (noble gas)
- In a compound, the charges of ions have to balance out, e.g. HCl exists, because of the formation of an H^+ ion and a Cl^- ion, also H_2SO_4 exists, because of the formation of $2H^+$ ions and a $SO4^{2-}$ ion (therefore, 2 hydrogen ions are needed here, due to the SO_4 ion having a 2- charge)
- common ions:
  - group 1: form 1+ ions, group 2: form 2+ ions, group 3: form 3+ ions
  - group 5: form 3- ions, group 6: form 2- ions, group 7: form 1- ions
  - ions from common acids: NO_3^- (nitric acid), Cl^- (hydrochloric acid), SO_4^{2-} (sulfuric acid)

(HT only) C3.1e construct balanced ionic equations

- Write out the full chemical equation
- Split (aq) substances up into ions e.g. HCl(aq) becomes H^+(aq) + Cl^-(aq) and write out as another equation
- Cancel out 'spectator ions' – unchanged ions on either side of the chemical equation
- You are now left with the ionic equation

C3.1f describe the physical states of products and reactants using state symbols (s, l, g and aq)

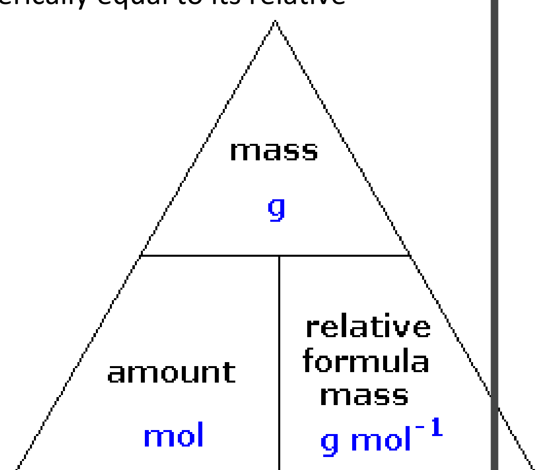
- (s) means solid, (l) liquid, (g) gas and (aq) aqueous

(HT only) C3.1g recall and use the definitions of the Avogadro constant (in standard form) and of the mole

- Chemical amounts are measured in moles. The symbol for the unit mole is mol.
- Mole = amount of substance
- The number of atoms, molecules or ions in a mole of a given substance is the Avogadro constant: 6.02×10^{23} per mole.

(HT only) C3.1h explain how the mass of a given substance is related to the amount of that substance in moles and vice versa

- The mass of one mole of a substance in grams is numerically equal to its relative formula mass.
- For example, the Ar of Iron is 56, so one mole of iron weighs 56g.
- The Mr of nitrogen gas (N2) is 28 (2 x 14), so one mole is 28g.
- One mole of a substance contains the same number of the stated particles, atoms, molecules or ions as one mole of any other substance
- You can convert between moles and grams by using this triangle:
    - o E.g how many moles are there in 42g of carbon?
        - ▪ Moles = Mass / Mr = 42/12 = 3.5 moles



C3.1i recall and use the law of conservation of mass

- Law of conservation of mass: no atoms are lost or made during a chemical reaction so the mass of the products = mass of the reactants
    - Therefore, 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.
- Use this law to write chemical equations

C3.1j explain any observed changes in mass in non-enclosed systems during a chemical reaction and explain them using the particle model

- If a reaction appears to involve a change in mass – check to see if this is due to a reactant or a product as a gas and its mass has not been taken into account
    - Example: when a metal reacts with oxygen – mass of metal oxide product > mass of metal started with

(HT only) C3.1k deduce the stoichiometry of an equation from the masses of reactants and products and explain the effect of a limiting quantity of a reactant

Stoichiometry:

- Stoichiometry refers to the balancing numbers in front of compounds/elements in reaction equations
- Balancing numbers in a symbol equation can be calculated from the masses of reactants and products:
    - convert the masses in grams to amounts in moles (moles = mass/Mr)
    - convert the numbers of moles to simple whole number ratios
- e.g. for the reaction: Cu + O_2 -> CuO (not balanced), 127 g Cu react, 32g of oxygen react and 159g of CuO are formed. Work out the balanced equation using the masses given:
    - moles: (moles = mass/Mr)
      Cu: moles = 127 / 63.5 = 2
      O_2: moles= 32 / (16 x 2) = 32/32 = 1
      CuO moles = 159 / (16 + 63.5) = 2
    - therefore you have a ratio of 2:1:2 for Cu:O_2:CuO, making the overall balanced equation 2Cu + O_2 -> 2CuO

Explain the effect of a limiting quantity of a reactant:

- In a chemical reaction with 2 reactants you will often use one in excess to ensure that all of the other reactant is used

- The reactant that is used up / not in excess is called the limiting reactant since it limits the amount of products

- if a limiting reagent is used, the amount reactant in excess that actually reacts is limited to the exact amount that reacts with the amount of limiting reagent you have, so you need to use the moles/mass of the limiting reagent for any calculations

(HT only) C3.1l use a balanced equation to calculate masses of reactants or products

- Find moles of the substance you're given the mass of: moles = mass / molar mass
- Use balancing numbers to find the moles of desired reactant or product (e.g. if you had the equation: $2NaOH + Mg \rightarrow Mg(OH)_2 + 2Na$, if you had 2 moles of Mg, you would form 2x2=4 moles of Na)
- Mass = moles x molar mass(of the reactant/product) to find mass