CAIE IGCSE Chemistry

3.1 Formulae

Notes

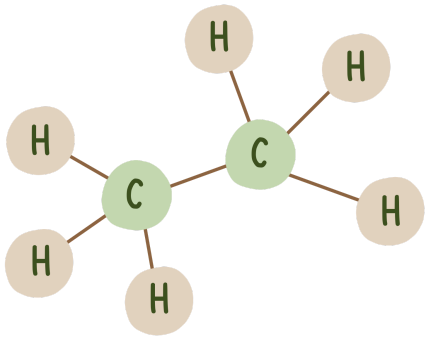
State the formulae of the elements and compounds named in the subject content

- Examples of symbols of the elements: Sodium (Na), Chlorine (Cl) etc…
- Example of a formula of a simple compound: Sodium chloride (NaCl)

Define the molecular formula of a compound as the number and type of different atoms in one molecule

- The molecular formula of a compound is the actual number of atoms of each element present in a compound
- E.g The molecular formula of water is H_2O

Deduce the formula of a simple compound from the relative numbers of atoms present in a model or a diagrammatic representation



- To determine the formula of a compound, count the number of atoms of each element in the model/diagram and repeat for each element
- E.g. in this ball and stick model, there are 6 hydrogen atoms and 2 carbon atoms so this compound is C_2H_6 (known as ethane)

Construct word equations and symbol equations to show how reactants form products, including state symbols

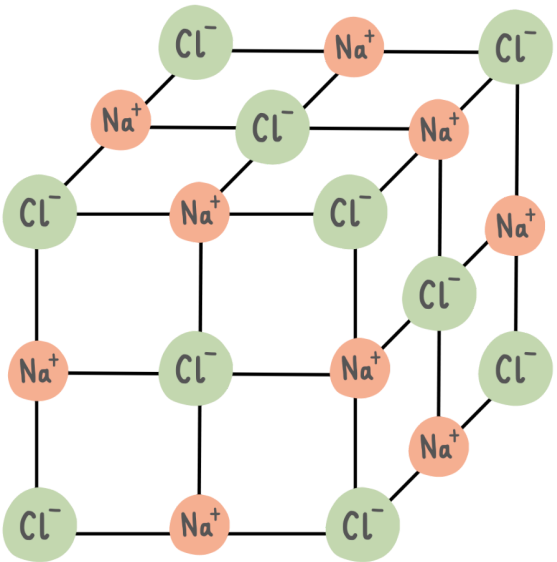
- The state symbols:
  - (s) means solid, e.g. most metals are solid at room temp: Na(s), Mg(s)
  - (l) means liquid e.g. bromine and mercury are liquid at room temp: Br_2(l), Hg (l). Pure water is also (l): H_2O (l)
  - (g) means gas, e.g. chlorine and nitrogen gas at room temp: Cl_2(g), N_2(g)
  - (aq) means aqueous, any substance dissolved in solution, e.g. NaCl (aq), H_2SO_4(aq)
- Example of word equation:
  Hydrochloric acid + Sodium hydroxide -> Sodium chloride + Water
- Example of balanced chemical equation:
  HCl (aq) + NaOH (aq) -> NaCl (aq) + H_2O (l)

(Extended only) Define the empirical formula of a compound as the simplest whole number ratio of the different atoms or ions in a compound

- The empirical formula of a compound is the simplest whole number ratio of atoms of each element in a compound
- E.g The molecular formula of a compound is C_2H_6 but the empirical formula of this compound would be CH_3 since both 2 and 6 can be simplified further.

(Extended only) Deduce the formula of an ionic compound from the relative numbers of the ions present in a model or a diagrammatic representation or from the charges on the ions

- To determine the formula of an ionic compound, identify the ions of each element in the model/diagram and take note of their charges
- An ionic compound will have an overall charge of zero
- E.g. in this ball and stick model, there are sodium ions with a +1 charge and chloride ions with a -1 charge, so together the charges make zero so the formula of this compound is NaCl (sodium chloride)
- E.g. an ionic compound with magnesium ions with a +2 charge and chloride ions with a -1 charge: to balance out the charges 2 chloride ions would be needed for every 1 magnesium ion, so the formula of this ionic compound is $MgCl_2$

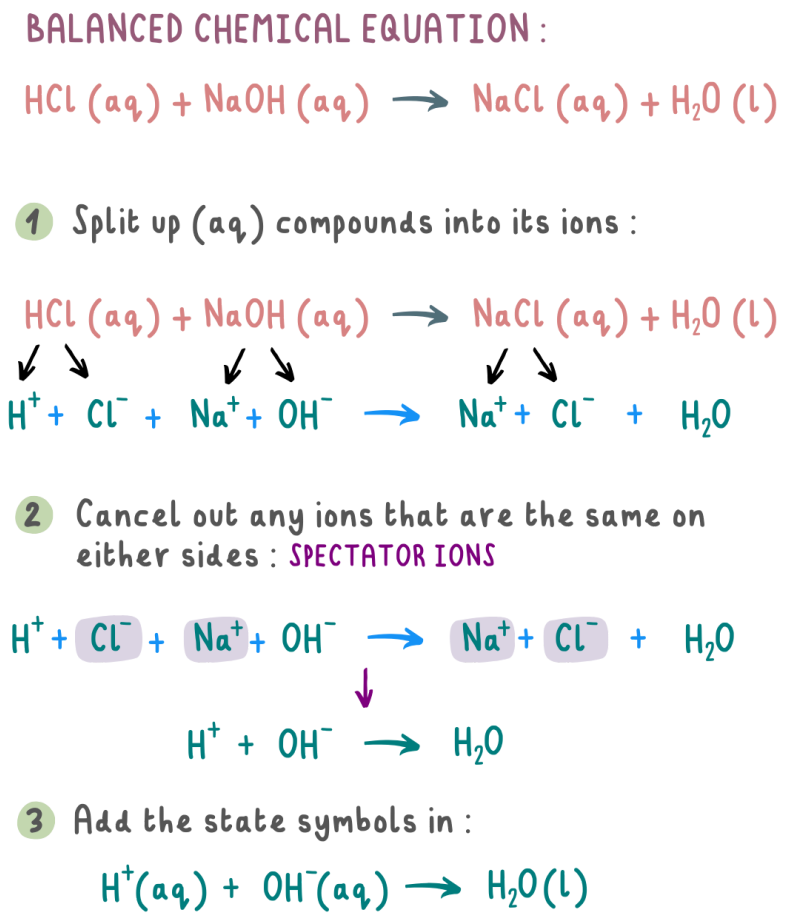


(Extended only) Construct symbol equations with state symbols, including ionic equations

- Chemical symbols and formulae are used to represent elements and compounds involved in the reaction
    - All metal elements and some non-metals are shown by just their symbols, e.g. Na, Mg, Li, Ca
    - Some non-metals are diatomic molecules, shown by the subscript 2 = 2 atoms in each molecule: H_2, N_2, O_2, F_2, Cl_2, Br_2, I_2
    - The format of equations: reactant (+ reactant) -> product (+ product)
    1. Find the symbols and formulae for each element/compound
    2. Put into format and see if the number of atoms of each element are the same on either side of the arrow
    3. Add in the state symbols

<u>Constructing ionic equations</u>

- In a balanced ionic equation:
    - the number of positive and negative charges on both sides of the arrow are the same
    - the numbers of atoms of each element on both sides of the arrow are the same



(Extended only) Deduce the symbol equation with state symbols for a chemical reaction, given relevant information

- E.g Construct a symbol equation, with state symbols, for the following reaction: Magnesium + Oxygen -> Magnesium oxide
    1. Find the symbols and formulae for each element
        - Magnesium: Mg Oxygen: O_2 Magnesium oxide: MgO
        - MgO: found by balancing the charges of magnesium ions (+2) and oxide ions (-2)

    2. Put into format and see if the reactants and products are balanced:
        - Unbalanced equation: Mg + O_2 -> MgO
        - There are 2 oxygen atoms on the left but only 1 on the right
        - To keep the product correctly balanced, we need 2 magnesium atoms on the left too
        - Balanced equation: 2Mg + O_2 -> 2MgO

    3. Add the state symbols in
        - Correct answer: 2Mg (s) + O_2 (g) -> 2MgO (s)