

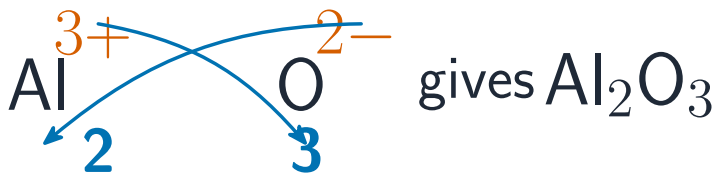
Exercise walk-through

3.2

Relative masses of atoms and molecules

IGCSE Chemistry

Chemical formulae



the charge numbers cross over to become the subscripts (then simplify if they share a factor)

- The **molecular formula** is the actual number of each atom in one **molecule**. For glucose it is C₆H₁₂O₆.
- The **empirical formula** is the simplest whole-number **ratio** of the atoms or **ions** in a **compound**. For glucose it is CH₂O.

Formulae, equations and state symbols

an ionic compound

work the formula out from the **charges**: total positive must balance total negative

the common ions

+: Na^+ , K^+ , Ca^{2+} , Mg^{2+} , Al^{3+} , NH_4^+ . -: Cl^- , OH^- , NO_3^- , SO_4^{2-} , CO_3^{2-} , O^{2-}

a word equation

uses names: *magnesium + oxygen → magnesium oxide*

a symbol equation

uses formulae, and must be **balanced**

state symbols

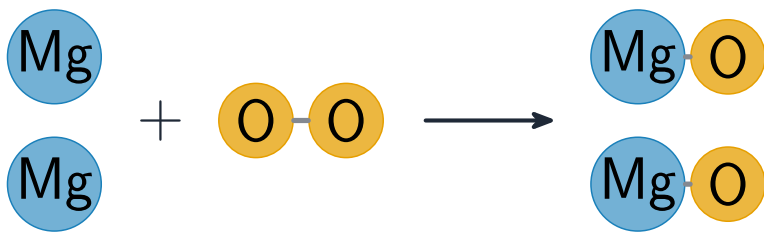
(s) solid, (l) liquid, (g) gas, (aq) **aqueous** – dissolved in water

an ionic equation

shows only the ions that actually change; spectator ions are left out

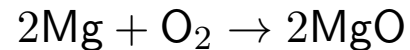
Balance by changing **the numbers in front**, never the formulae themselves. Changing a subscript makes it a different substance.

Writing and balancing equations



2 Mg and 2 O on each side: balanced

A **balanced** symbol equation has the **same** number of each atom on both sides.



State symbols :
(s) (l) (g) (aq).

The words an equation uses

ReactantsThe **reactants**

are on the left – what you start with.

ProductsThe **products**

are on the right – what you finish with.

Balancing

Change the *numbers in front*, never the formulas. Atoms are conserved, so each element must appear the same number of times on both sides.

In solution

A **solute** dissolves in a solvent to give a solution; concentration is moles of solute per dm^3 .

A balanced equation is a recipe in *moles*, which is why every reacting-mass calculation begins by writing one.

Exercises 2.1·2.2

2.1 Calculate the M_r of carbon dioxide, CO_2 (A_r : C = 12, O = 16). [2]

2.2 State what relative atomic mass means. [1]

Exercises 2.1·2.2

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2.1

- $M_r(\text{CO}_2) = 12 + (2 \times 16)$
 - 44
-

2.2 State what relative atomic mass means. [1]

2.2

- relative atomic mass is the **average mass of an atom** compared with $\frac{1}{12}$ the mass of a carbon-12 atom

Exercises 3.1·3.2

3.1 The relative formula mass of CaCO_3 (A_r : Ca = 40, C = 12, O = 16) is: [1]

☐

A 68

B 82

C 100

D 116

3.2 Calculate the M_r of ammonium nitrate, NH_4NO_3 (A_r : N = 14, H = 1, O = 16). [2]

Exercises 3.1·3.2

3.1 The relative formula mass of CaCO_3 (A_r : Ca = 40, C = 12, O = 16) is: [1]

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3.1 C

- $M_r(\text{CaCO}_3) = 40 + 12 + (3 \times 16) = \mathbf{100}$
- A and B miss oxygen atoms; D overcounts

3.2 Calculate the M_r of ammonium nitrate, NH_4NO_3 (A_r : N = 14, H = 1, O = 16). [2]

3.2

- $M_r(\text{NH}_4\text{NO}_3) = (2 \times 14) + (4 \times 1) + (3 \times 16)$
- $28 + 4 + 48 = \mathbf{80}$

Exercise 3.3 (a)

3.3 48 g of magnesium reacts completely with oxygen to form 80 g of magnesium oxide.

(a) Find the mass of magnesium oxide formed from 12 g of magnesium. [2]

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(a)

- 12 g is $\frac{1}{4}$ of 48 g

$$m(\text{MgO}) = \frac{1}{4} \times 80 \text{ g} = \mathbf{20 \text{ g}}$$

Exercise 3.3 (b)

3.3 48 g of magnesium reacts completely with oxygen to form 80 g of magnesium oxide.

(b) Find the mass of oxygen that reacted with the 48 g of magnesium. [1]

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(b)

- mass of oxygen $m_{\text{O}} = m_{\text{oxide}} - m_{\text{metal}} = 80 \text{ g} - 48 \text{ g} = \mathbf{32 \text{ g}}$