

Exercise walk-through

Formulas ■ 2.3

eXercise

You must be able to

- write formulas of ionic compounds from ionic charges and oxidation numbers
- write and balance equations (including ionic equations) with state symbols
- calculate empirical and molecular formulas from data

Method — Ionic formulas

The total + charge balances the total - charge. Charges from the group: Group 1 +1, 2 +2, 13 +3, 15 -3, 16 -2, 17 -1. Learn: NO_3^- , CO_3^{2-} , SO_4^{2-} , OH^- , NH_4^+ . E.g. iron(III) oxide = Fe_2O_3 (two Fe^{3+} balance three O^{2-}).

Method — Ionic formulas

75% ^{35}Cl

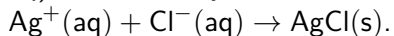
25% ^{37}Cl

$$A_r = \frac{(75 \times 35) + (25 \times 37)}{100} = 35.5$$

Formulae build from relative atomic masses

Method — Equations and ionic equations

A balanced equation has the same atoms on both sides; add **state symbols** (s, l, g, aq). An **ionic equation** shows only what changes (no **spectator ions** 旁观离子):



Method — Empirical formula

Divide each element's mass (or %) by its $A_r \rightarrow$ moles; divide by the smallest; round to whole numbers. **Example.** 40.0% C, 6.7% H, 53.3% O: moles $3.33 : 6.7 : 3.33 \rightarrow 1 : 2 : 1 \rightarrow \text{CH}_2\text{O}$. With M_r , scale up to the **molecular formula**.

Practice 2.1 ■ 2 marks

Write the formula of (a) calcium nitrate and (b) aluminium sulfate.

Solution 2.1

Worked steps

(a) $\text{Ca}(\text{NO}_3)_2$ **B1**; (b) $\text{Al}_2(\text{SO}_4)_3$ **B1**.

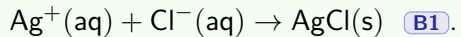
Practice 2.2 ■ 1 mark

Write the ionic equation for the reaction of silver ions with chloride ions to form silver chloride.

Solution 2.2

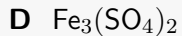
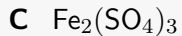
Method: Equations and ionic equations

Worked steps

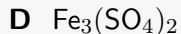
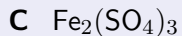
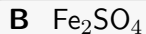


Exam-style 3.1 ■ 1 mark

What is the formula of iron(III) sulfate?



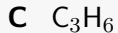
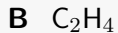
Solution 3.1

**Worked steps**

C. Two Fe^{3+} balance three $\text{SO}_4^{2-} \rightarrow \text{Fe}_2(\text{SO}_4)_3$.

Exam-style 3.2 ■ 1 mark

A compound has empirical formula CH_2 and $M_r = 42$. Its molecular formula is:



Solution 3.2

Method: Empirical formula

A CH₂

B C₂H₄

C C₃H₆



D C₄H₈

Worked steps

C. Empirical mass 14; $42/14 = 3 \rightarrow \text{C}_3\text{H}_6$.

Exam-style 3.3 ■ 2 marks

Balance this equation and add state symbols: $\text{Mg} + \text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$.

Solution 3.3

Method: Equations and ionic equations

Worked steps

$\text{Mg(s)} + 2\text{HCl(aq)} \rightarrow \text{MgCl}_2\text{(aq)} + \text{H}_2\text{(g)}$ **M1** **A1** *balanced, state symbols.*

Exam-style 3.4 ■ 3 marks

A compound contains 2.4 g of carbon, 0.4 g of hydrogen and 3.2 g of oxygen (A_r : C 12, H 1, O 16).

- (a) Calculate its empirical formula.
- (b) The M_r of the compound is 60. Deduce its molecular formula.

Solution 3.4

Method: Empirical formula

Worked steps

(a) moles: $\text{C} = 2.4/12 = 0.20$, $\text{H} = 0.4/1 = 0.40$, $\text{O} = 3.2/16 = 0.20$ (M1); divide by 0.20 $\rightarrow 1 : 2 : 1$ (M1); empirical formula CH_2O (A1).

(b) empirical mass 30; $60/30 = 2 \rightarrow \text{C}_2\text{H}_4\text{O}_2$ (B1).