# Exercise walk-through

Representations of Reactions ▪ 4.3

eXercise

# You must be able to

- connect the **symbolic** (equation), **particulate** (particle diagram), and **macroscopic** (observations) levels
- draw or read a particle diagram of a reaction
- match a balanced equation to a particle picture

## Method — The three levels

Chemists describe a reaction three ways:

- **Macroscopic** — what you see (a gas, a color change);
- **Symbolic** — the balanced equation, e.g. $2\mathrm{H}_2 + \mathrm{O}_2 \rightarrow 2\mathrm{H}_2\mathrm{O}$;
- **Particulate** — a diagram of the atoms/molecules before and after.

## Method — Particle diagrams conserve atoms

A correct particle diagram has the **same number of each atom** before and after (mass is conserved). If you start with 4 H and 2 O atoms, they must all appear in the products.

## Method — Reading coefficients as ratios

The coefficients give the **ratio** of particles: $2H_2 + O_2$ means two $H_2$ molecules react with one $O_2$. A particle diagram should show that ratio.

# Method — Matching levels

Given a balanced equation, a valid particle diagram shows the right numbers and types; given a diagram, you can write the balanced equation by counting.

## Practice 2.1 ▪ 3 marks

Name the three levels chemists use to represent a reaction.

# Solution 2.1

Method: The three levels

**Worked steps**

Macroscopic, symbolic, particulate B1 B1 B1.

## Practice 2.2 ▪ 1 mark

In $2H_2 + O_2 \rightarrow 2H_2O$, how many $H_2$ molecules react per $O_2$?

# Solution 2.2

**Worked steps**

Two B1.

## Practice 2.3 ▪ 1 mark

What must be equal on both sides of a particle diagram?

# Solution 2.3

Method: Particle diagrams conserve atoms

**Worked steps**

The number of each type of atom B1.

## Exam-style 3.1 ▪ 1 mark

A particle diagram of a reaction must show, before and after, the same number of each

**A** molecule

**B** atom

**C** color

**D** container

# Solution 3.1

Method: Particle diagrams conserve atoms

**A** molecule

**B** atom ✓

**C** color

**D** container

**Worked steps**

**B** — the same number of each atom (conservation of mass).

## Exam-style 3.2 ▪ 2 marks

A particle diagram shows 3 molecules of $N_2$ and 9 of $H_2$ fully reacting.
(a) Write the balanced equation for $N_2 + H_2 \rightarrow NH_3$.
(b) How many $NH_3$ molecules form from 3 $N_2$ and 9 $H_2$?

# Solution 3.2

**Worked steps**

(a) $N_2 + 3H_2 \rightarrow 2NH_3$ M1 A1. (b) 3 $N_2$ with 9 $H_2$ (a 1:3 ratio) makes 6 $NH_3$ M1 A1.

## Exam-style 3.3 ▪ 2 marks

Explain why a particle diagram cannot show 4 H atoms before and only 2 H atoms after a reaction.

# Solution 3.3

**Worked steps**

Atoms are conserved in a reaction; they are rearranged, not created or destroyed, so the count of each element must match on both sides M1 A1.