

4.3 Three Ways to Represent a Reaction

Name: _____ Class: _____ Date: _____

Total: 12 marks

Objective

Build the skills to answer exam questions on the **three ways to represent a reaction**—symbolic, particulate, and macroscopic.

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

1 Worked examples

Study these first. Each one shows the method for a question type used later—follow the steps and you can do the Practice and Exam-style questions yourself.

■ The three levels

Chemists describe a reaction three ways:

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

■ 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.

■ Reading coefficients as ratios

The coefficients give the **ratio** of particles: $2\text{H}_2 + \text{O}_2$ means two H_2 molecules react with one O_2 . A particle diagram should show that ratio.

■ 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.

2 Practice

Now apply the methods above.

2.1 Name the three levels chemists use to represent a reaction. [3]

2.2 In $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$, how many H_2 molecules react per O_2 ? [1]

2.3 What must be equal on both sides of a particle diagram? [1]

3 Exam-style questions

3.1 A particle diagram of a reaction must show, before and after, the same number of each [1]

- **A** molecule
- **B** atom
- **C** color
- **D** container

3.2 A particle diagram shows 3 molecules of N_2 and 9 of H_2 fully reacting.

(a) Write the balanced equation for $\text{N}_2 + \text{H}_2 \rightarrow \text{NH}_3$. [2]

(b) How many NH_3 molecules form from 3 N_2 and 9 H_2 ? [2]

3.3 Explain why a particle diagram cannot show 4 H atoms before and only 2 H atoms

after a reaction.

[2]

4 Go further

You are now ready for the real exam questions on this subtopic:

- work through the **4.3 Three Ways to Represent a Reaction** lesson on the **Learn** page;
- read the **Three Ways to Represent a Reaction** section of the AP Chemistry handout on the **Know** page.

Solutions

2.1 Macroscopic, symbolic, particulate.

2.2 Two.

2.3 The number of each type of atom.

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

3.2 (a) $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$. (b) 3 N_2 with 9 H_2 (a 1:3 ratio) makes 6 NH_3 .

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