AP CHEMISTRY • EXERCISE SHEET

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. $2H_2 + O_2 \rightarrow 2H_2O$;
- **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: $2H_2 + O_2$ 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 $2H_2 + O_2 \rightarrow 2H_2O$, 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 $N_2 + H_2 \rightarrow NH_3$. [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]

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) $N_2 + 3H_2 \rightarrow 2NH_3$. (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.