AP CHEMISTRY • EXERCISE SHEET

7.8 Representations of Equilibrium

Name: _____ Class: _____ Date: _____ **Total: 9 marks**

Objective

Build the skills to answer exam questions on **representations of equilibrium** — the particle picture.

You must be able to:

- read a **particle diagram** showing an equilibrium mixture
- connect the diagram's ratio to the size of K
- recognise that amounts stay constant at equilibrium

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.

Particle diagrams of equilibrium

An equilibrium particle diagram shows a **mixture** of reactant and product particles whose numbers stay **constant** over time (equal forward and reverse rates).

Reading K from the ratio

The ratio of product to reactant particles reflects the size of K: mostly products $\rightarrow$ large K; mostly reactants $\rightarrow$ small K; roughly equal $\rightarrow$ $K \approx 1$.

A worked reading

A box with 8 product particles and 2 reactant particles suggests products are favored, so $K > 1$. The exact value uses the equilibrium expression.

Constant over time

Two diagrams at different times, both at equilibrium, should show the **same** numbers of each particle — individual molecules interconvert, but the totals hold.

2 Practice

Now apply the methods above.

2.1 At equilibrium, do the numbers of each particle change over time? [1]

2.2 A diagram shows mostly product particles. Is K large or small? [1]

2.3 A diagram shows roughly equal reactant and product particles. Estimate K. [1]

3 Exam-style questions

3.1 An equilibrium particle diagram with mostly reactant particles indicates [1]

- **A** $K > 1$
- **B** $K < 1$
- **C** $K = 0$
- **D** no reaction

3.2 For A $\rightleftharpoons$ B, a box at equilibrium shows 3 A and 9 B particles (in a fixed volume).

(a) Estimate K (treat particle counts as concentrations). [2]

(b) State whether products or reactants are favored. [1]

3.3 Explain why two particle diagrams of the same equilibrium, taken 1 minute apart, should show the same numbers of each species. [2]

Solutions

2.1 No — they stay constant.

2.2 Large.

2.3 About 1.

3.1 **B** — mostly reactants means $K < 1$.

3.2 (a) $K = \dfrac{[\text{B}]}{[\text{A}]} = \dfrac{9}{3} = 3$. (b) Products favored ($K > 1$).

3.3 At equilibrium the forward and reverse rates are equal, so although individual molecules keep converting, the total number of each species does not change.