AP CHEMISTRY • EXERCISE SHEET

7.1 Introduction to Equilibrium

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

Objective

Build the skills to answer exam questions on **chemical equilibrium** —the dynamic balance of a reversible reaction.

You must be able to:

- describe **dynamic equilibrium** 动态平衡 (forward rate = reverse rate)
- explain that concentrations stay **constant**, not equal
- recognise the ⇌ symbol

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.

■ Dynamic equilibrium

In a closed system a reversible reaction reaches **equilibrium** when the **forward and reverse rates are equal**. Both reactions still happen —it is **dynamic**, not stopped.

■ Concentrations are constant, not equal

At equilibrium the concentrations of reactants and products stay **constant** over time, but they are usually **not equal** to each other.

■ The reversible arrow

The ⇌ symbol means the reaction goes **both** ways at once. A reaction that goes essentially to completion uses a single arrow.

■ Reaching equilibrium

Starting from reactants, the forward rate is high and falls as reactants deplete; the reverse rate starts at zero and rises. They meet —that is equilibrium.

2 Practice

Now apply the methods above.

2.1 At equilibrium, how do the forward and reverse rates compare? [1]

2.2 Are reactant and product concentrations equal at equilibrium? [1]

2.3 What does ”dynamic” mean in dynamic equilibrium? [1]

3 Exam-style questions

3.1 At equilibrium, the concentrations of reactants and products are [1]

- **A** equal to each other
- **B** constant over time
- **C** zero
- **D** always increasing

3.2 A reversible reaction is placed in a closed flask starting with only reactants.

(a) Describe how the forward and reverse rates change until equilibrium. [2]

(b) State what is true of the rates at equilibrium. [1]

3.3 Explain why equilibrium is called ”dynamic” even though concentrations do not change. [2]

4 Go further

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

- work through the **7.1 Introduction to Equilibrium** lesson on the **Learn** page;
- read the **Introduction to Equilibrium** section of the AP Chemistry handout on the **Know** page.

Solutions

2.1 They are equal.

2.2 Not necessarily —they are constant, but usually not equal.

2.3 Both the forward and reverse reactions continue at the molecular level.

3.1 B —constant over time.

3.2 (a) The forward rate starts high and falls as reactants deplete; the reverse rate starts at zero and rises as products build, until they meet. (b) They are equal.

3.3 The forward and reverse reactions continue at equal rates, so molecules keep converting both ways; the concentrations stay constant only because the two rates cancel.