AP CHEMISTRY • EXERCISE SHEET

7.9 Introduction to Le Chatelier's Principle

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

KEY WORDS le chatelier's principle 勒沙特列原理

Objective

Build the skills to answer exam questions on **Le Chatelier's principle**.

You must be able to:

- predict the shift when **concentration**, **pressure/volume**, or **temperature** changes
- state **Le Chatelier's principle** 勒沙特列原理
- treat a temperature change using the reaction's ΔH

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 principle

If a stress is applied to a system at equilibrium, it shifts to **counteract** the stress and restore equilibrium.

Concentration

Adding a reactant shifts **toward products** (to use it up); removing a product shifts **toward products** (to replace it).

Pressure and volume (gases)

Increasing pressure (smaller volume) shifts toward the side with **fewer gas moles**. If both sides have equal moles, pressure has no effect.

Temperature

Treat heat as a reactant/product using ΔH:

- **exothermic** (heat is a product): heating shifts **toward reactants** (backward);
- **endothermic** (heat is a reactant): heating shifts **toward products** (forward).

Only temperature changes the value of K.

2 Practice

Now apply the methods above.

2.1 State Le Chatelier's principle. [1]

2.2 For $\mathrm{A} + \mathrm{B} \rightleftharpoons \mathrm{C}$, which way does adding more A shift it? [1]

2.3 Which single change alters the value of K? [1]

3 Exam-style questions

3.1 Increasing the pressure on a gas equilibrium shifts it toward the side with [1]

- **A** more gas moles
- **B** fewer gas moles
- **C** solids
- **D** no change ever

3.2 Consider $\mathrm{N_2}(g) + 3\mathrm{H_2}(g) \rightleftharpoons 2\mathrm{NH_3}(g)$, $\Delta H < 0$.

(a) State the shift when the pressure is increased. [2]

(b) State the shift when the temperature is increased, with a reason. [2]

3.3 For $2\mathrm{SO_2} + \mathrm{O_2} \rightleftharpoons 2\mathrm{SO_3}$ ($\Delta H < 0$), state and explain the effect of removing $\mathrm{SO_3}$. [2]

Solutions

2.1 A system at equilibrium shifts to counteract an applied stress and restore equilibrium.

2.2 Toward products (forward).

2.3 A temperature change.

3.1 B — fewer gas moles.

3.2 (a) There are 4 gas moles left, 2 right; increasing pressure shifts toward the fewer-mole side — **toward products**. (b) Exothermic, so heat is a product; increasing temperature shifts **toward reactants** (backward).

3.3 Removing SO_3 (a product) shifts the equilibrium **forward** to replace it, making more SO_3.