

7 Le Chatelier's principle – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
Le Chatelier's principle	勒沙特列原理	_____

Recall

In Part A you met equilibrium. Now see what happens when you **disturb** it:

- Squeeze a gas equilibrium and it shifts one way.
- Heat it and it shifts another way.
- Factories use these tricks to get more product (like ammonia).

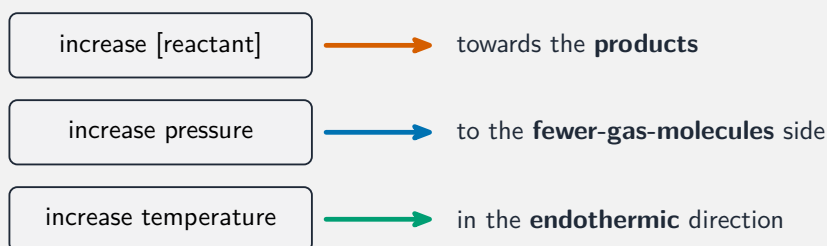
Each idea has a worked example before the Practice.

New ideas

■ 1 Le Chatelier's principle

Le Chatelier's principle 勒沙特列原理 says: if you disturb a system at equilibrium, it shifts to **partly cancel** the change.

the equilibrium shifts to *oppose* the change you make



a **catalyst** speeds both directions equally, so it gives *no shift*

■ 2 Changing concentration

- Add more **reactant** → the equilibrium shifts **forward** (toward products).
- Remove **product** → it also shifts **forward** to replace it.

Worked example. In $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$, adding more N_2 shifts the equilibrium toward the right, making more ammonia.

■ 3 Changing pressure

For gases, raising the pressure (by squeezing) shifts the equilibrium toward the side with **fewer** gas molecules.

Worked example. In $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$ (4 gas molecules → 2), higher pressure shifts it toward the ammonia side, which has fewer molecules.

■ 4 Changing temperature

Raising the temperature shifts the equilibrium in the **endothermic** direction (the one that absorbs heat); lowering it shifts the other way.

Watch out: a catalyst speeds a reaction reaching equilibrium, but it does **not** shift the position of the equilibrium –it changes the forward and reverse rates equally.

Practice

Try these in order. The methods are all above.

2.1 State what Le Chatelier's principle says a system does when disturbed. [1]

2.2 For $\text{A} + \text{B} \rightleftharpoons \text{C}$, state which way the equilibrium shifts if you (a) add more A, (b) remove C. [2]

2.3 For a gas reaction where the left side has more gas molecules than the right, state which way higher pressure shifts the equilibrium. [2]

2.4 State the effect of adding a catalyst on the **position** of an equilibrium. [1]

2.5 In the Haber process, explain why a high pressure gives a better yield of ammonia ($\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$). [2]
