

7 Le Chatelier's principle – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary

*Write each word three times.***English****Write it 3 times** (English)Le Chatelier's
principle

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 says: if you disturb a system at equilibrium, it shifts to **partly cancel** the change.

the equilibrium shifts to **oppose** the change you make

increase [reactant]

towards the **products**

increase pressure

to the **fewer-gas-molecules** side

increase temperature

in the **endothermic** direction

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]
