N14 - Equilibrium

Le Châtelier’s Principle

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Target: I can describe how a reaction shifts in response to a change in conditions (a stress) in order to reach a new equilibrium position.

Le Châtelier's Principle

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Guides us in predicting the effect various changes in conditions have on the position of equilibrium.

If a system at equilibrium is disturbed, the position of equilibrium will shift to minimize the disturbance.

You don't go back to the ORIGINAL equilibrium position, you will find a NEW equilibrium position.

Le Chatelier Example #1

A closed container of ice and water is at equilibrium. Then, the temperature is raised.

$$\text{Ice} + \text{Energy} \leftrightarrows \text{Liquid Water}$$

The system temporarily shifts to the **right** to reach a new equilibrium.

Le Chatelier Example #2

A closed container of N_2O_4 and NO_2 is at equilibrium. NO_2 is added to the container.

$$\mathbf{N_2O_4}\,(g) + \mathbf{Energy} \leftrightarrows \mathbf{2\ NO_2}\,(g)$$

The system temporarily shifts to the **left** to reach a new equilibrium.

Le Chatelier Example #3

A closed container of water and its vapor is at equilibrium. Vapor is removed from the system.

water + Energy ⇆ vapor

The system temporarily shifts to the **right** to reach a new equilibrium.

Le Chatelier Example #4

A closed container of N_2O_4 and NO_2 is at equilibrium. The pressure is increased.

$$\leftarrow$$

$$\mathbf{N_2O_4}\,(g) + \mathbf{Energy} \leftrightarrows \mathbf{2\ NO_2}\,(g)$$

The system temporarily shifts to the __left__ to reach a new equilibrium, because there are ***fewer moles of gas*** on that side of the equation.

The Effect of Volume Changes on Equilibrium

Increase Pressure, Lower Volume

Equilibrium will shift to the side that has ***fewer moles of gas particles***.

Helps to relieve the pressure.

$$N_{2(g)} + 3H_{2(g)} \leftrightarrow 2NH_{3(g)}$$

4 moles of gas | **2 moles of gas**

Reaction would shift to right, make more products

The Effect of Volume Changes on Equilibrium

Decrease Pressure, Increase Volume

Equilibrium will shift to the side that has ***more moles of gas particles***.

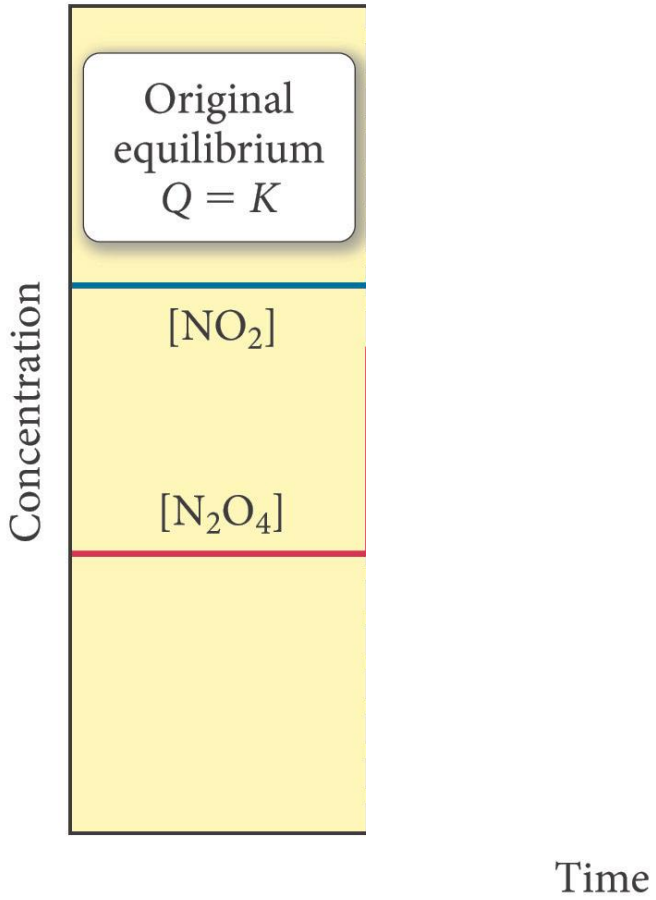
Helps to raise the pressure.

$$N_{2(g)} + 3H_{2(g)} \leftrightarrow 2NH_{3(g)}$$

4 moles of gas | **2 moles of gas**

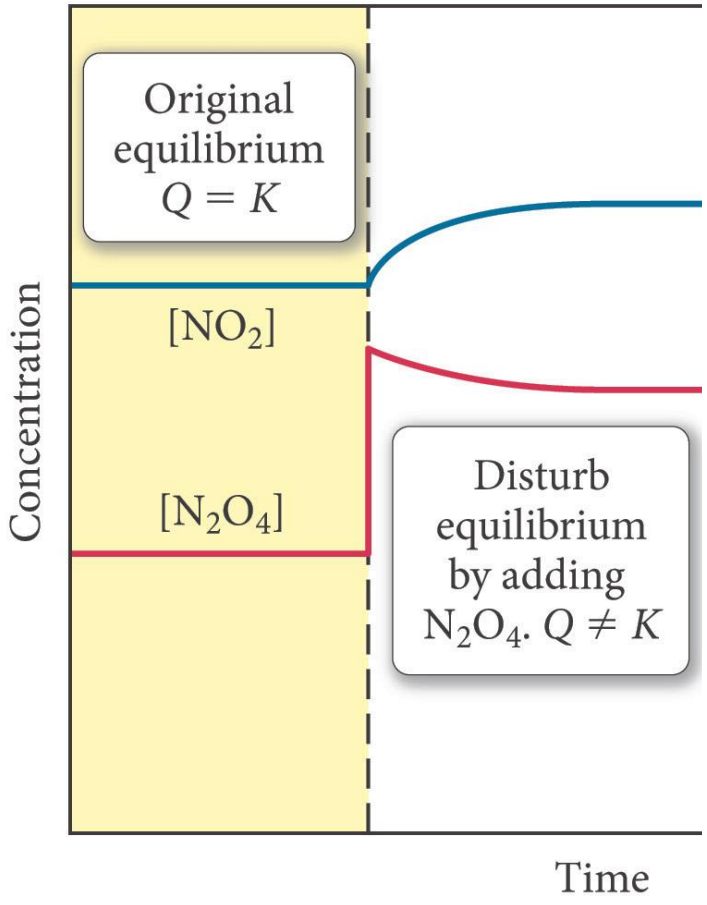
Reaction would shift to left, make more reactants

The Effect of [ ] Changes on Equilibrium



When N_2O_4 is added, some of it decomposes to make more NO_2.

The Effect of [ ] Changes on Equilibrium



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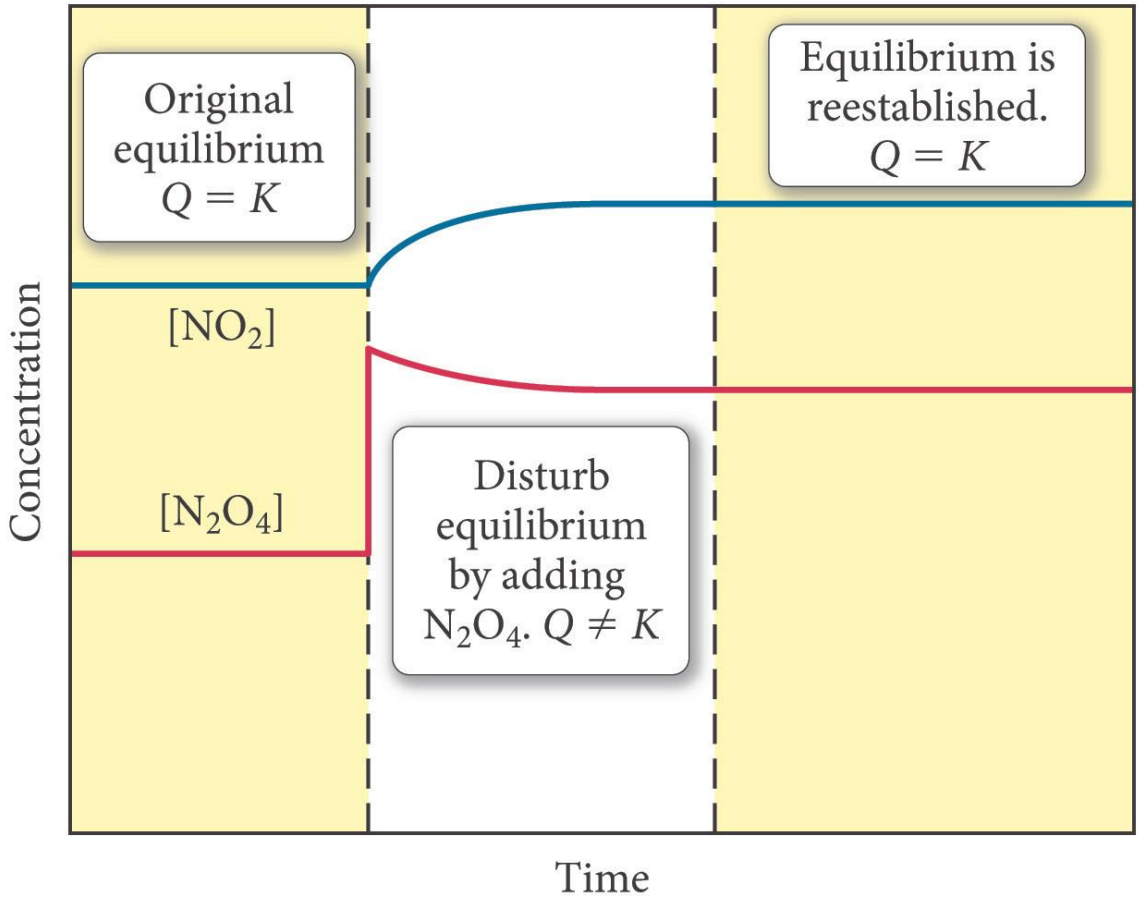

Notice how it is at a NEW equilibrium?

When N_2O_4 is added, some of it decomposes to make more NO_2.

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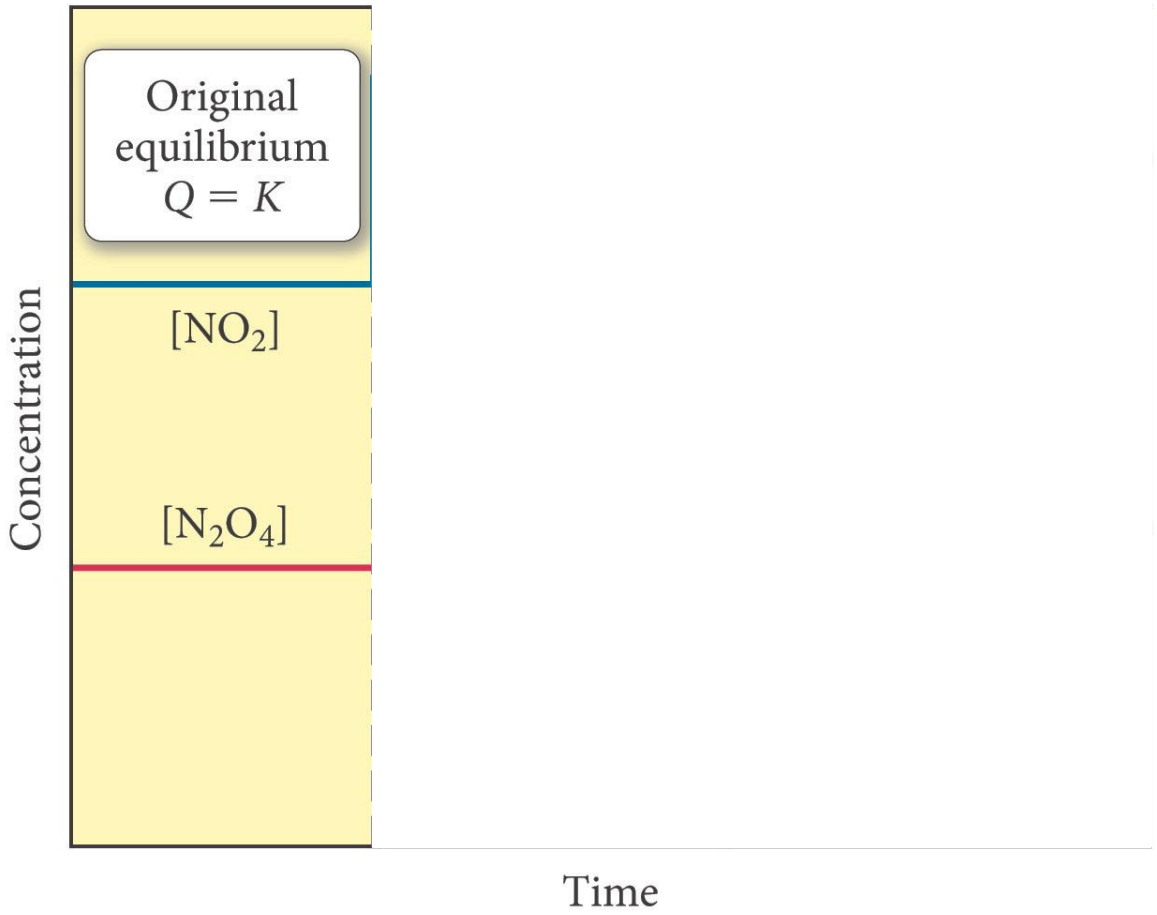

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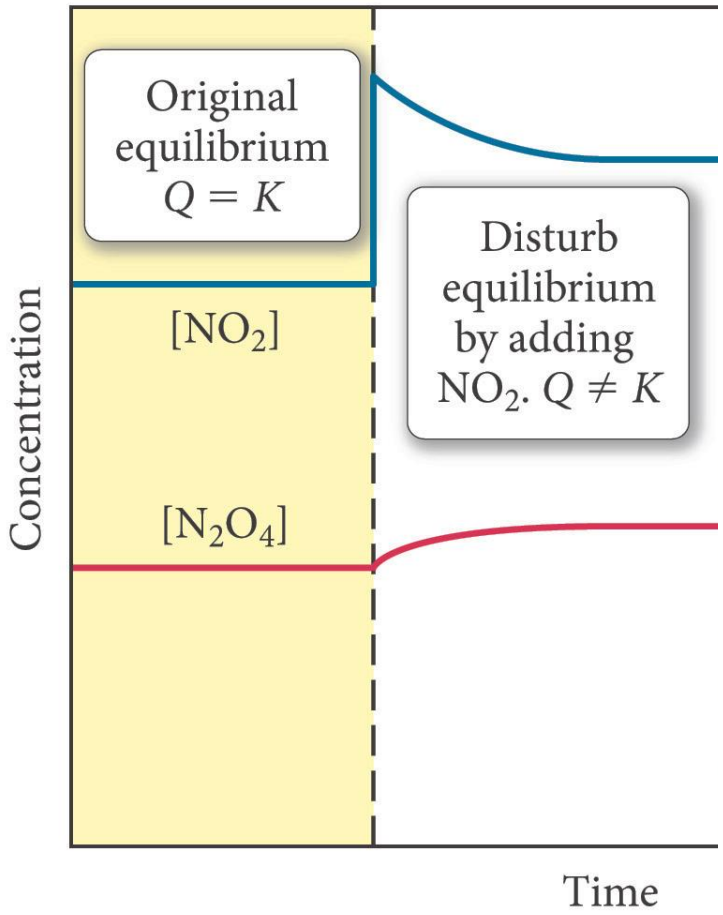

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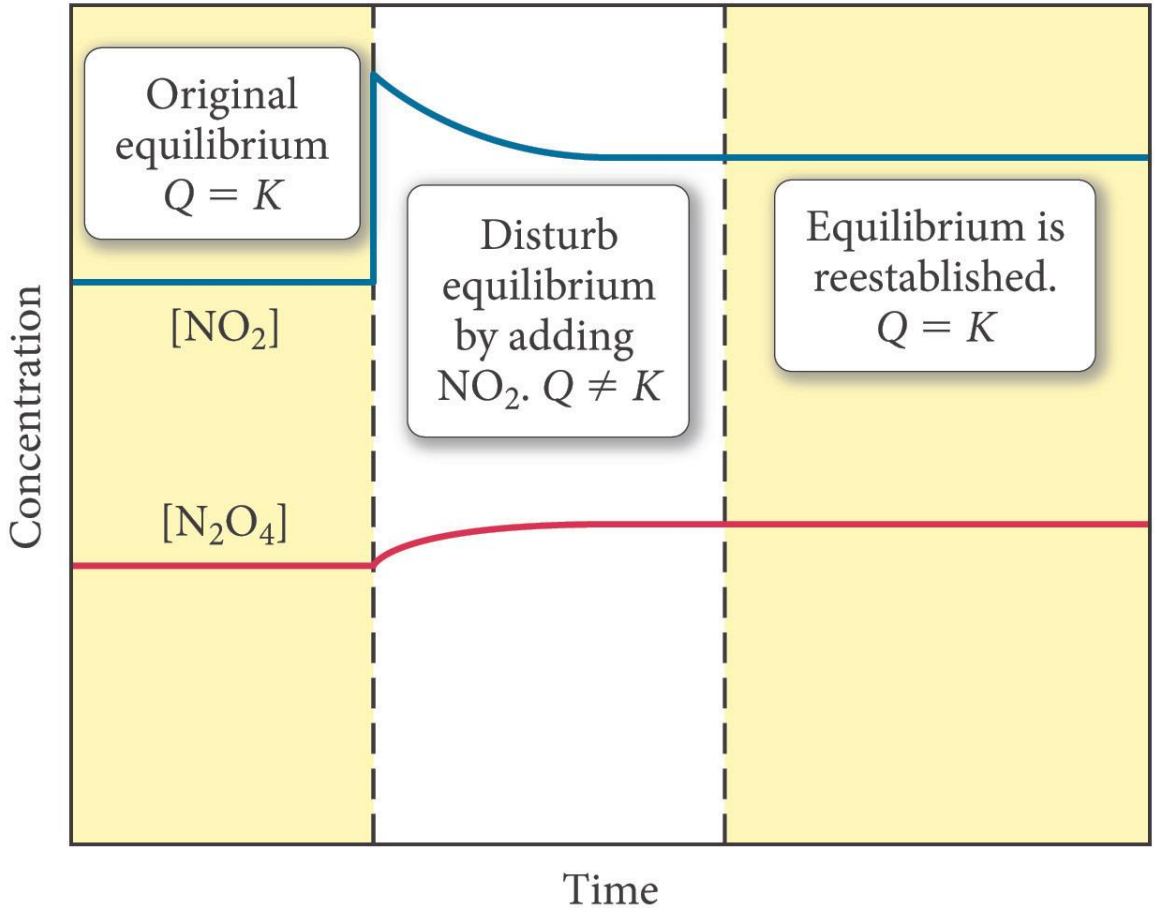


Notice how it is at a NEW equilibrium?

When NO_2 is added, some of it decomposes to make more N_2O_4 .

<u>The Effects of Catalysts</u> – *Careful!*

- Provide an alternative, more efficient mechanism.
- Works for both forward and reverse reactions.
- Affect the rate of the forward <u>*and*</u> reverse reactions by the same factor.
- Therefore, catalysts do <u>*not*</u> affect the position of equilibrium.

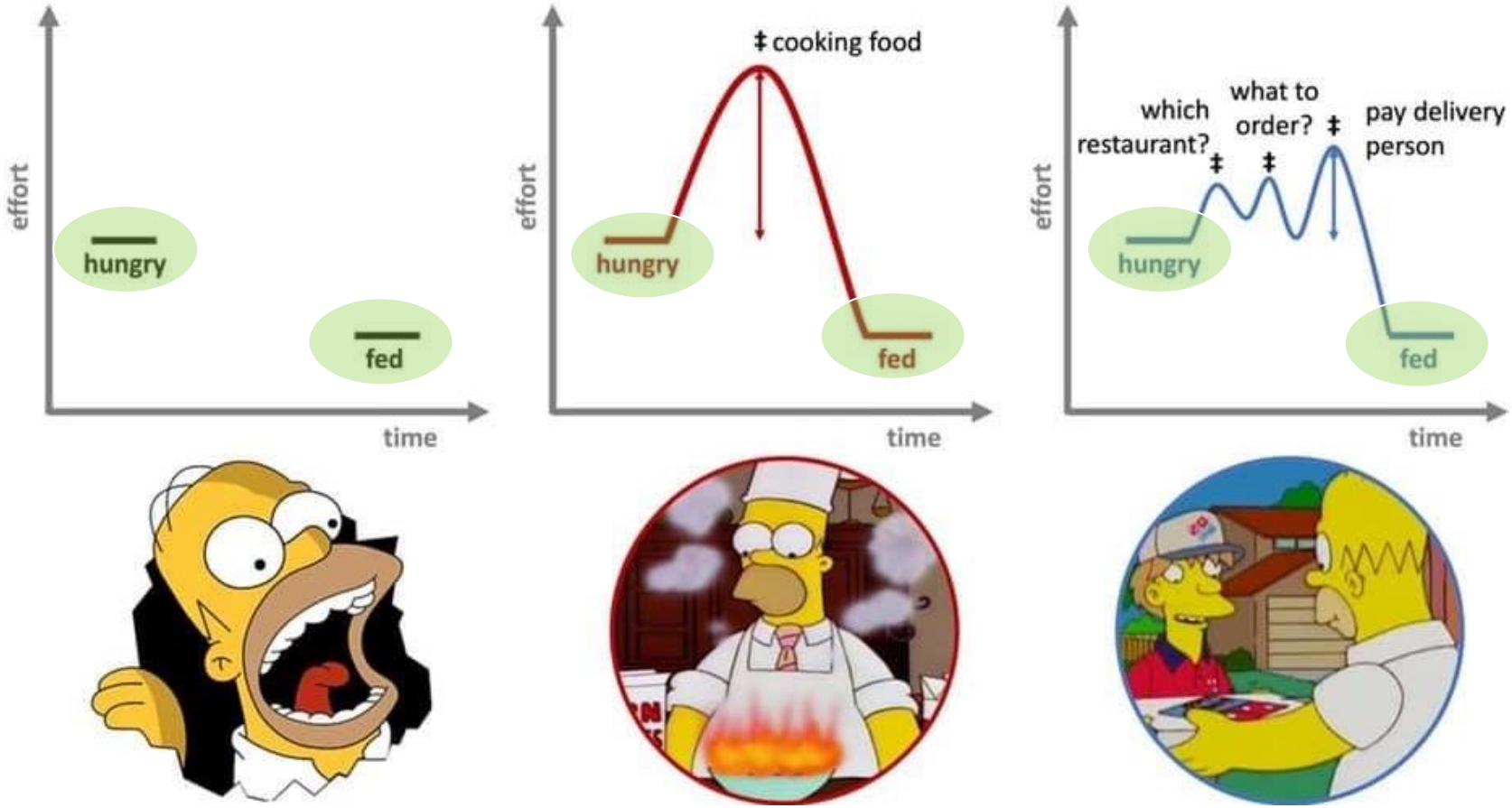
They do not change the <u>position</u> of equilibrium…

You just get to equilibrium <u>faster!</u>

The Effects of Catalysts

They do not change the position of equilibrium…

You just get to equilibrium faster!



Link to YouTube Presentation

https://youtu.be/lUdunOfj-OE