

Tutorial 4 - Solutions LeChatelier's Principle

Answer to questions 1 and 2 on page 3 of Tutorial 4

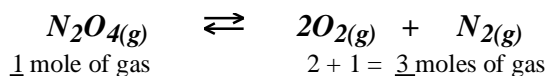
1. Given the reaction at equilibrium: $A_{(g)} + B_{(g)} + 32.5 \text{ kJ} \rightleftharpoons C_{(g)}$
- a) If the temperature was *increased*, which way would this equilibrium shift:
_____ **right (toward products)** _____
- b) If the temperature was *decreased*, which way would this equilibrium shift:
_____ **left (toward reactants)** _____
2. Given the reaction: $X_{(g)} + Y_{(g)} \rightleftharpoons W_{(g)} + Z_{(g)} \quad \Delta H = -75 \text{ kJ}$
- a) Rewrite this as a **thermochemical reaction (exothermic-heat term on right)**
- $$X_{(g)} + Y_{(g)} \rightleftharpoons W_{(g)} + Z_{(g)} + 75 \text{ kJ}$$
- b) If the temperature was *increased*, which way would this equilibrium shift:
_____ **left (reactants)** _____
- c) If the temperature was *decreased*, which way would this equilibrium shift:
_____ **right (products)** _____

Answers to question 3 on pages 4 and 5 of Tutorial 4.

3. Given the equilibrium equation:
- $$PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$$
- a) If the $[PCl_5]$ is *increased*, the equilibrium will shift to the right
- b) If the $[PCl_5]$ is *decreased*, the equilibrium will shift to the left
- c) If the $[PCl_3]$ is *increased*, the equilibrium will shift to the left
- d) If the $[PCl_3]$ is *decreased*, the equilibrium will shift to the right
- e) If the $[Cl_2]$ is *increased*, the equilibrium will shift to the left
- f) If the $[Cl_2]$ is *decreased*, the equilibrium will shift to the right

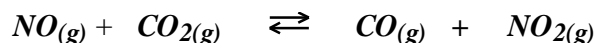
Answers to questions 4 and 5 on page 7 of Tutorial 4

4. Given the equilibrium equation:



- a) If the total pressure of this system is increased, the equilibrium will shift left
- b) If the total pressure of this system is decreased, the equilibrium will shift right
- c) If the total volume of this system is increased, **it means the same as decreasing the pressure so** the equilibrium will shift to the right.
- d) If the total volume of this system is decreased, **it means the same as increasing the pressure so** the equilibrium will shift to the left.

5. Given the equilibrium equation:



- a) If the total pressure of this system is increased, the equilibrium will not shift
- This is because the number of moles of gas is the same (2) on each side of the balanced equation. Shifting would not cause any changes in pressure, so in this case changing the total pressure or total volume in any way will not affect the equilibrium.**
- b) If the total pressure of this system is decreased, the equilibrium will not shift
- c) If the total volume of this system is increased, the equilibrium will not shift
- d) If the total volume of this system is decreased, the equilibrium will not shift

Answers to questions 6 and 7 on page 8 of Tutorial 4

6. Given the equilibrium equation:

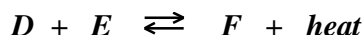


- a) Increasing the temperature will increase the rate of reaction.
- b) Increasing the temperature will cause the equilibrium to shift right

- c) Decreasing the temperature will decrease the rate of reaction.
- d) Decreasing the temperature will cause the equilibrium to shift left

Answers to question 7 on page 8 of Tutorial 4

7. Given the equilibrium equation:



- a) Increasing the temperature will increase the rate of reaction.

Yes, that's always true regardless which side of the equation has the heat term.

- b) Increasing the temperature will cause the equilibrium to shift left
- c) Decreasing the temperature will decrease the rate of reaction.

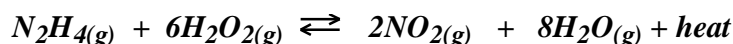
Yes, even though the equilibrium shifts right, (more F is formed at equilibrium), the rate of the reaction is still slower. (It will take longer to get to that equilibrium!)

- d) Decreasing the temperature will cause the equilibrium to shift right

Answers to the Self-Test on pages 8 & 9 of Tutorial 4

Self-Test on Tutorial 4

1. Given the following equilibrium equation:



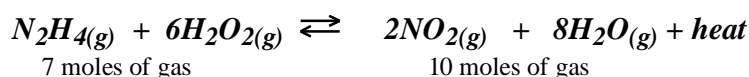
Which way will the equilibrium shift when each of the following changes are made?

- a) The [NO₂] is increasedleft
- b) The [H₂O₂] is increased right

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Unit 2 - Chemical Equilibrium

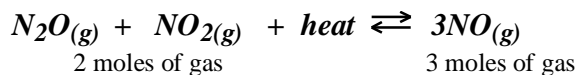
- c) The partial pressure of N₂H₄ is increased right
- d) The temperature is increased ..left
- e) The partial pressure of H₂O₂ is decreased left
- f) The partial pressure of H₂O is increased left
- g) The temperature is decreased right



- h) The total volume of the container is decreased
This means the total pressure has increased . left (less moles of gas)
 - i) The total pressure of the system is decreased (shifts to the side with more moles of gas) ..right
 - j) The [N₂H₄] is decreased left
2. Given the equilibrium equation: $N_2O(g) + NO_2(g) + heat \rightleftharpoons 3NO(g)$

What effect will each of the following changes have on the equilibrium partial pressure of NO? (The first question is done as an example.)

- a) the [N₂O] is increased **The partial pressure of NO increases because the equilibrium shifts to the right.**
- b) the total pressure of the system is decreased increase



- c) the temperature is decreased..... decrease
- d) the partial pressure of NO₂ is decreased..... decrease
- e) more NO₂ is added increase
- f) a catalyst is added no change
- g) the temperature is increased increase

- h) the total volume of the container is increasedincrease_____
**this is because the total pressure is decreased,
so the equilibrium shifts to the right (the side
with more moles of gas). A shift to the right
means that the partial pressure of NO increases.**

This is the end of Tutorial 4. If you have any questions, please get help at this point!
