LeChatelier's Principle Notes – Con't

3. EXAMPLE OF TEMPERATURE CHANGES: Remember, if a stress is added to a system, the system will counteract (do the opposite) of the stress.

- If temperature is increased, then the system will use up the added heat. The reaction will thus shift toward the endothermic reaction because this reaction absorbs (takes in) heat.

-If temperature is decreased, then the system will produce heat. The reaction will thus shift toward the exothermic reaction because this reaction releases (lets out) heat.

Consider the reaction:

$$N_2(g) + 3H_2(g) \rightleftarrows 2NH_3(g) + heat$$

- The forward reaction is exothermic since the heat is released and on the product side.
- The reverse reaction is endothermic since heat is absorbed and is on the reactant side.

Sample Questions:

1. If 60kJ of heat is added to the above reaction, what will happen to the amount of $N_2$?
   Solution: If heat is added, the system will want to use up the heat. (Think of it as looking at the arrow pointing away from the heat.) The system will shift toward the reverse reaction, which is endothermic because heat is a reactant going in the reverse.
   If the reaction shifts to the reverse, then $N_2$ becomes a product and will increase.

   So there you have it! Let me know if you need any help with the questions attached here.

# LeChatelier's Principle

With hints ☺

1) In which reaction will the point of equilibrium shift to the left when the pressure on the system is increased? → all gases only!

A) $CaCO_3(s) \leftrightarrow CaO(s) + CO_2(g)$
B) $2\ Mg(s) + O_2(g) \leftrightarrow 2\ MgO(s)$
C) $2\ H_2(g) + O_2(g) \leftrightarrow 2\ H_2O(g)$
D) $C(s) + O_2(g) \leftrightarrow CO_2(g)$

2) Given the system at equilibrium:

$N_2O_4(g) + 58.1\ kJ \leftrightarrow 2\ NO_2(g)$

What will be the result of an increase in temperature at constant pressure? → go "away" from heat

A) The equilibrium will shift to the right, and the concentration of $NO_2(g)$ will decrease.
B) The equilibrium will shift to the left, and the concentration of $NO_2(g)$ will decrease.
C) The equilibrium will shift to the right, and the concentration of $NO_2(g)$ will increase.
D) The equilibrium will shift to the left, and the concentration of $NO_2(g)$ will increase.

3) Given the reaction at equilibrium:

$C_2(g) + D_2(g) \leftrightarrow 2\ CD(g) + energy$

Which change will cause the equilibrium to shift?

A) addition of a catalyst
B) increase in volume
C) increase in pressure No! same moles on both sides!
D) addition of heat

4) Given the reaction at equilibrium:

$2\ SO_2(g) + O_2(g) \leftrightarrow 2\ SO_3(g)$

As the pressure is increased at constant temperature, the number of moles of $SO_3(g)$ produced will

A) decrease B) increase
C) remain the same

→ Increase pressure favors fewer moles!

5. Given the reaction at equilibrium:

$N_2(g) + 3\ H_2(g) \leftrightarrow 2\ NH_3(g)$

Increasing the concentration of $N_2(g)$ will increase the forward reaction rate due to

A) a decrease in the activation energy
B) a decrease in the number of effective collisions
C) an increase in the activation energy
D) an increase in the number of effective collisions

6. Given the reaction at equilibrium:

$C(s) + CO_2(g) + heat \leftrightarrow 2CO(g)$

Which stress on the system would favor the production of CO(g)? (forward reaction)

A) an increase in the pressure
B) an increase in the temperature
C) a decrease in the amount of C(s)
D) a decrease in the amount of $CO_2(g)$

7) Given the reaction at equilibrium:

$2\ SO_2(g) + O_2(g) \leftrightarrow 2\ SO_3(g) + heat$

Which change will shift the equilibrium to the right?

A) decreasing the amount of $SO_2(g)$
B) decreasing the amount of $O_2(g)$
C) increasing the pressure
D) increasing the temperature

8) What occurs when the temperature is increased in a system at equilibrium at constant pressure?

A) The rate of the forward reaction increases, and the rate of the reverse reaction decreases.
B) The rate of the forward reaction decreases, and the rate of the reverse reaction increases.
C) The rate of the exothermic reaction decreases.
D) The rate of the endothermic reaction increases.

(9) Given the equation representing a system at equilibrium:

$$N_2(g) + 3H_2(g) \leftrightarrow 2NH_3(g) + \text{energy}$$

Which changes occur when the temperature of this system is *decreased*?

A) The concentration of $H_2(g)$ decreases and the concentration of $NH_3(g)$ decreases.
B) The concentration of $H_2(g)$ decreases and the concentration of $N_2(g)$ increases.
C) The concentration of $H_2(g)$ increases and the concentration of $N_2(g)$ increases.
D) The concentration of $H_2(g)$ decreases and the concentration of $NH_3(g)$ increases.

(10) Given the equation representing a reaction at equilibrium:

$$N_2(g) + 3H_2(g) \leftrightarrow 2NH_3(g)$$

What occurs when the concentration of $H_2(g)$ is increased?

A) The equilibrium shifts to the left, and the concentration of $N_2(g)$ decreases.
B) The equilibrium shifts to the left, and the concentration of $N_2(g)$ increases.
C) The equilibrium shifts to the right, and the concentration of $N_2(g)$ decreases.
D) The equilibrium shifts to the right, and the concentration of $N_2(g)$ increases

**CHART #2:**

$$12.6\ \text{kcal} + H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$$

Whether forward or reverse reaction, reactants decrease & products increase

| Stress | Equilibrium Shift | [H2] | [I2] | [HI] |
|---|---|---|---|---|
| 1. Add H2 | | X | | |
| 2. Add I2 | | | X | |
| 3. Add HI | | | | X |
| 4. Remove H2 | | X | | |
| 5. Remove I2 | | | X | |
| 6. Remove HI | | | | X |
| 7. Increase temperature | | | | |
| 8. Decrease temperature | | | | |
| 9. Increase pressure (Fewer moles!) | | | | |
| 10. Decrease pressure | | | | |