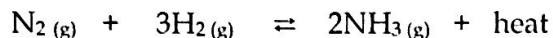
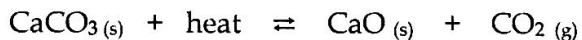


## LeChatelier's Principle Worksheet

\*\*\*Describe the changes that occur after each stress is applied to the equilibrium.\*\*\*



Stress	[N <sub>2</sub> ]	[H <sub>2</sub> ]	[NH <sub>3</sub> ]	Shifts Right or Left	Shifts to favor the Reactants or Products
1. [N <sub>2</sub> ] is increased	_____	_____	_____	_____	_____
2. [H <sub>2</sub> ] is increased	_____	_____	_____	_____	_____
3. [NH <sub>3</sub> ] is increased	_____	_____	_____	_____	_____
4. Temp is increased	_____	_____	_____	_____	_____
5. [N <sub>2</sub> ] is decreased	_____	_____	_____	_____	_____
6. [H <sub>2</sub> ] is decreased	_____	_____	_____	_____	_____
7. [NH <sub>3</sub> ] is decreased	_____	_____	_____	_____	_____
8. Temp is decreased	_____	_____	_____	_____	_____
9. A catalyst is added	_____	_____	_____	_____	_____



Note: Adding solids or liquids and removing solids or liquids does not shift the equilibrium. This is because you cannot change the concentration of a pure liquid or solid as they are 100% pure. It is only a concentration change that will change the # of collisions and hence shift the equilibrium.

Stress	[CO <sub>2</sub> ]	Shifts Right or Left	Shifts to favor the Reactants or Products
1. CaCO <sub>3</sub> is added	_____	_____	_____
2. CaO is added	_____	_____	_____
3. CO <sub>2</sub> is added	_____	_____	_____
4. Temp is decreased	_____	_____	_____
5. A catalyst is added	_____	_____	_____
6. [CO <sub>2</sub> ] is decreased	_____	_____	_____
7. Temp is increased	_____	_____	_____
8. CaO is removed	_____	_____	_____

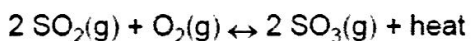
\*\*\*Choose the best answer to the following questions and briefly explain why each is correct. \*\*\*

1. Ammonia is produced commercially by the Haber reaction:



The formation of ammonia is favored by

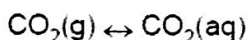
- (A) an increase in pressure  
(B) a decrease in pressure  
(C) removal of  $\text{N}_2(\text{g})$   
(D) removal of  $\text{H}_2(\text{g})$
2. Given the reaction at equilibrium:



Which change will shift the equilibrium to the right?

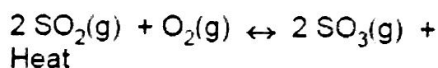
- (A) increasing the temperature  
(B) increasing the pressure  
(C) decreasing the amount of  $\text{SO}_2(\text{g})$   
(D) decreasing the amount of  $\text{O}_2(\text{g})$
3. Which system at equilibrium will be *least* affected by a change in pressure?
- (A)  $3 \text{H}_2(\text{g}) + \text{N}_2(\text{g}) \leftrightarrow 2 \text{NH}_3(\text{g})$   
(B)  $2 \text{S}(\text{s}) + 3 \text{O}_2(\text{g}) \leftrightarrow 2 \text{SO}_3(\text{g})$   
(C)  $\text{AgCl}(\text{s}) \leftrightarrow \text{Ag}^+(\text{aq}) + \text{Cl}^-(\text{aq})$   
(D)  $2 \text{HgO}(\text{s}) \leftrightarrow 2 \text{Hg}(\text{l}) + \text{O}_2(\text{g})$

4. Given the closed system at equilibrium:



As the pressure on the system increases, the solubility of the  $\text{CO}_2(\text{g})$

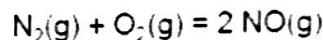
- (A) decreases (C) remains the same  
(B) increases
5. Given the equilibrium reaction:



When the pressure on the system is increased, the concentration of the  $\text{SO}_3$  will

- (A) decrease (C) remain the same  
(B) increase

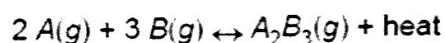
6. Given the reaction at equilibrium:



If the temperature remains constant and the pressure increases, the number of moles of  $\text{NO}(\text{g})$  will

- (A) decrease (C) remain the same  
(B) increase

7. Given the reaction at equilibrium:



Which change will not affect the equilibrium concentrations of  $\text{A}(\text{g})$ ,  $\text{B}(\text{g})$ , and  $\text{A}_2\text{B}_3(\text{g})$ ?

- (A) adding more  $\text{A}(\text{g})$   
(B) adding a catalyst  
(C) increasing the temperature  
(D) increasing the pressure

8. The addition of a catalyst to a system at equilibrium will increase the rate of
- (A) the forward reaction, only  
(B) the reverse reaction, only  
(C) both the forward and reverse reactions  
(D) neither the forward nor reverse reaction

9. Given the reaction at equilibrium:

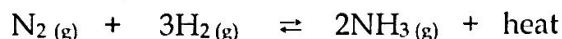


Which change will result in a *decrease* in the amount of  $\text{NO}(\text{g})$  formed?

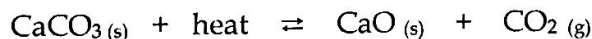
- (A) decreasing the pressure  
(B) decreasing the concentration of  $\text{N}_2(\text{g})$   
(C) increasing the concentration of  $\text{O}_2(\text{g})$   
(D) increasing the temperature

## LeChatelier's Principle Worksheet

\*\*\*Describe the changes that occur after each stress is applied to the equilibrium.\*\*\*



Stress	[N <sub>2</sub> ]	[H <sub>2</sub> ]	[NH <sub>3</sub> ]	Shifts Right or Left	Shifts to favor the Reactants or Products
1. [N <sub>2</sub> ] is increased	↓	↓	↑	right	products (Foe.)
2. [H <sub>2</sub> ] is increased	↓	↓	↑	right	products (Foe.)
3. [NH <sub>3</sub> ] is increased	↑	↑	↓	left	reactants (Rev.)
4. Temp is increased	↑	↑	↓	left	reactants (Rev.)
5. [N <sub>2</sub> ] is decreased	↑	↑	↓	left	reactants (rev.)
6. [H <sub>2</sub> ] is decreased	↑	↑	↓	left	reactants (Rev.)
7. [NH <sub>3</sub> ] is decreased	↓	↓	↑	right	products (Foe.)
8. Temp is decreased	↑	↑	↓	left	reactants (rev.)
9. A catalyst is added	—	—	—	no shift	—

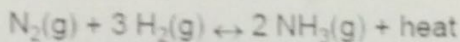


\*Note: Adding solids or liquids and removing solids or liquids does not shift the equilibrium. This is because you cannot change the concentration of a pure liquid or solid as they are 100% pure. It is only a concentration change that will change the # of collisions and hence shift the equilibrium.

Stress	[CO <sub>2</sub> ]	Shifts Right or Left	Shifts to favor the Reactants or Products
1. CaCO <sub>3</sub> is added	—	—	— its a solid.
2. CaO is added	—	—	— its a solid.
3. CO <sub>2</sub> is added	↓	left	reactants
4. Temp is decreased	↓	left	reactants
5. A catalyst is added	—	—	— no effect.
6. [CO <sub>2</sub> ] is decreased	↑	right	products.
7. Temp is increased	↑	right	products.
8. CaO is removed	—	—	— its a solid.

\*\*\*Choose the best answer to the following questions and briefly explain why each is correct.\*\*\*

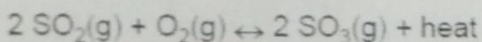
1. Ammonia is produced commercially by the Haber reaction:



The formation of ammonia is favored by

- A (A) an increase in pressure *fewer moles*  
 (B) a decrease in pressure *greater moles*  
 (C) removal of  $\text{N}_2(\text{g})$  ←  
 (D) removal of  $\text{H}_2(\text{g})$  ←

2. Given the reaction at equilibrium:



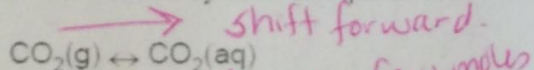
Which change will shift the equilibrium to the right?

- B (A) increasing the temperature ← *endo.*  
 (B) increasing the pressure *less moles* →  
 (C) decreasing the amount of  $\text{SO}_2(\text{g})$  *revert*  
 (D) decreasing the amount of  $\text{O}_2(\text{g})$  *revert*

3. Which system at equilibrium will be least affected by a change in pressure?

- C (A)  $3 \text{H}_2(\text{g}) + \text{N}_2(\text{g}) \leftrightarrow 2 \text{NH}_3(\text{g})$   
 (B)  $2 \text{S}(\text{s}) + 3 \text{O}_2(\text{g}) \leftrightarrow 2 \text{SO}_3(\text{g})$   
 (C)  $\text{AgCl}(\text{s}) \leftrightarrow \text{Ag}^+(\text{aq}) + \text{Cl}^-(\text{aq})$  *-no gases.*  
 (D)  $2 \text{HgO}(\text{s}) \leftrightarrow 2 \text{Hg}(\text{l}) + \text{O}_2(\text{g})$

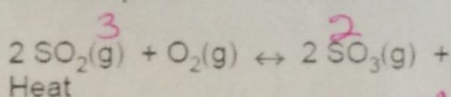
4. Given the closed system at equilibrium:



As the pressure on the system increases, the solubility of the  $\text{CO}_2(\text{g})$

- B (A) decreases (C) remains the same  
 (B) increases

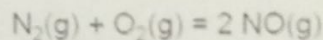
5. Given the equilibrium reaction:



When the pressure on the system is increased, the concentration of the  $\text{SO}_3$  will

- B (A) decrease (C) remain the same  
 (B) increase

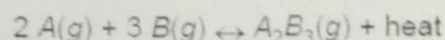
6. Given the reaction at equilibrium:



If the temperature remains constant and the pressure increases, the number of moles of  $\text{NO}(\text{g})$  will *fewer moles.*

- C (A) decrease (C) remain the same  
 (B) increase *# moles gas are equal*

7. Given the reaction at equilibrium:



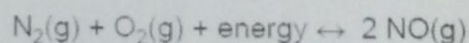
Which change will not affect the equilibrium concentrations of  $\text{A}(\text{g})$ ,  $\text{B}(\text{g})$ , and  $\text{A}_2\text{B}_3(\text{g})$ ?

- B (A) adding more  $\text{A}(\text{g})$  *increases rate forward + reverse equally.*  
 (B) adding a catalyst  
 (C) increasing the temperature  
 (D) increasing the pressure

8. The addition of a catalyst to a system at equilibrium will increase the rate of

- C (A) the forward reaction, only  
 (B) the reverse reaction, only  
 (C) both the forward and reverse reactions *lowers activation energy.*  
 (D) neither the forward nor reverse reaction

9. Given the reaction at equilibrium:



Which change will result in a decrease in the amount of  $\text{NO}(\text{g})$  formed? *shift left.*

- B (A) decreasing the pressure *moles of gas are equal.*  
 (B) decreasing the concentration of  $\text{N}_2(\text{g})$   
 (C) increasing the concentration of  $\text{O}_2(\text{g})$  *shifts right.*  
 (D) increasing the temperature *shifts endo (right)*