Worksheet: **Le Chatelier's Principle**

1. Ammonia is produced commercially by the Haber reaction :

$$N_2\,(g) + 3\,H_2\,(g) \rightleftharpoons 2\,NH_3\,(g) + \text{heat}$$

The formation of ammonia is favored by

(A) an increase in pressure

(B) a decrease in pressure

(C) removal of N_2 (g)

(D) removal of H_2 (g)

Ans. _____

2. Given the closed system at equilibrium :

$$CO_2\,(g) \rightleftharpoons CO_2\,(aq.)$$

As the pressure on the system increases, the solubility of the CO_2 (g)

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

Ans. _____

3. Consider the following equilibrium system :

$$FeO\,(s) + H_2\,(g) \rightleftharpoons Fe\,(s) + H_2O\,(g)$$

Describe the effect that a decrease in volume would have on the position of equilibrium and the $[H_2]$ in the above system.

4. When the volume of the following mixture of gases is increased, what will be the effect on the equilibrium position?

$$4\,HCl\,(g) + O_2\,(g) \rightleftharpoons 2\,H_2O\,(g) + 2\,Cl_2\,(g)$$

5. Predict the effect of decreasing the container volume for each equilibrium.

(a) $2\,H_2O\,(g) + N_2\,(g) \rightleftharpoons 2\,H_2\,(g) + 2\,NO\,(g)$ _____

(b) $SiO_2\,(s) + 4\,HF\,(g) \rightleftharpoons SiF_4\,(g) + 2\,H_2O\,(g)$ _____

(c) $CO\,(g) + H_2\,(g) \rightleftharpoons C\,(s) + H_2O\,(g)$ _____

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The formation of ammonia is favored by

(A) an increase in pressure

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(C) removal of N_2 (g)

(D) removal of H_2 (g)

Ans. A

2. Given the closed system at equilibrium :

$$CO_2\,(g) \rightleftharpoons CO_2\,(aq.)$$

As the pressure on the system increases, the solubility of the CO_2 (g)

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

Ans. B

3. Consider the following equilibrium system :

$$FeO\,(s) + H_2\,(g) \rightleftharpoons Fe\,(s) + H_2O\,(g)$$

Describe the effect that a decrease in volume would have on the position of equilibrium and the $[H_2]$ in the above system.

Since there is an equal number of gas particles on the reactant and product sides, there would be no shift to the equilibrium position. The $[H_2]$ would increase as a result of decreasing the volume.

4. When the volume of the following mixture of gases is increased, what will be the effect on the equilibrium position?

$$4\,HCl\,(g) + O_2\,(g) \rightleftharpoons 2\,H_2O\,(g) + 2\,Cl_2\,(g)$$

Shifts toward the left to increase the number of gas molecules.

5. Predict the effect of decreasing the container volume for each equilibrium.

(a) $2\,H_2O\,(g) + N_2\,(g) \rightleftharpoons 2\,H_2\,(g) + 2\,NO\,(g)$ Equilibrium will shift to favor reactants.

(b) $SiO_2\,(s) + 4\,HF\,(g) \rightleftharpoons SiF_4\,(g) + 2\,H_2O\,(g)$ Equilibrium will shift to favor products.

(c) $CO\,(g) + H_2\,(g) \rightleftharpoons C\,(s) + H_2O\,(g)$ Equilibrium will shift to favor products.