Name:

1) Equilibrium can be reached by

A) both physical changes and chemical changes

- B) physical changes, only D) both nuclear changes and chemical changes
- 2) When a reversible reaction is at equilibrium, the concentration of products and the concentration of reactants must be

C) nuclear changes, only

A) constant B) decreasing C) increasing D) equal

3) Which one of the following statements describes a reaction at equilibrium?

- A) The number of moles of the reactants must equal the number of moles of the products.
- B) The mass of the products must equal the mass of the reactants.
- C) The entropy of the reactants must equal the entropy of the products.
- D) The rate of formation of the products must equal the rate of formation of the reactants.
- 4) Which one of the following equations represents a chemical equilibrium?

A) $N_2(\ell) \rightleftharpoons N_2(g)$ B) $NH_3(\ell) \rightleftharpoons NH_3(g)$ C) $2NO_2(g) \rightleftharpoons N_2O_4(g)$ D) $CO_2(s) \rightleftharpoons CO_2(g)$

5) Given the equation representing a system at equilibrium:

 $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

Which one of the following statements describes this system?

- A) The concentrations of $PCl_5(g)$ and $PCl_3(g)$ are equal.
- B) The concentration of $PCl_5(g)$ is increasing.
- C) The concentration of $PCl_5(g)$ is decreasing.
- D) The concentrations of PCl₅(g) and PCl₃(g) are constant.
- 6) Given the equation representing a chemical reaction at equilibrium in a sealed, rigid container:

 $H_2(g) + I_2(g) + energy \rightleftharpoons 2HI(g)$

When the concentration of $H_2(g)$ is increased by adding more hydrogen gas to the container at constant temperature, the equilibrium shifts

A) to the left, and the concentration of HI(g) decreases

B) to the right, and the concentration of HI(g) increases

C) to the right, and the concentration of HI(g) decreases

D) to the left, and the concentration of HI(g) increases

7) Given the equation representing a solution equilibrium:

 $BaSO_4(s) \stackrel{H_2O}{\rightleftharpoons} Ba^{2+}(aq) + SO_4^{2-}(aq)$

What occurs when $Na_2SO_4(s)$ is added to this system, increasing the concentration of $SO_4^{2-}(aq)$?

- A) The equilibrium shifts to the right, and the concentration of $Ba^{2+}(aq)$ decreases.
- B) The equilibrium shifts to the left, and the concentration of $Ba^{2+}(aq)$ increases.
- C) The equilibrium shifts to the left, and the concentration of $Ba^{2+}(aq)$ decreases.
- D) The equilibrium shifts to the right, and the concentration of $Ba^{2+}(aq)$ increases.
- 8) Given the equation representing a system at equilibrium:

 $PCl_5(g) + energy \rightleftharpoons PCl_3(g) + Cl_2(g)$

Which change will cause the equilibrium to shift to the right?

A) adding a catalyst	C) adding more PCl ₃ (g)
B) increasing the temperature	D) increasing the pressure

9) Given the equation representing a system at equilibrium in a sealed, rigid container:

 $2HI(g) \rightleftharpoons H_2(g) + I_2(g) + energy$

Increasing the temperature of the system causes the concentration of

A) H_2 to remain constant B) H_2 to increase C) HI to remain constant D) HI to increase

10) Given the equation for a system at equilibrium:

 $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) + energy$

If only the concentration of $N_2(g)$ is increased, the concentration of

A) $H_2(g)$ remains the same	C) $H_2(g)$ increases
B) $NH_3(g)$ remains the same	D) $NH_3(g)$ increases

11) Given the equation representing a system at equilibrium:

 $AgCl(s) \xleftarrow{H_2O} Ag^+(aq) + Cl^-(aq)$

When the concentration of $Cl^{-}(aq)$ is increased, the concentration of $Ag^{+}(aq)$

A) increases, and the amount of AgCl(s) decreases C) decreases, and the amount of AgCl(s) decreases

B) decreases, and the amount of AgCl(s) increases D) in

D) increases, and the amount of AgCl(s) increases

12) Given the equation representing a system at equilibrium:

$$KNO_3(s) + energy \xrightarrow{H_2O} K^+(aq) + NO_3^-(aq)$$

Which change causes the equilibrium to shift?

A) adding a catalyst B) increasing pressure

C) increasing temperature D) adding a noble gas