CHAPTER 16

QUESTIONS

1. In the equilibrium system

$$2SO_2(g) + O_2(g) \rightleftarrows 2SO_3(g) + \text{heat}$$

the concentration of SO_3 may be increased by (1) increasing the concentration of SO_2 (2) decreasing the concentration of SO_2 (3) increasing the temperature (4) decreasing the concentration of O_2

2. Given the reaction at constant temperature:

$$CO_2(s) \rightleftarrows CO_2(g)$$

As pressure increases, the amount of $CO_2(g)$ present (1) increases (2) decreases (3) remains the same

3. Given the reaction at equilibrium:

$$H_2(g) + Cl_2(g) \rightleftarrows 2HCl(g) + \text{heat}$$

The equilibrium will shift to the left when there is an increase in (1) temperature (2) pressure (3) H_2 concentration (4) Cl_2 concentration

4. Given the reaction at equilibrium:

$$A(g) + B(g) \rightleftarrows C(g) + D(g)$$

At constant temperature and pressure, an increase in the concentration of A(g) causes (1) an increase in the concentration of B(g) (2) a decrease in the concentration of B(g) (3) a decrease in the concentration of C(g) (4) a decrease in the concentration of D(g)

5. Given the reaction at equilibrium:

$$H_2(g) + Cl_2(g) \rightleftarrows 2HCl(g) + \text{heat}$$

The equilibrium will shift to the right when there is an increase in (1) temperature (2) pressure (3) concentration of $H_2(g)$ (4) concentration of HCl(g)

* 6. Given the equilibrium:

$$AgCl(s) \rightleftarrows Ag^+(aq) + Cl^-(aq)$$

The addition of KCl to this system will cause a shift in the equilibrium to the (1) left, and the concentration of $Ag^+(aq)$ ions will increase (2) right, and the concentration of $Ag^+(aq)$ ions will increase (3) left, and the concentration of $Ag^+(aq)$ ions will decrease (4) right, and the concentration of $Ag^+(aq)$ ions will decrease

7. Which of the following equilibrium systems at constant temperature will shift to the right if the pressure is increased?

(1) $2H_2(g) + O_2(g) \rightleftarrows 2H_2O(g)$
(2) $2SO_3(g) \rightleftarrows 2SO_2(g) + O_2(g)$
(3) $2NO(g) \rightleftarrows N_2(g) + O_2(g)$
(4) $2CO_2(g) \rightleftarrows 2CO(g) + O_2(g)$

8. For a system at equilibrium, a catalyst (1) increases the rate of forward reaction only (2) increases the rate of reverse reaction only (3) increases the rates of forward and reverse reactions equally (4) increases the activation energy

9. In the Haber process,

$$N_2(g) + 3H_2(g) \rightleftarrows 2NH_3(g) + 22 \text{ kcal}$$

larger yield of NH_3 is obtained when (1) temperature and pressure are decreased (2) temperature and pressure are increased (3) temperature is increased and pressure is decreased (4) temperature is decreased and pressure is increased

10. Which is the correct equilibrium expression for the following system?

$$A(g) + B(g) \rightleftarrows C(g) + D(g)$$

(1) $K = [C][D]$ (2) $K = \dfrac{[C][D]}{[A][B]}$

(3) $K = \dfrac{[C] + [D]}{[A] + [B]}$ (4) $K = \dfrac{[A] + [B]}{[C] + [D]}$

11. Which is the correct equilibrium expression for the following system?

$$H_2(g) + I_2(g) \rightleftarrows 2HI(g)$$

(1) $K = \dfrac{[HI]^2}{[H_2][I_2]}$ (2) $K = \dfrac{[HI]^2}{[2H][2I]}$

(3) $K = \dfrac{[H_2][I_2]}{[HI]^2}$ (4) $K = \dfrac{[HI]^2}{[H][I]}$

12. Which is the correct equilibrium expression for the following system?

$$2A(g) + B(s) \rightleftarrows 3C(g)$$

(1) $K = \dfrac{[C]^3}{2[A]^2[B]}$ (2) $K = \dfrac{[C]^3}{[A]^2}$

(3) $K = \dfrac{[C]^3}{[A]^2 + [B]}$ (4) $K = \dfrac{[C]^3}{[2A][B]}$

13. For the equilibrium system

$$H_2(g) + \tfrac{1}{2}O_2(g) \rightleftarrows H_2O(g) + \text{heat}$$

the value of the equilibrium constant can be changed by (1) changing the pressure (2) changing the temperature (3) adding more O_2 (4) adding a catalyst

14. When a system is at equilibrium, the concentrations of the reactants (1) increase (2) decrease (3) remain the same

* 15. For the solubility equilibrium system

$$AgCl(s) \rightleftarrows Ag^+(aq) + Cl^-(aq)$$

the equilibrium constant will change when there is an increase in the (1) concentration of Ag^+ ions (2) pressure (3) concentration of Cl^- ions (4) temperature

16. In any chemical system that has reached equilibrium (1) the forward reaction stops (2) the reverse reaction stops (3) the concentrations of products and reactants are equal (4) the rates of the forward and reverse reactions are equal

17. Which pair represents the substances formed in the reverse reaction for the equilibrium expression

$$K = \frac{[X][Y]}{[A][B]}$$

(1) A and B (2) A and X (3) B and Y (4) X and Y

* 18. Based on Reference Table M (see page 109), at 25°C, which salt is less soluble than AgBr? (1) Li_2CO_3 (2) AgCl (3) $BaSO_4$ (4) $PbCO_3$

* 19. Based on Reference Table M (see page 109), in a saturated solution of $PbCrO_4$ at 1 atmosphere and 298 K, the product of $[Pb^{2+}]$ and $[CrO_4^{2-}]$ is equal to (1) 2.8×10^{-13} (2) 1.3×10^{-7} (3) 1.8×10^{14} (4) 1.8×10^{-7}

20. For the reaction $A + B \rightleftarrows AB$, the greatest amount of AB would be produced if the equilibrium constant of the reaction was to be (1) 1×10^{-5} (2) 1×10^{-1} (3) 1×10^{1} (4) 1×10^{5}

* 21. Based on Reference Table M (see page 109), which salt forms a saturated solution that is most dilute? (1) AgCl (2) $BaSO_4$ (3) $CaSO_4$ (4) $PbCrO_4$

22. Which is the solubility product constant expression for the following system?

$$Mg(OH)_2(s) \rightleftarrows Mg^{2+}(aq) + 2OH^-(aq)$$

(1) $[Mg^{2+}][2OH^-]$ (2) $[Mg^{2+}] + 2[OH^-]$

(3) $[Mg^{2+}][OH^-]^2$ (4) $[Mg^{2+}] + [OH^-]$

* 23. When AgBr(s) dissolves in water, what is the ratio of Ag^+ ions to Br^- ions?

(1) 1:1 (2) $\dfrac{7.7 \times 10^{-13}}{1.0 \times 10^{-14}}$ (3) $\dfrac{7.7 \times 10^{-13}}{7.7 \times 10^{-1}}$ (4) $\dfrac{7.7 \times 10^{-13}}{1.0 \times 10^{-7}}$

QUESTIONS

1. A solution in which equilibrium exists between undissolved and dissolved solute is always
(1) saturated (2) unsaturated (3) dilute (4) concentrated

2. A liquid in a stoppered flask is allowed to stand at constant temperature until the liquid level in the flask remains constant. Which condition then exists in the flask? (1) Only liquid is evaporating. (2) Only vapor is condensing (3) The rate of condensation is greater than the rate of evaporation. (4) The rate of condensation is equal to the rate of evaporation.

3. A flask at 25°C is partially filled with water and stoppered. After a period of time the water level remained constant. Which relationship best explains this observation?
(1) The rate of condensation exceeds the rate of evaporation.
(2) The rates of condensation and evaporation are both zero.
(3) The rate of evaporation exceeds the rate of condensation.
(4) The rate of evaporation equals the rate of condensation.

4. Given the equation:

$$H_2(g) + I_2(g) \rightleftarrows 2HI(g)$$

Which statement is always true when this reaction has reached chemical equilibrium? (1) $[H_2] \times [I_2] > [HI]$. (2) $[H_2] \times [I_2] < [HI]$. (3) $[H_2]$, $[I_2]$, and $[HI]$ are all equal. (4) $[H_2]$, $[I_2]$, and $[HI]$ remain constant.

5. Given the reaction:

$$HC_2H_3O_2(aq) + H_2O \rightleftarrows H_3O^+(aq) + C_2H_3O_2^-(aq)$$

When the reaction reaches a state of equilibrium, the concentrations of the reactants (1) are less than the concentrations of the products (2) are equal to the concentrations of the products (3) begin decreasing (4) become constant

6. Which change would most likely increase the rate of a chemical reaction? (1) decreasing a reactant's concentration (2) decreasing a reactant's surface area (3) cooling the reaction mixture (4) adding a catalyst to the reaction mixture

Given the system $CO_2(s) \rightleftarrows CO_2(g)$ at equilibrium. As the pressure increases at constant temperature, the amount of $CO_2(g)$ will (1) decrease (2) increase (3) remain the same

Which system at equilibrium will shift to the right when the pressure is increased?

(1) $NaCl(s) \overset{H_2O}{\rightleftarrows} Na^+(aq) + Cl^-(aq)$

(2) $C_2H_5OH(\ell) \overset{H_2O}{\rightleftarrows} C_2H_5OH(aq)$

(3) $NH_3(g) \overset{H_2O}{\rightleftarrows} NH_3(aq)$

(4) $C_6H_{12}O_6(s) \overset{H_2O}{\rightleftarrows} C_6H_{12}O_6(aq)$

13. Given the system

$$2O_3(g) \rightleftarrows 3O_2(g) \qquad (K_{eq} = 2.5 \times 10^{23})$$

At equilibrium, the concentrations of O_3 and O_2

12. Given the solution at equilibrium

$$BaSO_4(s) \rightleftarrows Ba^{2+}(aq) + SO_4^{2-}(aq)$$

The K_{sp} of $BaSO_4(s)$ at 25°C is 1.08×10^{-10}. Which change wi affect the K_{sp} value? (1) increasing the $[Ba^{2+}]$ (2) increasing th $[SO_4^{2-}]$ (3) increasing the pressure (4) increasing the temperatu

13. What effect does the addition of a catalyst have on a chemic reaction at equilibrium? (1) It increases the rate of the forwa reaction only (2) It increases the rate of the reverse reaction, on (3) It increases the rate of both the forward and reverse reaction (4) It decreases the rate of both the forward and reverse reaction

14. At which temperature can water contain the most dissolve oxygen at a pressure of 1 atomsphere? (1) 10.°C (2) 20.° (3) 30.°C (4) 40.°C

15. The reaction:
$Ba(NO_3)_2(aq) + Na_2SO_4(aq) \rightarrow 2NaNO_3(aq) + BaSO_4(s)$ goes completion because a (1) gas is formed (2) precipitate is forme (3) nonionized product is formed (4) soluble salt is formed

16. Consider the following reaction:

$$A(g) + 2B(g) \rightleftarrows C(g) + \text{heat}$$

The reaction is carried out in a high-pressure container at constant temperature. The initial concentration of A is 1.0 mole/liter. At equilibrium, the concentration of C is .25 mole/liter.
The concentration of A at equilibrium in moles per liter is (1) 1.0 (2) 0.75 (3) 0.50 (4) 0.25

17. According to Reference Table D, a temperature change from 10° to 30°C would have the *least* effect on the solubility of (1) NaCl (2) $KClO_3$ (3) NH_3 (4) SO_2

18. According to Reference Table D, which is the best description the system prepared by dissolving 30 grams of $NH_3(g)$ in 100 gran of water at 20°C? (1) a saturated solution of NH_3 with no exce $NH_3(g)$ (2) a saturated solution of NH_3 in contact with exce $NH_3(g)$ (3) an unsaturated solution of NH_3 with no excess $NH_3(g)$ (4) an unsaturated solution of NH_3 in contact with excess $NH_3(g)$

9. Given the reaction at equilibrium:

$$2SO_2(g) + O_2(g) \rightleftarrows 2SO_3(g) + \text{heat}$$

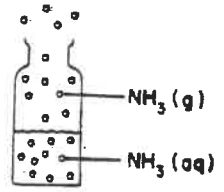
The rate of the forward reaction can be increased by adding mo SO_2 because the (1) temperature will increase (2) number molecular collisions between reactants will increase (3) reacti will shift to the left (4) forward reaction is endothermic

10. Given the reaction at equilibrium:

$$CO(g) + \tfrac{1}{2}O_2(g) \rightleftarrows CO_2(g) + 67.7 \text{ kcal}$$

As the temperature increases, the rate of the forward reacti (1) decreases (2) increases (3) remains the same

11. The diagram below shows a bottle containing $NH_3(g)$ dissolved water. How can the equilibrium $NH_3(g) \rightleftarrows NH_3(aq)$ be reache



(1) Add more water (2) Add more $NH_3(g)$ (3) Cool the conte (4) Stopper the bottle