Pre-Assessment **Name:** **Grade & Section:**

Choose the best answer from the options that follow each question.

____ 1. A 15.0 mL volume of 0.0100 M $Pb(NO_3)_2$ is added to 15.0 mL of 0.0100 M NaI. A precipitate is formed, and equilibrium is established. The K_{sp} equilibrium expression for the dissolution of PbI_2 is

a. $[Pb^{2+}][I^-]^2$.
b. $[Pb][I^2]$.
c. $[Pb^{2+}][2I^-]^2$.
d. $2[Pb^{2+}][I^-]$.

____ 2. A 15.0 mL volume of 0.0100 M $Pb(NO_3)_2$ is added to 15.0 mL of 0.0100 M NaI. A precipitate is formed, and equilibrium is established. What is the ion product for the for the reaction that produces PbI_2?

a. 1.00×10^{-8}
b. 1.25×10^{-7}
c. 1.00×10^{-6}
d. 2.5×10^{-5}

____ 3. What is the equilibrium expression for the following equation?

$$Fe(OH)_3(aq) \leftrightarrows Fe^{3+}(aq) + 3OH^-(aq)$$

a. $\dfrac{[Fe^{3+}][OH^-]}{[Fe(OH)_3]}$

b. $\dfrac{[Fe^{3+}][OH^-]^3}{[Fe(OH)_3]}$

c. $\dfrac{[Fe(OH)_3]}{[Fe^{3+}][OH^-]^3}$

d. $\dfrac{[Fe(OH)_3]}{[Fe^{3+}][OH^-]}$

____ 4. In a bottle of unopened cola, the CO_2 gas dissolved in the liquid is in equilibrium with the CO_2 gas above the liquid. The dissolved gas reacts with water molecules in the cola to form carbonic acid, which also dissociates into carbon dioxide and water. Which chemical equation(s) best describe this equilibrium system?

a. $CO_2(g) \leftrightarrows CO_2(l)$
b. $CO_2(g) \leftrightarrows CO_2(aq)$ and $CO_2(l) + H_2O(l) \leftrightarrows H_2CO_3(aq)$
c. $CO_2(g) \leftrightarrows CO_2(aq)$
d. $CO_2(g) \leftrightarrows CO_2(aq)$ and $CO_2(aq) + H_2O(l) \leftrightarrows H_2CO_3(aq)$

____ 5. The Haber process, $N_2(g) + 3H_2(g) \leftrightarrows 2NH_3(g) + 92$ kJ, is operated at temperatures of about 500°C because

a. a higher temperature would favor the products.
b. K is a maximum at 500°C.
c. the forward reaction rate is too slow at lower temperatures.
d. K is equal to 1 at 500°C.

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____ 6. Which of the following would not affect the aqueous equilibrium reaction represented by the equation below?

$HNO_2(aq) \leftrightarrows H^+(aq) + NO^-_2(aq)$

a. the addition of $NaNO_3(s)$
b. an increase in H^+ concentration
c. the addition of $NaNO_2(s)$
d. a decrease in NO^-_2 concentration

____ 7. Consider the equilibrium system represented by the equation below.

$$\underset{\text{yellow}}{H_2O(l) + 2CrO^{2-}_4(aq)} \leftrightarrows \underset{\text{orange}}{Cr_2O^{2-}_7(aq)} + 2OH^-(aq)$$

If the hydroxide ions were removed, how would the color change?

a. to darker yellow
b. to lighter orange
c. to darker orange
d. not at all

____ 8. The Fe^+ ion present in acid mine drainage is colorless and surrounded by water molecules. If phenanthroline (Phe) is added, the solution turns orange as a colored complex is formed according to the equation $Fe^{3+} \cdot H_2O + Phe \leftrightarrows Fe^{3+} \cdot Phe + H_2O$. The color is commonly used as an indicator of the Fe^+ ion concentration. What would an increase in color from light to dark orange indicate in this system?

a. an applied stress that shifted the equilibrium to favor the reverse reaction
b. an applied stress that shifted the equilibrium to favor the forward reaction
c. an increase in the rate of the reverse reaction
d. addition of water to the system

____ 9. The solubility product constant expression includes

a. a concentration of zero for undissolved salt.
b. the concentrations of dissolved and undissolved salt.
c. an exponent corresponding to the charge on each ion.
d. the concentrations of dissociated ions.

____ 10. In a reaction that goes nearly to completion,

a. the re-formation of reactants is much slower than the formation of the products.
b. the rate of the reverse reaction is faster than the rate of the forward reaction.
c. the re-formation of reactants is much faster than the rate of formation of the products.
d. the forward reaction rate increases.

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____ 11. Which of the following K_{eq} expressions is correct for the formation of ammonia, NH_3, from its elements, as represented by the equation
$3H_2 + N_2 \leftrightarrows 2NH_3 + 92$ kJ?

a. $\dfrac{[NH_3]^2}{[H_2]^3[N_2]}$

b. $\dfrac{[H_2]^3[N_2]}{[NH_3]^2}$

c. $\dfrac{[NH_3]}{[H_2][N_2]}$

d. $\dfrac{[H_2][N_2]}{[NH_3]}$

____ 12. When you calculate the K_{sp} of calcium fluoride, CaF_2, if the concentration of the F^- ion is 4.2×10^{-4} M, then the concentration of the Ca^{2+} ion is

a. 2.1×10^{-4} M.
b. 8.4×10^{-4} M.
c. 4.2×10^{-4} M.
d. 3.7×10^{-11} M.

____ 13. Which of the following salts is *least* soluble?

a. Ag_2CO_3 $K_{sp} = 8.4 \times 10^{-12}$
b. Ag_2CrO_4 $K_{sp} = 1.1 \times 10^{-12}$
c. AgI $K_{sp} = 1.5 \times 10^{-16}$
d. AgBr $K_{sp} = 5.4 \times 10^{-13}$

____ 14. Consider the reaction represented by the equation $2NO(g) + O_2(g) \leftrightarrows 2NO_2(g)$. If the volume of the reaction chamber is decreased, then the

a. forward reaction will be favored.
b. reverse reaction will be favored.
c. initial pressure of NO_2 will decrease.
d. initial pressure of O_2 will remain constant.

____ 15. Consider the reaction represented by the equation $Ag_2SO_4(aq) \leftrightarrows 2Ag^+(aq) + SO_4^{2-}(aq)$. You can shift the equilibrium to favor the reverse reaction by adding

a. $CaCl_2$.
b. $AgNO_3$.
c. Na_2SO_4.
d. Both (b) and (c)

____ 16. A chemical reaction that is at equilibrium always has

a. a high K_{eq} value.
b. a forward reaction rate that equals the reverse reaction rate.
c. equal concentrations of reactants and products.
d. Both (a) and (b)

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____ 17. Which of these is true about the chemical equation below?

reactants ⇆ products

a. The concentration of the products is greater than the concentration of the reactants.
b. K_{eq} of the forward reaction has a low value.
c. The reaction favors the products.
d. K_{eq} is equal to 1.

____ 18. In which of the following reactions, described by the equations below, will an increase in pressure have no effect on the equilibrium of the system?

a. $2NO_2(g) \leftrightarrows N_2O_4(g)$
b. $2NOCl(g) \leftrightarrows 2NO(g) + Cl_2(g)$
c. $H_2O(g) + CO(g) \leftrightarrows H_2(g) + CO_2(g)$
d. $N_2(g) + 3H_2(g) \leftrightarrows 2NH_3(g)$

____ 19. The common-ion effect promotes

a. dissolution.
b. precipitation.
c. boiling.
d. ionization.

____ 20. What is the acid ionization expression for the equation $HA(aq) + H_2O(l) \leftrightarrows H_3O^+(aq) + A^-(aq)$?

a. $\frac{[A^-][H_3O^+]}{[HA][H_2O]}$

b. $\frac{[A^-]}{[HA][H_2O]}$

c. $\frac{[A^-][H_3O^+]}{[HA]}$

d. $[A^-][H_3O^+][HA][H_2O]$

____ 21. The reaction represented by the equation $BH^+(aq) + H_2O(l) \leftrightarrows H_3O^+(aq) + B(aq)$ is an example of a(n)

a. cation hydrolysis reaction.
b. anion hydrolysis reaction.
c. conjugated reaction.
d. pH reaction.

____ 22. What is the value of K_w?

a. 1×10^{-14}
b. 1×10^{14}
c. 1×10^{7}
d. 14×10^{-14}

____ 23. An example of a good buffer solution is one that contains

a. HCl and NaCl.
b. HNO_2 and NaCl.
c. HNO_2 and $NaNO_2$.
d. CH_3COOH and NaCl.

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____ 24. When H_3O^+ ions are added to an aqueous solution of acetic acid,

a. the reaction forms more CH_3COO^-.
b. the reaction forms more water.
c. the reaction forms more CH_3COOH.
d. nothing happens.

____ 25. Which of the following is a conjugate acid-base pair in the reaction represented by the equation below?

$H_2PO_4^- + H_2O \leftrightarrows H_3PO_4 + OH^-$

a. $H_2PO_4^-$ and H_2O
b. $H_2PO_4^-$ and OH^-
c. $H_2PO_4^-$ and H_3PO_4
d. None of the above

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