

Quiz
Chapter 18

Name: Solutions

Date: _____

Matching: Match each item with the correct statement below.

[5 pts]

- a. activated complex
- b. reaction rate
- c. inhibitor

- d. chemical equilibrium
- e. activation energy

- E 1. the minimum energy colliding particles must have in order to react
- C 2. a substance that interferes with a catalyst
- B 3. the number of atoms, ions, or molecules that react in a given time to form products
- A 4. arrangement of atoms at the peak of an energy barrier
- D 5. when the forward and reverse reactions take place at the same rate

Multiple Choice: Identify the choice that best completes the statement or answers the question. [15 pts]

- B 1. Which expression represents a reaction rate?
 - a. time/mass
 - b. number/time
 - c. energy/time
 - d. time/energy
- C 2. At what stage of a reaction do atoms have the highest energy?
 - a. reactant stage
 - b. product stage
 - c. transition state stage
 - d. The stage of highest energy depends on the atom.
- C 3. Why does a higher temperature cause a reaction to go faster?
 - a. There are more collisions per second only.
 - b. Collisions occur with greater energy only.
 - c. There are more collisions per second and the collisions are of greater energy.
 - d. There are more collisions per second or the collisions are of greater energy.
- A 4. Why does a higher concentration make a reaction faster?
 - a. There are more collisions per second only.
 - b. Collisions occur with greater energy only.
 - c. There are more collisions per second and the collisions are of greater energy.
 - d. There are more collisions per second or the collisions are of greater energy.
- A 5. What happens to a catalyst in a reaction?
 - a. It is unchanged.
 - b. It is incorporated into the products.
 - c. It is incorporated into the reactants.
 - d. It evaporates away.
- A 6. A catalyst works by _____.
 - a. lowering the activation energy barrier
 - b. shifting the equilibrium position toward the products
 - c. changing the temperature of the reactants
 - d. changing the particle size of the reactants

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- D 7. Which of the following substances act as catalysts in the body?
a. carbohydrates
b. nucleic acids
c. lipids
 d. enzymes
- C 8. At equilibrium, what is the rate of production of reactants compared with the rate of production of products?
a. much higher
b. higher
 c. the same
d. lower
- C 9. If a reaction is reversible, what are the relative amounts of reactant and product at the end of the reaction?
a. no reactant; all product
b. no product; all reactant
 c. some product; some reactant
d. The relationship between reactants and products cannot be determined.
- A 10. If sulfur dioxide and oxygen can be made into sulfur trioxide, what is the reverse reaction?
 a. $2\text{SO}_3 \rightarrow 2\text{SO}_2 + \text{O}_2$
b. $\text{SO}_3 + \text{O}_2 \rightarrow \text{SO}_5$
c. $2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$
d. $\text{SO}_2 + 2\text{SO}_3 \rightarrow 3\text{S} + 4\text{O}_2$
- A 11. Consider the reaction $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$. What is the effect of decreasing the volume on the contained gases?
 a. The reaction shifts toward the product gas.
b. The system reacts by increasing the number of gas molecules.
c. The pressure on the gases decreases momentarily.
d. Ammonia is consumed in the reaction.
- A 12. In an endothermic reaction at equilibrium, what is the effect of raising the temperature?
 a. The reaction makes more products.
b. The reaction makes more reactants.
c. The reaction is unchanged.
d. The answer cannot be determined.
- C 13. Which of the changes listed below would shift the following reaction to the right?
 $4\text{HCl}(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{Cl}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$
a. addition of Cl_2
b. removal of O_2
 c. increase of pressure
d. decrease of pressure
- B 14. What is the equilibrium constant for the following reaction?
 $\text{C} + \text{O}_2 \rightleftharpoons \text{CO}_2$
a. $\frac{[\text{C}][\text{O}_2]}{[\text{CO}_2]}$
b. $\frac{[\text{CO}_2]}{[\text{C}][\text{O}_2]}$
c. $\frac{[\text{C}]^2[\text{O}_2]^2}{[\text{CO}_2]^2}$
d. $\frac{[\text{CO}_2]^2}{[\text{C}]^2[\text{O}_2]^2}$

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A 15. The K_{eq} of a reaction is 4×10^{-7} . At equilibrium, the ____.

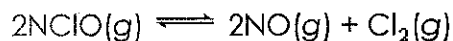
- a. reactants are favored
- b. products are favored
- c. reactants and products are present in equal amounts
- d. rate of the forward reaction is much greater than the rate of the reverse reaction

Problem Solving – Answer each question in the space provided. Show ALL work for questions involving calculations to receive full value.

1. What is the expression to calculate the equilibrium constant for the following reaction?
 $3A + 2B \rightleftharpoons 2C$ [1 pt]

$$K_{eq} = \frac{[C]^2}{[A]^3[B]^2}$$

2. An analysis of the equilibrium mixture in a 1-L flask gives the following results: NClO, 1.6 mol; NO, 6.4 mol; Cl₂, 0.49 mol for the reaction:



- a) Calculate the value of K_{eq} for the following reaction at equilibrium. [2 pts]

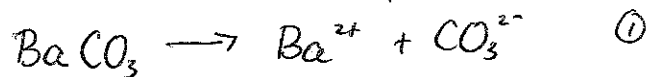
$$K_{eq} = \frac{[Cl_2][NO]^2}{[NClO]^2} = \frac{(0.49)(6.4)^2}{(1.6)^2} = 7.84$$

①

- b) Which side of the reaction is favored? How do you know? [1 pt]

Products - $K_{eq} > 1$

3. What is the concentration of barium ion in a 1.0 L solution of barium carbonate to which 0.25 mol of K₂CO₃ has been added? K_{sp} of BaCO₃ = 5.1×10^{-9} [3 pts]



$$K_{sp} = [CO_3^{2-}][Ba^{2+}] \quad \text{①}$$

$$K_{sp} = 5.1 \times 10^{-9} = (0.25)[Ba^{2+}]$$

$$[Ba^{2+}] = 2.04 \times 10^{-8} M$$

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4. Determine the ion concentrations for each of the following:

a. Silver chloride, K_{sp} is 1.8×10^{-10}

[3 pts]



$$\textcircled{5} K_{sp} = [\text{Ag}^+][\text{Cl}^-] \qquad [\text{Ag}^+] = [\text{Cl}^-] \textcircled{1}$$

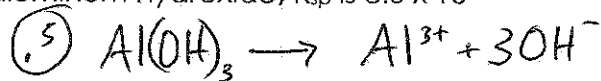
$$K_{sp} = [\text{Ag}^+]^2$$

$$1.8 \times 10^{-10} = [\text{Ag}^+]^2$$

$$\textcircled{1} \begin{cases} [\text{Ag}^+] = 1.34 \times 10^{-5} \text{ M} \\ [\text{Cl}^-] = 1.34 \times 10^{-5} \text{ M} \end{cases}$$

b. aluminum hydroxide, K_{sp} is 3.0×10^{-34}

[4 pts]



$$\textcircled{5} K_{sp} = [\text{Al}^{3+}][\text{OH}^-]^3$$

$$3[\text{Al}^{3+}] = [\text{OH}^-] \textcircled{1}$$

$$K_{sp} = [\text{Al}^{3+}](3[\text{Al}^{3+}])^3$$

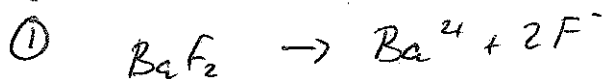
$$\textcircled{1} K_{sp} = 27[\text{Al}^{3+}]^4$$

$$3.0 \times 10^{-34} = 27[\text{Al}^{3+}]^4$$

$$\textcircled{1} \begin{cases} [\text{Al}^{3+}] = 1.8 \times 10^{-9} \text{ M} \\ [\text{OH}^-] = 5.5 \times 10^{-9} \text{ M} \end{cases}$$

5. Will precipitation occur if 100.0 mL of $5.0 \times 10^{-3} \text{ M}$ barium nitrate is added to 100.0 mL of $2.00 \times 10^{-2} \text{ M}$ sodium fluoride if the K_{sp} of barium fluoride is 1.05×10^{-6} ?

[4 pts]



$$[\text{Ba}^{2+}] = \frac{5 \times 10^{-3}}{2} = 2.5 \times 10^{-3}$$

$$\textcircled{1} [\text{F}^-] = \frac{2 \times 10^{-2}}{2} = 1 \times 10^{-2}$$

$$K_{sp} = [\text{Ba}^{2+}][\text{F}^-]^2$$

$$\textcircled{1} K_{sp} = (2.5 \times 10^{-3})(1 \times 10^{-2})^2$$

$$K_{sp} = 2.5 \times 10^{-7} < 1.05 \times 10^{-6}$$

$\textcircled{1}$ ppt does NOT occur.

