Reviewsheet: Equilibrium & Kinetics

1. A 1.0-gram piece of zinc reacts with 5 milliliters of HCl(aq). Which of these conditions of concentration and temperature would produce the greatest rate of reaction?
   (A) 1.0 M HCl(aq) at 20.°C (C) 2.0 M HCl(aq) at 20.°C
   (B) 1.0 M HCl(aq) at 40.°C (D) 2.0 M HCl(aq) at 40.°C
2. Given the reaction:

   $A_2(g) + B_2(g) \leftrightarrow 2\,AB(g) + \text{heat}$

   An increase in the concentration of $A_2(g)$ will
   (A) decrease the production of $AB(g)$
   (B) decrease the frequency of collisions between $A_2(g)$ and $B_2(g)$
   (C) increase the production of $B_2(g)$
   (D) increase the frequency of collisions between $A_2(g)$ and $B_2(g)$
3. Beaker *A* contains a 1 gram piece of zinc and beaker *B* contains 1 gram of powdered zinc. If 100 milliliters of 0.1 M HCl is added to each of the beakers, how does the rate of reaction in beaker *A* compare to the rate of reaction in beaker *B*?
   (A) The rate in *A* is greater due to the smaller surface area of the zinc.
   (B) The rate in *A* is greater due to the larger surface area of the zinc.
   (C) The rate in *B* is greater due to the smaller surface area of the zinc.
   (D) The rate in *B* is greater due to the larger surface area of the zinc.
4. Base your answer to the following question on the table below, which represents the production of 50 milliliters of CO_2 in the reaction of HCl with $NaHCO_3$. Five trials were performed under different conditions as shown. (The same mass of $NaHCO_3$ was used in each trial.)

Trial	Particle Size of $NaHCO_3$	Concentration of HCl	Temperature (°C) of HCl
A	small	1 M	20
B	large	1 M	20
C	large	1 M	40
D	small	2 M	40
E	large	2 M	40

   Which trial would produce the fastest reaction?
   (A) trial *A* (C) trial *C*
   (B) trial *B* (D) trial *D*
5. When a single 1-gram piece of zinc is added to 3 M hydrochloric acid at 25ºC, the reaction is slow. Which procedure would most likely increase the rate of reaction if the reaction were repeated?
   (A) using 1 gram of powdered zinc
   (B) using 1 M hydrochloric acid
   (C) decreasing the temperature to 20.ºC
   (D) decreasing the concentration of the zinc
6. Adding a catalyst to a chemical reaction results in
   (A) a decrease in activation energy and a decrease in the reaction rate
   (B) a decrease in activation energy and an increase in the reaction rate
   (C) an increase in activation energy and a decrease in the reaction rate
   (D) an increase in activation energy and an increase in the reaction rate
7. The energy needed to start a chemical reaction is called
   (A) potential energy (C) activation energy
   (B) kinetic energy (D) ionization energy
8. As the temperature increases, the rate of an exothermic reaction
   (A) decreases (C) remains the same
   (B) increases
9. In a reversible chemical reaction, which factors must be equal when the reaction is at equilibrium?
   (A) rate at which reactants are formed and rate at which products are formed
   (B) concentration of reactants and concentration of products
   (C) potential energy of reactants and potential energy of products
   (D) activation energy of reactants and activation energy of products
10. Given the reaction:

    $$AgCl(s) \underset{}{\overset{H_2O}{\rightleftharpoons}} Ag^+(aq) + Cl^-(aq)$$

    Once equilibrium is reached, which statement is accurate?
    (A) The concentration of $Ag^+(aq)$ is greater than the concentration of $Cl^-(aq)$.
    (B) The AgCl(s) will be completely consumed.
    (C) The rates of the forward and reverse reactions are equal.
    (D) The entropy of the forward reaction will continue to decrease.
11. Given the reaction:

    $AgI(s) \leftrightarrow Ag^+(aq) + I^-(aq)$

    Solution equilibrium is reached in the system when
    (A) dissolving stops occurring
    (B) crystallization stops occurring
    (C) both dissolving and crystallization stops occurring
    (D) dissolving occurs at the same rate that crystallization occurs

12. Given the reaction at equilibrium:

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

Which expression correctly represents the K_{eq} for this reaction?

(A) $K_{eq} = \frac{[2HI]}{[H_2][I_2]}$

(B) $K_{eq} = \frac{[H_2][I_2]}{[HI]^2}$

(C) $K_{eq} = \frac{[HI]^2}{[H_2][I_2]}$

(D) $K_{eq} = \frac{[H][I]}{[HI]^2}$

13. Given the reaction at equilibrium:

$A(g) + B(g) \leftrightarrow AB(g)$

Which equilibrium constant, K_{eq}, most favors the formation of *AB*(g)?

(A) 1×10^{-3}

(B) 2×10^{-6}

(C) 3×10^{-9}

(D) 4×10^{-12}

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Answer Key

1. D
2. D
3. D
4. D
5. A
6. B
7. C
8. B
9. A
10. C
11. D
12. C
13. A

Version A

Given the equation $A(g) \rightleftharpoons B(g) + 2C(g)$. At a particular temperature, $K = 1.4 \times 10^5$.

1. If you mixed 1.2 mol B, 0.050 mol C, and 0.003 mol A in a 1-L container, in which direction would the reaction initially proceed?

   [A] to the right
   [B] The mixture is in the equilibrium state.
   [C] to the left
   [D] cannot tell from the information given

2. Addition of chemical B to an equilibrium mixture of the above

   [A] will cause [A] to increase
   [B] cannot be determined
   [C] will cause [C] to increase
   [D] will have no effect
   [E] none of these

3. Placing the equilibrium mixture in an ice bath (thus lowering the temperature)

   [A] will have no effect
   [B] cannot be determined
   [C] will cause [A] to increase
   [D] will cause [B] to increase
   [E] none of these

4. Raising the pressure by decreasing the volume of the container

   [A] will have no effect
   [B] cannot be determined
   [C] will cause [B] to increase
   [D] will cause [A] to increase
   [E] none of these

5. Which of the following is true of a system for which the equilibrium constant is relatively small?

   [A] The equilibrium lies to the left.
   [B] It will take a short time to reach equilibrium.
   [C] The equilibrium lies to the right.
   [D] It will take a long time to reach equilibrium.
   [E] two of these

Consider the reaction

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

at some equilibrium position. Using the following choices, indicate what will happen if the following changes are made.

a. shifts to the left
b. shifts to the right
c. no change

6. Additional $SO_2(g)$ is injected into the reaction vessel.

7. Some $SO_3(g)$ is removed from the reaction vessel.

Consider the reaction

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

at some equilibrium position. Using the following choices, indicate what will happen if the following changes are made.

a. shifts to the left
b. shifts to the right
c. no change

8. The size of the reaction vessel is decreased.

9. Some He(*g*) is injected into the reaction vessel.

[1] [A]

[2] [A]

[3] [B]

[4] [D]

[5] [A]

[6] b. shifts to the right

[7] b. shifts to the right

[8] b. shifts to the right

[9] c. no change