Name: _____ **Off. Class:** _____ **Per:** _____ **Date:** _____

Teacher: _____ **Unit 9: Kinetics & Equilibrium Practice Test** **Chemistry**

1. According to Table I, which salt releases energy as it dissolves?

   A) NH_4NO_3 B) KNO_3
   C) LiBr D) NaCl

2. Which equation represents a chemical equilibrium?

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

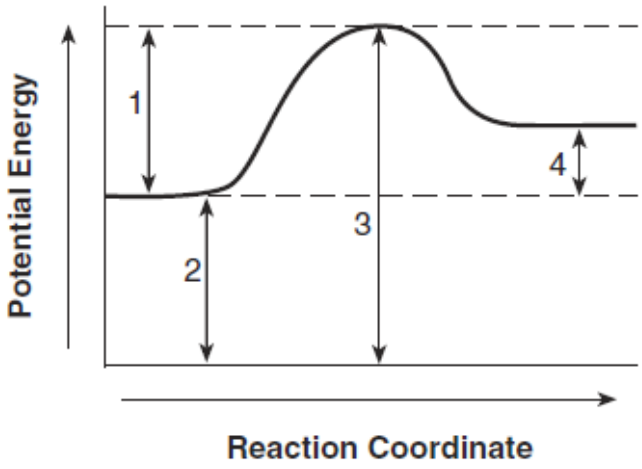
3. Given the system at equilibrium:

   $N_2O_4(g) + 58.1\ kJ \leftrightarrow 2\ NO_2(g)$

   What will be the result of an increase in temperature at constant pressure?

   A) The equilibrium will shift to the right, and the concentration of $NO_2(g)$ will increase.
   B) The equilibrium will shift to the right, and the concentration of $NO_2(g)$ will decrease.
   C) The equilibrium will shift to the left, and the concentration of $NO_2(g)$ will increase.
   D) The equilibrium will shift to the left, and the concentration of $NO_2(g)$ will decrease.

4. Given the potential energy diagram for a reaction:



   Which intervals are affected by the addition of a catalyst?

   A) 1 and 2 **B) 1 and 3**
   C) 2 and 4 D) 3 and 4

5. According to Reference Table I, which gas is formed from its elements as a result of an endothermic reaction?

   A) H_2O **B) NO_2** C) C_2H_6 D) CO_2

6. Based on Reference Table I, when 2.00 moles of NaOH(s) dissolves in water

   A) 89 kJ of energy is absorbed and the temperature of the water decreases
   B) 44.5 kJ of energy is released and the temperature of the water increases
   C) 89 kJ of energy is released and the temperature of the water increases
   D) 44.5 kJ of energy is absorbed and the temperature of the water decreases

7. Which expression represents the heat of reaction for a chemical change in terms of potential energy, *PE*?

   A) $(PE_{products}) - (PE_{reactants})$
   B) $(PE_{products}) \times (PE_{reactants})$
   C) $(PE_{products}) \div (PE_{reactants})$
   D) $(PE_{products}) + (PE_{reactants})$

8. Given the equation representing a reaction at equilibrium:

   $$N_2(g) + 3H_2(g) \leftrightarrow 2NH_3(g)$$

   What occurs when the concentration of $H_2(g)$ is increased?

   A) The equilibrium shifts to the left, and the concentration of $N_2(g)$ decreases.
   B) The equilibrium shifts to the left, and the concentration of $N_2(g)$ increases.
   C) The equilibrium shifts to the right, and the concentration of $N_2(g)$ decreases.
   D) The equilibrium shifts to the right, and the concentration of $N_2(g)$ increases

9. A chemical reaction is most likely to occur when the colliding particles have the proper

   A) ionic radii and mass
   B) atomic radii and volume
   C) solubility and density
   D) energy and orientation

10. Given the balanced equation:

$$KNO_3(s) + 34.89\,kJ \xrightarrow{H_2O} K^+(aq) + NO_3^-(aq)$$

Which statement best describes this process?

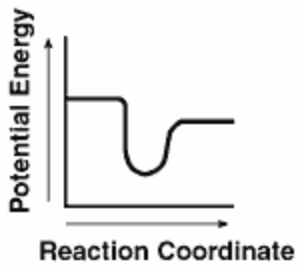
A) It is exothermic and entropy increases.
B) It is endothermic and entropy increases.
C) It is exothermic and entropy decreases.
D) It is endothermic and entropy decreases.

11. Given the reaction:

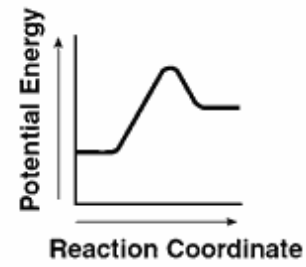
$S(s) + O_2(g) \rightarrow SO_2(g) + energy$

Which diagram best represents the potential energy changes for this reaction?

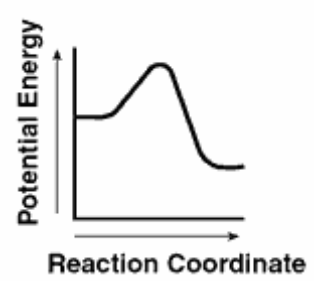
A)



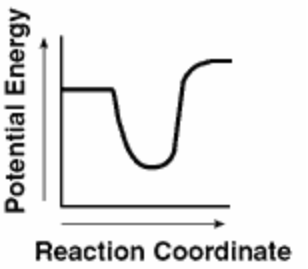
B)



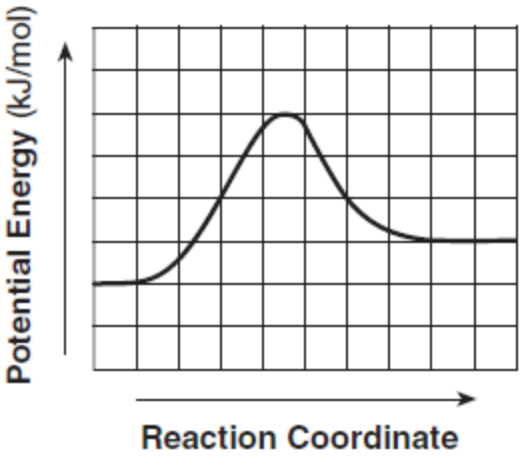
C)



D)



12. Given the potential energy diagram for a reversible chemical reaction:



Each interval on the axis labeled "Potential Energy (kJ/mol)" represents 10. kilojoules per mole. What is the activation energy of the forward reaction?

A) 10. kJ/mol
B) 30. kJ/mol
C) 40. kJ/mol
D) 60. kJ/mol

13. Given the reaction at equilibrium:

$$2\,SO_2(g) + O_2(g) \leftrightarrow 2\,SO_3(g)$$

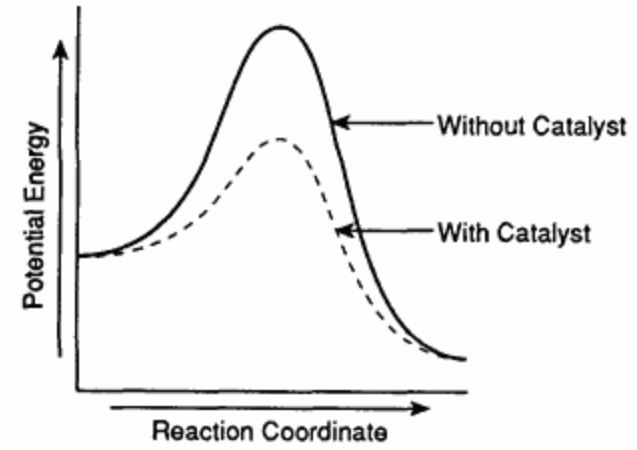
If the temperature remains constant, an increase in pressure will

A) have no effect on the equilibrium
B) shift the equilibrium to the right
C) shift the equilibrium to the left
D) change the value of the equilibrium constant

14. Systems in nature tend to undergo changes that result in

A) lower energy and higher entropy
B) higher energy and lower entropy
C) higher energy and higher entropy
D) lower energy and lower entropy

15. A potential energy diagram is shown below.



Which reaction would have the lowest activation energy?

A) the forward uncatalyzed reaction
B) the reverse uncatalyzed reaction
C) the forward catalyzed reaction
D) the reverse catalyzed reaction

16. Which conditions will increase the rate of a chemical reaction?

A) decreased temperature and decreased concentration of reactants
B) decreased temperature and increased concentration of reactants
C) increased temperature and increased concentration of reactants
D) increased temperature and decreased concentration of reactants

17. Given the reaction at equilibrium:

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

The addition of a catalyst will

A) shift the equilibrium to the left
B) increase the rate of forward and reverse reactions equally
C) have no effect on the forward or reverse reactions
D) shift the equilibrium to the right

18. What is required for a chemical reaction to occur?

A) a catalyst added to the reaction system
B) effective collisions between reactant particles
C) standard temperature and pressure
D) an equal number of moles of reactants and products

19. Ammonia is produced commercially by the Haber reaction:

$N_2(g) + 3\ H_2(g) \leftrightarrow 2\ NH_3(g) + \text{heat}$

The formation of ammonia is favored by

A) removal of $N_2(g)$
B) removal of $H_2(g)$
C) an increase in pressure
D) a decrease in pressure

20. 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 larger surface area of the zinc.
D) The rate in *B* is greater due to the smaller surface area of the zinc.

21. Base your answer to the following question on the information below and on your knowledge of chemistry.

Common household bleach is an aqueous solution containing hypochlorite ions. A closed container of bleach is an equilibrium system represented by the equation below.

$$Cl_2(g) + 2OH^-(aq) \rightleftharpoons ClO^-(aq) + Cl^-(aq) + H_2O(\ell)$$

Compare the rate of the forward reaction to the rate of the reverse reaction for this system.

22. Given the equation representing a reaction at equilibrium:

$$N_2(g) + 3H_2(g) \leftrightarrow 2NH_3(g)$$

Explain, in terms of collision theory, why the rate of the forward reaction *decreases when the concentration of $N_2(g)$ is decreased.*

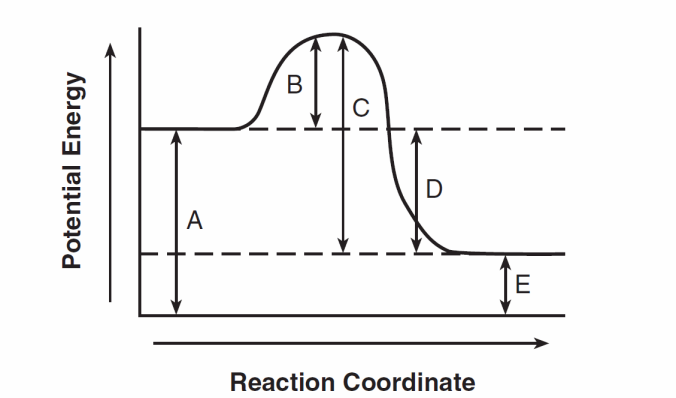
23. Base your answer to the following question on the information below and on your knowledge of chemistry.

The compounds KNO_3 and $NaNO_3$ are soluble in water.

Compare the entropy of 30. grams of solid KNO_3 at 20.°C with the entropy of 30. grams of KNO_3 dissolved in 100. grams of water at 20.°C.

24. Base your answer to the following question on the information below.

The chemical reaction between methane and oxygen is represented by the potential energy diagram and balanced equation below.



$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(\ell) + 890.4\ kJ$$

Explain, in terms of collision theory, why a lower concentration of oxygen gas *decreases* the rate of this reaction.

Answer Key
Kinetics & Equilibrium Practice Test

1. **C**
2. **A**
3. **A**
4. **B**
5. **B**
6. **C**
7. **A**
8. **C**
9. **D**
10. **B**
11. **C**
12. **C**
13. **B**
14. **A**
15. **C**
16. **C**
17. **B**
18. **B**
19. **C**
20. **C**
21. – The rate of the forward reaction is equal to the rate of the reverse reaction. – They are the same. – equal
22. *Examples:* – The rate of the forward reaction decreases because there are fewer N_2 molecules to collide with H_2 molecules. – The rate slows down because collisions are less frequent. – fewer effective collisions
23. – The entropy of $KNO_3(s)$ is less than the entropy of $KNO_3(aq)$. – The KNO_3 is more disordered. – The solution is more random the solid.
24. Acceptable responses include, but are not limited to: • A lower concentration of oxygen gas decreases the number of effective collisions between O_2 molecules and CH_4 molecules.