

# Review - Kinetics / Equilibrium

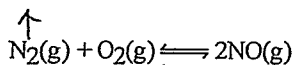
18-19

Key

Name: \_\_\_\_\_

- 2) 1) As a catalyst is added to a system at equilibrium, the value of the equilibrium constant
- 1) increases
  - 2) remains the same
  - 3) decreases

3) 2) Given the reaction at equilibrium:



As the concentration of  $\text{N}_2(\text{g})$  increases, the concentration of  $\text{O}_2(\text{g})$  will

- 1) remain the same
- 2) increase
- 3) decrease

3) 3) At room temperature, which reaction would be expected to have the fastest reaction rate?

- 1)  $\text{Pb}^{2+}(\text{aq}) + \text{S}^{2-}(\text{aq}) \rightarrow \text{PbS}(\text{s})$
- 2)  $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{l})$
- 3)  $\text{N}_2(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow 2\text{NO}_2(\text{g})$
- 4)  $2\text{KClO}_3(\text{s}) \rightarrow 2\text{KCl}(\text{s}) + 3\text{O}_2(\text{g})$

ions in solution are always fastest

3) 4) Which reaction may be represented by the chemical equilibrium expression  $K = \frac{[\text{B}]}{[\text{A}]}$ ?

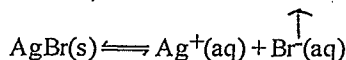
- 1)  $\text{A}(\text{aq}) + 2\text{B}(\text{aq}) \rightleftharpoons \text{C}(\text{s})$
- 2)  $\text{C}(\text{s}) + \text{B}(\text{aq}) \rightleftharpoons 2\text{A}(\text{aq})$
- 3)  $2\text{C}(\text{s}) + \text{A}(\text{aq}) \rightleftharpoons \text{B}(\text{aq})$
- 4)  $2\text{C}(\text{s}) \rightleftharpoons \text{A}(\text{aq}) + 3\text{B}(\text{aq})$

3) 5) What is the equilibrium expression for the reaction  $4\text{Al}(\text{s}) + 3\text{O}_2(\text{g}) \rightleftharpoons 2\text{Al}_2\text{O}_3(\text{s})$ ?

- 1)  $K_{eq} = [\text{O}_2]^3$
- 2)  $K_{eq} = [3\text{O}_2]$
- 3)  $K_{eq} = \frac{1}{[\text{O}_2]^3}$
- 4)  $K_{eq} = \frac{1}{[3\text{O}_2]}$

do not include solids

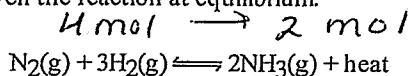
2) 6) Given a saturated solution of silver chloride:



As  $\text{NaBr}(\text{s})$  is dissolved in the solution, the concentration of the  $\text{Ag}^+$  ions in the solution

- 1) decreases and the concentration of  $\text{Br}^-$  ions remains the same
- 2) decreases and the concentration of  $\text{Br}^-$  ions increases
- 3) increases and the concentration of  $\text{Br}^-$  ions remains the same
- 4) increases and the concentration of  $\text{Br}^-$  ions increases

1) 7) Given the reaction at equilibrium:



increase in pressure favors less moles of gas.

At constant temperature, which changes would produce a greater yield of  $\text{NH}_3(\text{g})$ ?

- 1) increasing the pressure and increasing the concentration of  $\text{N}_2(\text{g})$
- 2) increasing the pressure and decreasing the concentration of  $\text{N}_2(\text{g})$
- 3) decreasing the pressure and decreasing the concentration of  $\text{N}_2(\text{g})$
- 4) decreasing the pressure and increasing the concentration of  $\text{N}_2(\text{g})$

3) 8) In the reaction  $2\text{Mg}(\text{s}) + \text{O}_2(\text{g}) \rightarrow 2\text{MgO}(\text{s})$ , as the surface area of  $\text{Mg}(\text{s})$  increases, the rate of the reaction

- 1) remains the same
- 2) decreases
- 3) increases

1) 9) A catalyst changes the rate of a chemical reaction by lowering the

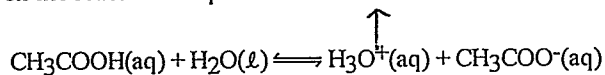
- 1) activation energy of the reaction
- 2) potential energy of the reactants
- 3) heat of the reaction
- 4) potential energy of the products

4) 10) Which change results in an increase in entropy?

- 1)  $\text{H}_2\text{O}(\text{g}) \rightarrow \text{H}_2\text{O}(\text{s})$
- 2)  $\text{H}_2\text{O}(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l})$
- 3)  $\text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_2\text{O}(\text{s})$
- 4)  $\text{H}_2\text{O}(\text{s}) \rightarrow \text{H}_2\text{O}(\text{l})$

more randomness

- 11) Given the reaction at equilibrium:



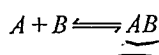
The addition of what ion will cause a decrease in the concentration of  $\text{CH}_3\text{COO}^-(\text{aq})$ ?

- 1)  $\text{H}_3\text{O}^+$                       2)  $\text{OH}^-$                       3)  $\text{Na}^+$                       4)  $\text{Cl}^-$

- 12) Raising the temperature speeds up the rate of a chemical reaction by increasing

- 1) neither the effectiveness nor the frequency of the collisions  
2) the effectiveness of the collisions, only  
3) the frequency of the collisions, only  
4) both the effectiveness and the frequency of the collisions

- 13) Given the reaction:

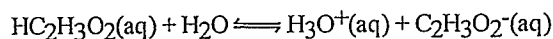


$\frac{P}{R}$  when products are favored,  
 $K_{eq}$  is large

The *greatest* amount of AB would be produced if the equilibrium constant of the reaction is equal to

- 1)  $1.0 \times 10^1$                       2)  $1.0 \times 10^{-5}$                       3)  $1.0 \times 10^5$                       4)  $1.0 \times 10^{-1}$

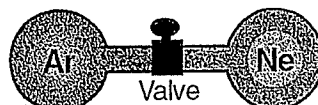
- 14) Given the reaction:



When the reaction reaches a state of equilibrium, the concentrations of the reactants

- 1) begin decreasing                      3) are equal to the concentrations of products  
2) become constant                      4) are less than the concentration of the products

- 15) The diagram below shows a system of gases with the valve closed.

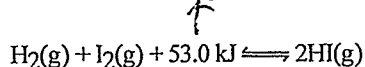


As the valve is opened, the entropy of the gaseous system

more random when they are mixed vs. separate

- 1) increases                      2) remains the same                      3) decreases

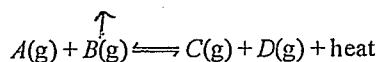
- 16) Given the reaction at equilibrium:



The equilibrium will shift to the right if there is an increase in

- 1) volume of the reaction container                      3) pressure  
2) concentration of  $\text{HI}(\text{g})$                       4) temperature

- 17) Given the reaction at equilibrium:

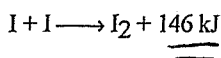


As additional  $B(\text{g})$  is added to the system at constant temperature, the concentration of  $A(\text{g})$

- 1) decreases                      2) remains the same                      3) increases
- absorb energy

4  
18

Given the equation:



*release of energy*

This equation shows that the formation of an iodine molecule is an

- 1) endothermic process in which energy is absorbed
- 2) exothermic process in which energy is absorbed
- 3) endothermic process in which energy is released
- 4) exothermic process in which energy is released

3

19) Activation energy is required to initiate

- 1) exothermic reactions, only
- 2) endothermic reactions, only

- 3) both exothermic and endothermic reactions
- 4) neither exothermic nor endothermic reactions

X

20) When a reaction has a negative  $\Delta G$ , it must be

- 1) nonspontaneous
- 2) endothermic

- 3) exothermic
- 4) spontaneous

2

21) Which condition will increase the rate of a chemical reaction?

- 1) decreased temperature and decreased concentration of reactants
- 2) increased temperature and increased concentration of reactants
- 3) decreased temperature and increased concentration of reactants
- 4) increased temperature and decreased concentration of reactants

4

22) A reaction must be spontaneous if its occurrence is

- 1) endothermic with an increase in entropy
- 2) endothermic with a decrease in entropy

3) exothermic with a decrease in entropy

4) exothermic with an increase in entropy  $-\Delta H$  and  $+\Delta S$

2

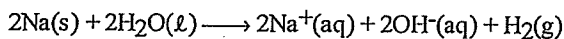
23) In a chemical reaction, the difference between the potential energy of the products and the potential energy of the reactants is the

- 1) heat of fusion
- 2) heat of reaction

- 3) free energy
- 4) activation energy

X

24) Given the reaction:



This reaction goes to completion because one of the products formed is

- 1) a gas
- 2) an insoluble base
- 3) a soluble base
- 4) a precipitate

3

25) The addition of a catalyst to a reaction will cause a change in the

- 1) potential energy of the reactants
- 2) potential energy of the products
- 3) activation energy
- 4) heat of reaction

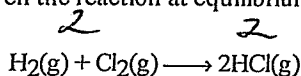
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26) Which reaction has the equilibrium expression  $K = \frac{[A][B]^2}{[AB_2]}$ ?

- 1)  $AB_2(g) \rightleftharpoons A(g) + 2B(g)$
- 2)  $2AB(g) \rightleftharpoons A(g) + B_2(g)$
- 3)  $A(g) + B_2(g) \rightleftharpoons 2AB(g)$
- 4)  $A(g) + 2B(g) \rightleftharpoons AB_2(g)$

3

27) Given the reaction at equilibrium:



*Same moles of gas on left and right*

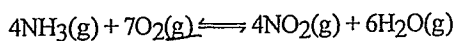
As the pressure increases at constant temperature, the number of moles of HCl

- 1) increases
- 2) decreases
- 3) remains the same

- 1 28) A system is said to be in a state of dynamic equilibrium when the
- 1) rate at which products are formed is the same as the rate at which reactants are formed
  - 2) concentration of products is greater than the concentration of reactants
  - 3) rate at which products are formed is greater than the rate at which reactants are formed
  - 4) concentration of products is the same as the concentration of reactants

- 2 29) A piece of Mg(s) ribbon is held in a bunsen burner flame and begins to burn according to the equation  $2\text{Mg}(s) + \text{O}_2(g) \rightarrow 2\text{MgO}(s)$ . The reaction begins because the reactants
- 1) underwent an increase in entropy
  - 2) are activated by heat from the bunsen burner flame
  - 3) underwent a decrease in entropy
  - 4) are activated by heat from the burning magnesium

- 4 30) Which of the following is the correct equilibrium expression for the reaction below?



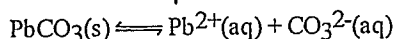
1)  $K_{eq} = \frac{[\text{NH}_3][\text{O}_2]}{[\text{NO}_2][\text{H}_2\text{O}]}$

3)  $K_{eq} = \frac{[\text{NH}_3]^4[\text{O}_2]^7}{[\text{NO}_2]^4[\text{H}_2\text{O}]^6}$

2)  $K_{eq} = \frac{[\text{NO}_2][\text{H}_2\text{O}]}{[\text{NH}_3][\text{O}_2]}$

4)  $K_{eq} = \frac{[\text{NO}_2]^4[\text{H}_2\text{O}]^6}{[\text{NH}_3]^4[\text{O}_2]^7}$

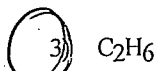
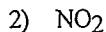
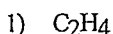
- 1 31) Given the equilibrium system:



Which change occurs as  $\text{Pb}(\text{NO}_3)_2(s)$  is added to the system at equilibrium?

- 1) The amount of  $\text{PbCO}_3(s)$  increases, and the concentration of  $\text{CO}_3^{2-}(aq)$  decreases.
- 2) The amount of  $\text{PbCO}_3(s)$  decreases, and the concentration of  $\text{CO}_3^{2-}(aq)$  decreases.
- 3) The amount of  $\text{PbCO}_3(s)$  increases, and the concentration of  $\text{CO}_3^{2-}(aq)$  increases.
- 4) The amount of  $\text{PbCO}_3(s)$  decreases, and the concentration of  $\text{CO}_3^{2-}(aq)$  increases.

- 3 32) According to the *Heat of Reaction at 101.3 kPa and 298 K* chemistry reference table, which compound forms exothermically?  $-\Delta H$



- X 33) The change in free energy of a chemical reaction is represented by

1)  $\Delta G$

2)  $\Delta H$

3)  $\Delta S$

4)  $\Delta T$

- 2 34) The change of reactants into products will *always* be spontaneous if the products, compared to the reactants, have

1) higher enthalpy and lower entropy

3) higher enthalpy and higher entropy

2) lower enthalpy and higher entropy -  $\Delta H$  and  $+\Delta S$

4) lower enthalpy and lower entropy

- 2 35) As the number of effective collisions of reacting particles increases, the rate of reaction

1) remains the same

2) increases

3) decreases

- 2 36) 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?

1) The rate in A is greater due to the larger surface area of the zinc.

2) The rate in B is greater due to the larger surface area of the zinc.

3) The rate in B is greater due to the smaller surface area of the zinc.

4) The rate in A is greater due to the smaller surface area of the zinc.

- 2 37) The addition of a catalyst to a system at equilibrium will increase the rate of

1) the forward reaction, only

3) neither the forward nor reverse reaction

2) both the forward and reverse reactions

4) the reverse reaction, only