

Name: _____

key

Unit 11 Practice Test: Kinetics and Equilibrium

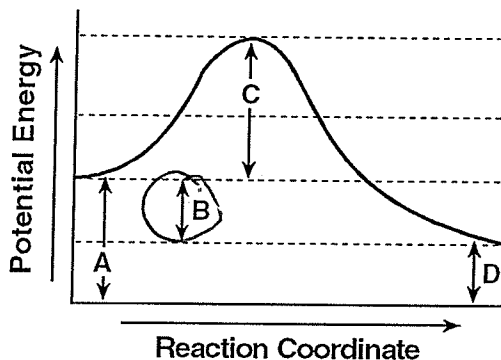
2) 1) A system is said to be in a state of dynamic equilibrium when the

- 1) rate at which products are formed is greater than the rate at which reactants are formed
- 2) rate at which products are formed is the same as the rate at which reactants are formed
- 3) concentration of products is greater than the concentration of reactants
- 4) concentration of products is the same as the concentration of reactants

At equilibrium:

- rates, equal
- concentrations, constant

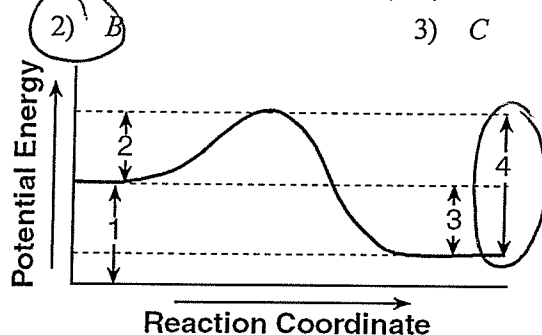
2) 2) The potential energy diagram of a chemical reaction is shown below.



Which letter in the diagram represents the heat of reaction (ΔH)?

PE products - PE reactants

- 1) A
- 2) B
- 3) C
- 4) D

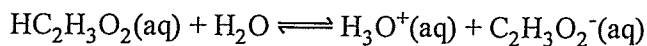


The activation energy for the reverse reaction is represented by

- 1) 1
- 2) 2
- 3) 3

4) 4

Given the reaction:



constant

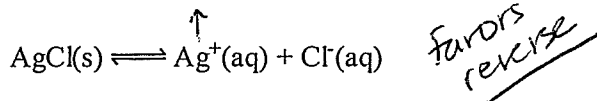
When the reaction reaches a state of equilibrium, the concentrations of the reactants

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

1 5) Which of the following statements is true for a saturated solution?

- 1) The rate of dissolving equals the rate of crystallizing.
- 2) It must be a concentrated solution.
- 3) Neither dissolving nor crystallizing is occurring.
- 4) It must be a dilute solution.

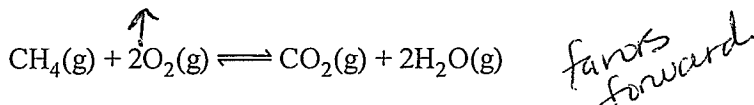
2 6) Given the reaction at equilibrium:



As the concentration of the Ag^+ ions is increased, at a constant temperature, the concentration of Cl^- ions

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

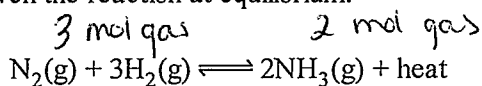
1 7) Given the reaction at equilibrium:



An increase in the concentration of $\text{O}_2(g)$ at constant temperature and pressure will result in

- 1) an increase in the concentration of $\text{CO}_2(g)$
- 2) an increase in the concentration of $\text{CH}_4(g)$
- 3) a decrease in the concentration of $\text{O}_2(g)$
- 4) a decrease in the concentration of $\text{H}_2\text{O}(g)$

4 8) Given the reaction at equilibrium:



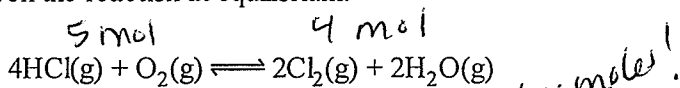
Which change would shift the equilibrium to the right?

- 1) Decrease the $[\text{N}_2]$.
- 2) Decrease the $[\text{H}_2]$.
- 3) Increase the temperature.
- 4) Increase the pressure. (*less moles!*)

3 9) Which system at equilibrium will be *least* affected by a change in pressure?

- 1) $2\text{S}(s) + 3\text{O}_2(g) \rightleftharpoons 2\text{SO}_3(g)$
- 2) $3\text{H}_2(g) + \text{N}_2(g) \rightleftharpoons 2\text{NH}_3(g)$
- 3) $\text{AgCl}(s) \rightleftharpoons \text{Ag}^+(aq) + \text{Cl}^-(aq)$
- 4) $2\text{HgO}(s) \rightleftharpoons 2\text{Hg}(l) + \text{O}_2(g)$

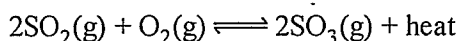
2 10) Given the reaction at equilibrium:



If the pressure on the system is increased, the concentration of $\text{Cl}_2(g)$ will

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

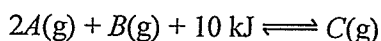
4 11) Given the reaction at equilibrium:



The concentration of $\text{SO}_3(g)$ may be increased by

- 1) decreasing the concentration of $\text{SO}_2(g)$
- 2) increasing the temperature
- 3) decreasing the concentration of $\text{O}_2(g)$
- 4) increasing the pressure (*less moles*)

12) 3 Given the equilibrium system:



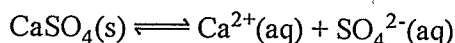
Which conditions would yield the *most* product?

- 1) low temperature and high pressure
- 2) low temperature and low pressure
- 3) high temperature and high pressure
- 4) high temperature and low pressure

4 13) When a catalyst is added to a chemical reaction, there is a change in the

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

2 14) Given the system at equilibrium:



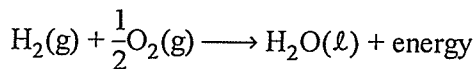
If $\text{K}_2\text{SO}_4(s)$ is added and the temperature remains constant, the $\text{Ca}^{2+}(aq)$ concentration will

- 1) increase, and the amount of $\text{CaSO}_4(s)$ will decrease
- 2) decrease, and the amount of $\text{CaSO}_4(s)$ will increase
- 3) increase, and the amount of $\text{CaSO}_4(s)$ will increase
- 4) decrease, and the amount of $\text{CaSO}_4(s)$ will decrease

1 15) When NH_4NO_3 is dissolved in water, the temperature of the water decreases. When NaOH is dissolved in a separate water sample, the temperature of the water increases. Based on these observations, it can be concluded that the dissolving of

- 1) NH_4NO_3 is endothermic and the dissolving of NaOH is exothermic
- 2) both salts are endothermic
- 3) both salts are exothermic
- 4) NH_4NO_3 is exothermic and the dissolving of NaOH is endothermic

3 16) Consider the reaction:



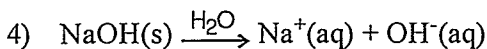
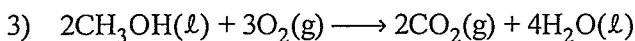
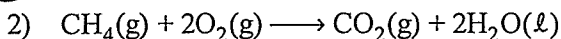
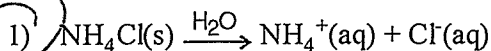
Which of the following phrases *best* describes this reaction?

- 1) exothermic, absorbing energy
- 2) endothermic, releasing energy
- 3) exothermic, releasing energy
- 4) endothermic, absorbing energy

4 17) Based on the *Heats of Reaction at 101.3 kPa and 298 K* chemistry reference table, the *most* energy would be released when oxygen reacts completely with 1.0 mole of

- | | | | |
|------------------------------------|------------------------|----------------------------|---|
| 1) CH_3OH
-1452 | 2) CO
-566 | 3) CH_4
-890.4 | 4) $\text{C}_6\text{H}_{12}\text{O}_6$
-2804 |
|------------------------------------|------------------------|----------------------------|---|

18) According to the *Heats of Reaction at 101.3 kPa and 298 K* chemistry reference table, in which reaction do the products have a *higher* energy content than the reactants?



↳ endo (+ΔH)
use Table I

19) Based on the *Heat of Reaction at 101.3 kPa and 298 K* chemistry reference table, how many kilojoules of heat are given off when 0.500 mole of $\text{Al}_2\text{O}_3(s)$ is formed from its elements?

1) 3,351 kJ

2) 13,404 kJ

3) 1,676 kJ

4) 838 kJ

20) Activation energy is required to initiate

1) endothermic reactions, only

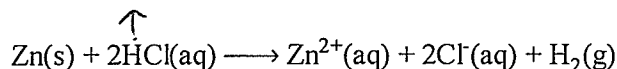
2) both exothermic and endothermic reactions

3) exothermic reactions, only

4) neither exothermic nor endothermic reactions

$$\frac{0.500 \text{ mol} \times -3351 \text{ kJ}}{1} = \frac{-1675.5 \text{ kJ}}{2 \text{ mol}} = -838 \text{ kJ}$$

21) Given the reaction:



If the concentration of the $\text{HCl}(\text{aq})$ is increased, the frequency of reacting collisions will

1) increase, producing an increase in the reaction rate

2) decrease, producing an increase in the reaction rate

3) decrease, producing a decrease in the reaction rate

4) increase, producing a decrease in the reaction rate

22) In a gaseous system, temperature remaining constant, a decrease in pressure will

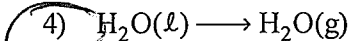
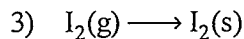
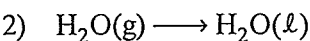
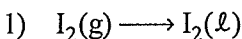
1) increase the reaction rate

2) decrease the activation energy

3) decrease the reaction rate

4) increase the activation energy

23) Which change represents an increase of entropy?



24) Which tendency favors a spontaneous reaction?

1) decreasing enthalpy and increasing entropy

2) decreasing enthalpy and decreasing entropy

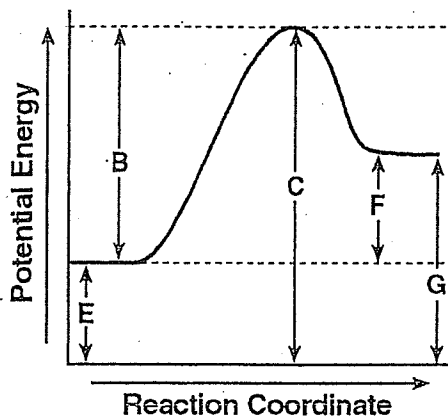
3) increasing enthalpy, and decreasing entropy

4) increasing enthalpy and increasing entropy

↳ -ΔH and +ΔS

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The diagram below represents a potential energy diagram of a chemical reaction.



What interval represents the heat of reaction (ΔH)?

- A) C B) D C) G D) E

2) D

A catalyst changes the rate of a chemical reaction by lowering the

- A) heat of the reaction C) potential energy of the products
 B) potential energy of the reactants D) activation energy of the reaction

3) A

Based on the *Heats of Reaction at 101.3 kPa and 298 K* chemistry reference table, which reaction is endothermic?

- A) $\text{NH}_4\text{Cl}(s) \xrightarrow{\text{H}_2\text{O}} \text{NH}_4^+(\text{aq}) + \text{Cl}^-(\text{aq})$ C) $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \longrightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}$
 B) $\text{CO}(\text{g}) + \text{O}_2(\text{g}) \longrightarrow 2\text{CO}_2(\text{g})$ D) $\text{NaOH}(s) \xrightarrow{\text{H}_2\text{O}} \text{Na}^+(\text{aq}) + \text{OH}^-(\text{aq})$

4) B

A student dissolved a salt in water and noted that the temperature of the water decreased during the dissolving process. A logical conclusion based on this observation is that the salt

- A) ionized in water C) dissolved exothermically
 B) dissolved endothermically D) oxidized in water

5) B

The phase change represented by $\text{H}_2\text{O}(\ell) \longrightarrow \text{H}_2\text{O}(\text{g})$ is

- A) exothermic with an increase in entropy C) exothermic with a decrease in entropy
 B) endothermic with an increase in entropy D) endothermic with a decrease in entropy

6) D

According to the *Heats of Reaction at 101.3 kPa and 298 K* chemistry reference table, the decomposition of which compound would be an exothermic reaction? (-)

- A) $\text{CO}_2(\text{g})$ B) $\text{H}_2\text{O}(\text{g})$ C) $\text{NH}_3(\text{g})$ D) $\text{NO}_2(\text{g})$

7) C As the number of effective collisions of reacting particles increases, the rate of reaction (C) increases

D Which condition will increase the rate of a chemical reaction?
 A) increased temperature and decreased concentration of reactants
 B) decreased temperature and increased concentration of reactants
 C) decreased temperature and decreased concentration of reactants
D) increased temperature and increased concentration of reactants

8) B The table below records 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 ($^\circ\text{C}$) 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

What two trials could be used to measure the effect of surface area?

- A) trials B and D B) trials A and B. C) trials A and C D) trials A and D

9) C If the concentration of one of the reactants in a chemical reaction is increased, the rate of the reaction usually (C) increases

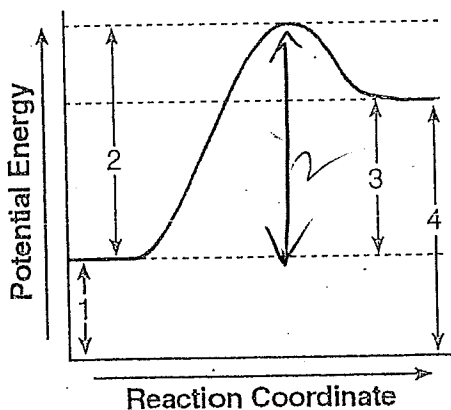
10) A Beaker A contains a 1-gram piece of zinc and beaker B contains 1 gram of powdered zinc. If 100 milliliters of 0.1 M HCl is added to each of the beakers, how does the rate of reaction in beaker A compare to the rate of reaction in beaker B?

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

11) B Which of the following will occur if a catalyst is added to a reaction mixture?

- A) Only the rate of the forward reaction will be increased.
B) The activation energy will be changed.
 C) The energy change (ΔH) of the reaction will be decreased.
 D) Only the rate of the reverse reaction will be increased.

12) B The potential energy diagram below represents the reaction $2\text{KClO}_3 \rightarrow 2\text{KCl} + 3\text{O}_2$.



What numbered interval on the diagram would change when a catalyst is added?

- A) 1 B) 2 ~~C) 3~~ D) 4

13) A

Given the system $\text{CO}_2(\text{s}) \rightleftharpoons \text{CO}_2(\text{g})$ at equilibrium. As the pressure increases at constant temperature, the amount of $\text{CO}_2(\text{g})$ will

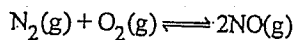
A) decrease

B) increase

C) remain the same

14) C

Given the reaction at equilibrium:



If the temperature remains constant and the pressure increases, the number of moles of $\text{NO}(\text{g})$ will

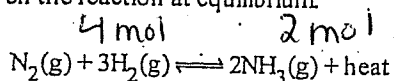
A) decrease

B) increase

C) remain the same

15) D

Given the reaction at equilibrium:



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

A) decreasing the pressure and decreasing the concentration of $\text{N}_2(\text{g})$

B) decreasing the pressure and increasing the concentration of $\text{N}_2(\text{g})$

C) increasing the pressure and decreasing the concentration of $\text{N}_2(\text{g})$

D) increasing the pressure and increasing the concentration of $\text{N}_2(\text{g})$

16) D

As products are formed in the reaction $\text{NH}_4\text{Cl}(\text{s}) + 14.6 \text{ kJ} \xrightarrow{\text{H}_2\text{O}} \text{NH}_4^+(\text{aq}) + \text{Cl}^-(\text{aq})$, the entropy of the system

A) decreases and heat is released

C) increases and heat is released

B) decreases and heat is absorbed

D) increases and heat is absorbed

17) A

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

A) lower enthalpy and higher entropy

C) higher enthalpy and higher entropy

B) lower enthalpy and lower entropy

D) higher enthalpy and lower entropy

18) C

What factors must be equal in a reversible chemical reaction at equilibrium?

A) the concentration of the reactants and products

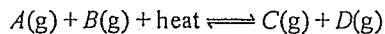
B) the activation energies of the forward and reverse reactions

C) the rates of reaction of the forward and reverse reactions

D) the potential energies of the reactants and products

19) C

Given the reaction at equilibrium:



The equilibrium will shift to the right when the

A) pressure is decreased

C) temperature is increased

B) concentration of $\text{C}(\text{g})$ is increased

D) concentration of $\text{A}(\text{g})$ is decreased

20) B

What change takes place when a catalyst is added to a reaction at equilibrium?

A) The rates of the forward and reverse reactions are increased unequally.

B) The rates of the forward and reverse reactions are increased equally.

C) The point of equilibrium is shifted to the right.

D) The point of equilibrium is shifted to the left.

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