Name _____ Kinetic and Equilibrium Review

_____1. Chemical reactions require activation energy and are:
1. Either exothermic or endothermic
2. Exothermic, only
3. Neither exothermic nor endothermic
4. Endothermic, only

_____2. When a catalyst lowers the activation energy of a reaction, the rate of the reaction:
1. Decreases
2. Increases
3. Remains the same

_____3. When a catalyst is added to a chemical reaction, what will remain constant?
1. △H of the reaction
2. Rate of the reaction
3. Potential energy of the activated complex
4. Activation energy of the forward reaction

_____4. Consider the reaction: $H_2O_{(l)}$ + ENERGY → $H_{2(g)}$ + ½ $O_{(g)}$
Which phrase best describes this reaction?
1. Exothermic, releasing energy
2. Exothermic, absorbing energy
3. Endothermic, releasing energy
4. Endothermic, absorbing energy

_____5. As products are formed in the reaction: $NH_4Cl_{(s)}$ + 14.78 kJ → $NH_4^+{}_{(aq)}$ + $Cl^-{}_{(aq)}$, the entropy of the system,
1. Decreases and heat is absorbed
2. Decreases and heat is released
3. Increases and heat is absorbed
4. Increases and heat is released

_____6. Which set of characteristics is associated with a spontaneous reaction at all temperatures?
1. △H positive, △S negative
2. △H positive, △S positive
3. △H negative, △S negative
4. △H negative, △S positive

Base your answers to question 7 through 8 on the equation below.

$$A + B \leftrightarrows AB \qquad \triangle H = +153.2 \text{ kJ}$$

_____7. The enthalpy change for the reverse reaction is:
1. + 153.2 kJ
2. – 153.2 kJ
3. + 306.4 kJ
4. – 304.6 kJ

_____8. The forward reaction is:
1. Exothermic
2. Endothermic
3. Isothermic
4. Incomplete

_____9. Based on Reference Table I, which compound forms from its elements spontaneously?
1. $C_2H_{4(g)}$
2. $C_2H_{6(g)}$
3. $NO_{2(g)}$
4. $NO_{(g)}$

_____10. Based on Reference Table I, which reaction occurs spontaneously?
1. $N_{2(g)} + 2O_{2(g)} \rightarrow 2NO_{2(g)}$
2. $N_{2(g)} + O_{2(g)} \rightarrow 2NO_{(g)}$
3. $2C_{(s)} + 3H_{2(g)} \rightarrow C_2H_{6(g)}$
4. $2C + 2H_{2(g)} \rightarrow C_2H_{4(g)}$

_____11. Given the reaction for the Haber process: $N_2 + 3H_2 \Leftrightarrow 2NH_3$ + heat
The temperature of the reaction is raised in order to:
1. increase the percent yield(amount) of nitrogen
2. increase the rate of formation of ammonia
3. affect the forward reaction rate most
4. affect the reverse reaction least

____12. In a reversible reaction, chemical equilibrium is attained when the:

1. rate of the forward reaction is greater than the rate of the reverse reaction
2. rate of the reverse reaction is greater than the rate of the forward reaction
3. concentration of the reactants reaches zero
4. concentration of the products remains constant

____13. In a reversible chemical reaction, which factors must be equal when the reaction is at equilibrium?

1. rate at which reactants are formed and rate at which products are formed
2. concentration of reactants and concentration of products
3. potential energy of reactants and potential energy of products
4. activation energy of reactants and activation energy of products.

____14. After being ignited in a Bunsen burner flame, a piece of magnesium ribbon burns brightly, giving off heat and light. In this situation, the Bunsen burner flame provides:

1. ionization energy
2. activation energy
3. heat of vaporization
4. heat of reaction

____15. Given the solution at equilibrium: $CaSO_{4\,(S)} \Leftrightarrow Ca^{2+}{}_{(aq)} + SO_4^{2-}{}_{(aq)}$

When Na_2SO_4 is added to the system, how will the equilibrium shift?

1. The amount of $CaSO_4$ will decrease, and the concentration of $Ca^{2+}{}_{(aq)}$ will decrease
2. The amount of $CaSO_4$ will decrease, and the concentration of $Ca^{2+}{}_{(aq)}$ will increase
3. The amount of $CaSO_4$ will increase, and the concentration of $Ca^{2+}{}_{(aq)}$ will decrease
4. The amount of $CaSO_4$ will increase, and the concentration of $Ca^{2+}{}_{(aq)}$ will increase

_____16. Given the reaction at equilibrium**:** $2H_{2(g)} + O_{2(g)} \leftrightarrow 2H_2O_{(g)} + HEAT$.

Which concentration changes occur when the temperature of the system is increased:

1. The $[H_2]$ decreases and the $[O_2]$ decreases
2. The $[H_2]$ decreases and the $[O_2]$ increases
3. The $[H_2]$ increases and the $[O_2]$ decreases
4. The $[H_2]$ increases and the $[O_2]$ increases

_____17. In the equilibrium system: $2SO_{2(g)} + O_{2(g)} \leftrightarrows 2SO_{3(g)} + HEAT$, the concentration of $SO_{3(g)}$ may be increased by:

1. Increasing the pressure
2. Decreasing the concentration of $SO_{2(g)}$
3. Increasing the temperature
4. Decreasing the concentration of $O_{2(g)}$

____18. Given the reaction at equilibrium: $SO_{2(g)} + NO_{2(g)} \leftrightarrow SO_{3(g)} + NO_{(g)}$.

The amount of $SO_{3(g)}$ will increase if the concentration of:

1. $NO_{(g)}$ increases
2. $SO_{2(g)}$ increases
3. $NO_{2(g)}$ decreases
4. $SO_{2(g)}$ decreases

____19. Given the reaction at equilibrium: $2CO_{(g)} + O_{2(g)} \Leftrightarrow 2CO_{2(g)}$

When the reaction is subjected to stress, a change will occur in the concentration of:

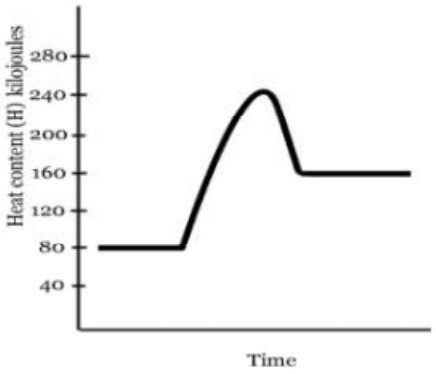
1. reactants, only
2. products, only
3. both reactants and products
4. neither reactants nor products

____20. Given the reaction: $4HCl_{(g)} + O_{2(g)} \Leftrightarrow 2Cl_{(g)} + 2H_2O_{(g)}$

If the pressure on the system is increased, the concentration of $Cl_{2(g)}$ will:

1. decrease
2. increase
3. remain the same

21. Use the potential energy diagram below to answer the following questions.



a. The heat content of the reactants of the forward reaction is about _____ kilojoules.

b. The heat content of the products of the forward reaction is about _____ kilojoules.

c. The heat content of the activated complex of the forward reaction is about _____ kilojoules.

d. The activation energy of the forward reaction is about _____ kilojoules.

e. The heat of reaction (ΔH) of the forward reaction is about _____ kilojoules.

f. The forward reaction is _____ (endothermic or exothermic).

g. The heat content of the reactants of the reverse reaction is about _____ kilojoules.

h. The heat content of the products of the reverse reaction is about _____ kilojoules.

i. The heat content of the activated complex of the reverse reaction is about _____ kilojoules.

j. The activation energy of the reverse reaction is about _____ kilojoules.

k. The heat of reaction (ΔH) of the reverse reaction is about _____ kilojoules.

l. The reverse reaction is _____ (endothermic or exothermic).

22. Given the reaction: $N_2(g) + 2\ O_2(g) \rightarrow 2\ NO_2(g)$ $\Delta H = +66.4$ kJ

a) Rewrite the reaction to include the enthalpy value: _____

b) If 25.7 moles of $NO_2(g)$ are to be formed, how much heat energy is needed?

23. Determine the heat of reaction for the following using the Enthalpy Heats of Formation chart.

$NaOH(s) + HCl(g) \longrightarrow NaCl(s) + H_2O(g)$

24. Given the overall reaction: $3H_2$ (g) + 2C (s) + ½ O_2 (g) → C_2H_5OH (l) determine ΔH using the intermediate steps below.

C_2H_5OH (l) + 3 O_2 (g) → 2 CO_2 (g) + 3 H_2O (l)	ΔH = -875. kJ
C (s) + O_2 (g) → CO_2 (g)	ΔH = -394.51 kJ
H_2 (g) + ½ O_2 (g) → H_2O (l)	ΔH = -285.8 kJ

25. In this reaction: CO_2 (g) + H_2 (g) + heat ↔ CO (g) + H_2O (g)

a. Is heat absorbed or released by the forward reaction? _____

b. In which direction (←, → or none) will the equilibrium shift if these changes are made?

CO is added _____	H_2 is removed _____
temperature is increased _____	pressure is increased _____
CO_2 is added _____	catalyst is added _____
temperature is decreased _____	

26. In this reaction: 2 NO (g) + H_2 (g) ↔ N_2O (g) + H_2O (g) + heat

a. What will happen to the H_2O concentration (inc., dec. or stay same) when equilibrium is reestablished after these stresses are applied?

temperature is increased _____	NO is added _____
a catalyst is added _____	N_2O is removed _____
pressure is decreased _____	

Answers

1. 1
2. 2
3. 1
4. 4
5. 3
6. 4
7. 2
8. 2
9. 2
10. 3
11. 1
12. 4
13. 1
14. 2
15. 3
16. 4
17. 1
18. 2
19. 3
20. 2
21. a) 80
    b) 160
    c) 240
    d) 160
    e) +80
    f) endo
    g) 160
    h) 80
    i) 240
    j) 80
    k) -80
    l) exo
22. a) $N_2+O_2+66.4kJ-->2\ NO_2$
    b) -853.24 kJ
23. -986.3 kJ
24. -771.41 kJ
25. a) absorbed
    b) ← ←
    → none
    → none
    ←
26. dec inc
    same inc
    dec

Answers

1. 1
2. 2
3. 1
4. 4
5. 3
6. 4
7. 2
8. 2
9. 2
10. 3
11. 1
12. 4
13. 1
14. 2
15. 3
16. 4
17. 1
18. 2
19. 3
20. 2
21. a) 80
    b) 160
    c) 240
    d) 160
    e) +80
    f) endo
    g) 160
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    → none
    → none
    ←
26. dec inc
    same inc
    dec

Answers

1. 1
2. 2
3. 1
4. 4
5. 3
6. 4
7. 2
8. 2
9. 2
10. 3
11. 1
12. 4
13. 1
14. 2
15. 3
16. 4
17. 1
18. 2
19. 3
20. 2
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    b) 160
    c) 240
    d) 160
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