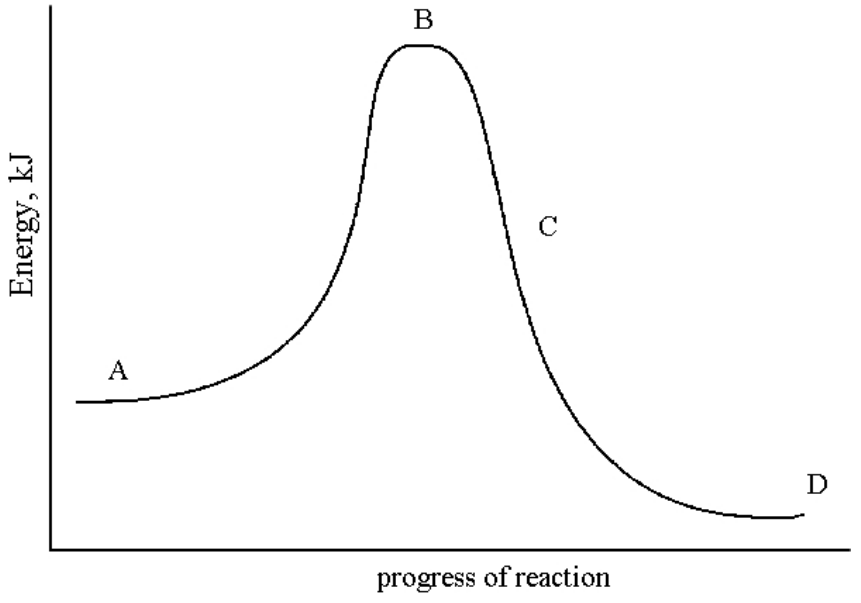
Exam_980318

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.



1) Consider the reaction profile shown above. The point labelled B refers to the
   A) activation energy.
   B) products.
   C) reactants.
   D) catalyst.
   E) activated complex.

   Answer: E

2) Consider the reaction profile shown above. The activation energy of the reaction is represented by the difference in energy between points
   A) C and D. B) B and C. C) A and B. D) A and D. E) A and C.

   Answer: C

3) Consider the reaction profile shown above. Is the reaction endothermic or exothermic, and why?
   A) Endothermic, because the reaction must possess a large amount of energy in order to go from A → B.
   B) Endothermic, because the reaction at point A possesses more energy than the reaction at point D.
   C) Exothermic, because the transition state (B) is much higher in energy than the products (D).
   D) Exothermic, because the difference in energy between point A and point D is a negative value.
   E) The reaction profile doesn't indicate whether a reaction is endothermic or exothermic.

   Answer: D

4) Consider the reaction profile shown above. Addition of a catalyst to the reaction will cause
   A) the difference in energy between point A and B to decrease.
   B) the energy of point D to increase.
   C) the energy of point C to increase.
   D) the difference in energy between point A and D to decrease.
   E) the energy of point A to decrease.

Answer: A

5) An equilibrium mixture of $NO_{(g)}$, $O_{2\,(g)}$ and $NO_{2\,(g)}$ is allowed to expand from 1.0 L to 2.0 L at a constant temperature.

$$2\,NO_{(g)} + O_{2\,(g)} \Leftrightarrow 2\,NO_{2\,(g)}$$

Which of the following statements is correct?
   A) The value of Kp would decrease.
   B) Concentration of all three gases are unchanged.
   C) The number of moles of all three gases are unchanged.
   D) The number of moles of O_2 would increase.
   E) The number of moles of NO_2 would increase.

Answer: D

6) The reaction of O_3 with $Cl\cdot$ is believed to occur by the mechanism shown below.

$$O_3 + Cl\cdot \rightarrow ClO\cdot + O_2$$
$$ClO\cdot + O \rightarrow Cl\cdot + O_2$$

In this mechanism, $Cl\cdot$ is
   A) an intermediate.
   B) the activated complex.
   C) a reactant in the overall reaction.
   D) a product of the overall reaction.
   E) the catalyst.

Answer: E

7) At some point during a reaction, the following concentrations are measured.

$$2\,ICl_{(g)} \rightleftharpoons I_{2\,(g)} + Cl_{2(g)} \qquad K_c = 8.33 \times 10^{-4}$$
$$0.15\ M \qquad 0.00125\ M \quad 0.0075\ M$$

Which of the following represents a true statement?
   A) The reaction will proceed until all ICl is consumed.
   B) The concentration of Cl_2 will increase in reaching equilibrium.
   C) The reaction is at equilibrium.
   D) I_2 will be consumed in reaching equilibrium.

Answer: B

8) In the plot of ln(*k*) versus 1/T for a first order reaction, the frequency factor (A) can be determined by
   A) the intercept on the y-axis.
   B) the slope of the line times R.
   C) the intercept of the x-axis.
   D) the slope of the line.
   E) the negative of the slope of the line times R.

Answer: A

9) For first order reactions the slope of a plot of ln [A] vs. time is
   A) k ln $[A]_0$. B) -k. C) kt. D) k. E) k/t.

Answer: B

10) Based on a reaction profile, the energy of activation for the forward reaction is 411 kJ and the enrgy of activation for the backward reaction is 169 kJ. What is the enthalpy of reaction?
   A) -242 B) 0.411 C) 242 D) 580 E) 2.43

Answer: C

11) If 0.22 atm $H_2S_{(g)}$ are added to a 1.0 L flask containing an excess of $I_{2(s)}$, what will be the equilibrium concentration of HI? (note: equation unbalanced)

$$H_2S\,(g) + I_2\,(s) \rightarrow HI\,(g) + S\,(s) \qquad K_p = 1.34 \times 10^{-5} \text{ at } 60°C$$

   A) 3.0×10^{-6} atm
   B) 6.9×10^{-3} atm
   C) 8.6×10^{-4} atm
   D) 1.7×10^{-3} atm
   E) More information is needed to answer this question.

Answer: D

12) At equilibrium in the following reaction at 319 K, the concentration of $NO_2\,(g)$ is 2.09 M. What is the concentration of $N_2O_4\,(g)$ if the equilbrium constant for this reaction is determined to be 39.68 at 319K?

$$2\ NO_2\,(g) \leftrightarrow N_2O_4\,(g)$$

   A) 362 B) 19.0 C) 82.9 D) 173 E) 0.110

Answer: D

13) Balance the following equation and determine the equilibrium constant expression, K_c.

$$C_{(s)} + H_2O_{(g)} \Leftrightarrow C_2H_5OH_{(g)} + O_{2(g)} \quad \text{(not balanced)}$$

A) $\dfrac{[C_2H_5OH][O_2]}{[H_2O]}$

B) $\dfrac{[C][H_2O]}{[C]^2[H_2O]^3}$

C) $[C_2H_5OH]\,[O_2]$

D) $\dfrac{[C_2H_5OH][O_2]}{[C][H_2O]}$

E) $\dfrac{[C_2H_5OH][O_2]}{[H_2O]^3}$

Answer: E

14) What is the value of Q for the following reaction if [HI] = 0.16 M, $[H_2]$ = 0.899 M, and $[I_2]$ = 0.90 M?

$$H_2 + I_2 \rightarrow 2\ HI$$

A) 2.5 B) 5.1 C) 0.32 D) 0.40 E) 0.032

Answer: E

15) A mixture is prepared with [CO] = 0.035, $[Cl_2]$ = 0.015, and $[COCl_2]$ = 0.95. It is known that K_c for the equilibrium $CO_{(g)} + Cl_{2(g)} \Leftrightarrow COCl_{2(g)}$ is 1.2×10^3 at 400°C. Predict what will happen.

A) The reaction occurs in the forward direction.
B) The reaction is at equilibrium so no net reaction occurs.
C) The reaction occurs in the reverse direction.
D) It is impossible to predict without more information.

Answer: C

16) Without doing detailed calculations, estimate the length of time required for the following reaction to have used up all but 25% of the starting material.

$$H_2 + C_2H_4 \rightarrow C_2H_6 \qquad t_{1/2} = 2.5 \text{ minutes}$$

A) 5.0 minutes B) 2.5 minutes C) 7.5 minutes D) 100 minutes E) 0.6 minutes

Answer: A

Two mechanisms proposed for the following reaction of nitrogen dioxide with carbon monoxide are shown below. Use this information to answer the following questions.

$NO_2\,(g) + CO \rightarrow CO_2\,(g) + NO\,(g)$

Mechanism I: $NO_2\,(g) + CO \rightarrow CO_2\,(g) + NO\,(g)$ (one step)

Mechanism II: $NO_2\,(g) + NO_2\,(g) \rightarrow NO_3\,(g) + NO\,(g)$ (slow)
$NO_3\,(g) + CO\,(g) \rightarrow CO_2\,(g) + NO_2\,(g)$ (fast)

Figure 1

17) Refer to the information in Figure 1. What is the predicted rate law for Mechanism I?
A) rate = $k[NO_2]$
B) rate = $k[NO_2]^2$
C) rate = $k[NO_2]^2[CO]$
D) rate = $k[NO_2][CO]$
E) rate = $k[NO][CO_2]$

Answer: D

18) Refer to the information in Figure 1. What is the predicted rate law for Mechanism II?
A) rate = $k[NO_3][CO]$
B) rate = $k[NO_2]^2$
C) rate = $k[NO_2][CO]$
D) rate = $k[NO_2]$
E) rate = $k[NO_2]^2[CO]$

Answer: B

19) Refer to the information in Figure 1. If the activation energy for the forward reaction is greater than the activation energy for the reverse reaction, the reaction is
A) exothermic.
B) endothermic.
C) faster in the forward direction.
D) faster in the reverse direction.
E) spontaneous.

Answer: B

20) Refer to the information in Figure 1. The experimental rate law is found to be: rate = $k[NO_2]^2$. Which (if any) mechanism is consistent with this rate law?
A) Mechanism II
B) Mechanism I
C) Neither mechanism is consistent with this rate law.

Answer: A

21) What is the equilibrium constant if [A] = 0.01M, [B] =0.90M, [C] = 0.70M in the presence of 0.50M D?
$2A\,(aq) \rightarrow B\,(aq) + C\,(aq) + D\,(s)$
A) 6300 B) 130 C) 0.016 D) 3150 E) 450

Answer: A

22) How many of the following factors affect the numerical value of the equilibrium constant K?

pressure initial concentration
volume temperature
chemical equation

A) 0 B) 1 C) 2 D) 3 E) 4

Answer: C

23) Which direction will the following reaction (in a 5.0 L flask) proceed if more calcium oxide is added to the system?

$$CaCO_3\,(s) \rightarrow CaO\,(s) + CO_2\,(g) \qquad K_p = 1.9 \times 10^{-23}$$

A) to the right
B) to the left
C) The equilibrium constant gets smaller to reflect the added calcium oxide.
D) The equilibrium position will not shift because calcium oxide is a solid.
E) More information is needed to answer this question.

Answer: D

24) The decomposition of N_2O on a platinum surface is found to be zero order with a rate

$$2\,N_2O\,(g) \rightarrow 2\,N_2\,(g) + O_2\,(g)$$

constant, k = 1.48×10^{-3} M s^{-1}. If the initial concentration of N_2O is 0.240 M, what would be the half-life for the reaction, in s?

A) 13.0 B) 36.4 C) 52.4 D) 128 E) 81.1

Answer: E

25) The rate constant for a particular reaction is $2.7 \times 10^{-2} s^{-1}$ at 25°C and $6.2 \times 10^{-2} s^{-1}$ at 115°C. What is the activation energy for the reaction, in kJ/mol?

A) 87 B) 0.089 C) 8.9 D) 0.0045 E) 13

Answer: C

26) Consider the following exothermic reaction:

$$N_2\,(g) + 3\,H_2\,(g) \Leftrightarrow 2\,NH_3\,(g)$$

Which of the following changes would not increase the amount of NH_3 produced from given quantities of N_2 and H_2?

A) an increase in T
B) an increase in P
C) a decrease in V
D) removing some NH_3 and reestablishing equilibrium
E) none of the above

Answer: A

27) Which is not correct concerning equilibrium?
A) The rates of the forward and reverse reactions are the same.
B) At equilibrium, the rates of the forward and reverse reaction become zero.
C) Either the reactants or the products of a reaction could be used to attain equilibrium for a reversible reaction.
D) The ratio of the concentrations of products and reactants, raised to appropriate powers, is a constant.
E) The concentration of reactants and products are no longer changing.

Answer: B

28) According to the following equilibrium,

$$2\ HI_{(g)} \Leftrightarrow H_{2\ (g)} + I_{2\ (g)} \quad \Delta H = -26.48\ kJ/mol$$

the concentration of HI in equilibrium with H_2 and I_2 will decrease
A) by increasing the pressure of the system.
B) by adding some hydrogen gas.
C) by addition of a catalyst to the reaction.
D) by heating the system.
E) by removing some iodine gas.

Answer: E

29) Which is not usually a factor in determining the rate of a reaction according to collision theory?
A) kinetic energy of the molecules that collide
B) orientation of the molecules that collide
C) the stability of the product
D) the temperature of the reaction mixture
E) the number of particles per unit volume in the sample

Answer: C

30) The equilibrium system $PCl_{5\ (g)} \Leftrightarrow PCl_{3\ (g)} + Cl_{2\ (g)}$ is disturbed by adding chlorine. When equilibrium is reestablished, what can be predicted about the new concentration compared to the original equilibrium concentration?
A) $[PCl_5]$ is larger, $[PCl_3]$ larger, $[Cl_2]$ smaller
B) $[PCl_5]$ is larger, $[PCl_3]$ larger, $[Cl_2]$ larger
C) $[PCl_5]$ is larger, $[PCl_3]$ smaller, $[Cl_2]$ smaller
D) $[PCl_5]$ is smaller, $[PCl_3]$ larger, $[Cl_2]$ larger
E) $[PCl_5]$ is larger, $[PCl_3]$ smaller, $[Cl_2]$ larger

Answer: E

31) Determine the value of K_c for the following reaction given the K_p.

$$CO_{(g)} + Cl_{2\ (g)} \Leftrightarrow COCl_{2\ (g)} \quad K_p = 15.0 \text{ at } 300°C \quad (R = 0.0821\ L \cdot atm/molK)$$

A) 706 B) 1.42×10^{-3} C) 369 D) 3.14 E) 0.319

Answer: A

32) For the system $CaO_{(s)} + CO_{2(g)} \Leftrightarrow CaCO_{3(s)}$, the equilibrium constant expression is

A) $[CO_2]$
B) $1/[CaO][CO_2]$
C) $[CaCO_3] / [CaO][CO_2]$
D) $1/[CO_2]$
E) $[CaO][CO_2] / [CaCO_3]$

Answer: D

33) Consider the reaction below:

$$CO_{(g)} + H_2O_{(g)} \Leftrightarrow CO_{2(g)} + H_{2(g)} \quad \Delta H° = -41 \text{ kJ}$$

All of the following changes would shift the equilibrium to the *right* except one. Which one would not cause the equilibrium to shift to the right?

A) Decrease the temperature.
B) Add some CO.
C) Increase the partial pressure of H_2O.
D) Decrease the container volume.
E) Remove some CO_2.

Answer: D

34) At a certain temperature, the equilibrium mixture of the reaction $PCl_{5(g)} \Leftrightarrow PCl_{3(g)} + Cl_{2(g)}$ has $P_{PCl_5} = 1.5$ atm, $P_{PCl_3} = 0.10$ atm, and $P_{Cl_2} = 7.50$ atm. Calculate the value of K_p at this temperature.

A) 2.0 B) 0.77 C) 1.0 D) 0.50 E) 1.3

Answer: D

35) Which direction will the following reaction (in a 5.0 L flask) proceed if the pressure of $CO_{2(g)}$ is 1.0 atm?

$$CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)} \qquad K_p = 1.9 \times 10^{-23}$$

A) to the right because $Q < K_p$
B) to the left because $Q < K_p$
C) to the right because $Q > K_p$
D) to the left because $Q > K_p$
E) The reaction is at equilibrium.

Answer: D

36) For first-order reactions, the rate constant, k, has the units

A) time^{-1}.
B) time mol L^{-1}.
C) time.
D) L mol^{-1}.
E) mol L^{-1} time^{-1}.

Answer: A

37) Suppose that at some point in a reaction, [A] = 0.50 M and after 290 s, [A] = 0.10 M. What is the average rate of this reaction?

A) 0.000345 M/s
B) 0.00138 M/s
C) -0.00138 M/s
D) 0.400 M/s
E) 116 M/s

Answer: B

38) The reaction: $2\ NO_{(g)} + Cl_{2\ (g)} \Leftrightarrow 2\ NOCl_{(g)}$ is allowed to reach equilibrium. Analysis of the equilibrium mixture shows [NO] = 0.0574, $[Cl_2]$ = 0.126, and [NOCl] = 0.248. Calculate K_c for this reaction at this temperature.

A) 1.00 B) 6.75×10^{-3} C) 2.92×10^{-3} D) 148 E) 34.2

Answer: D

39) The value of K_c is changed when

A) the pressure of the system is changed.
B) the concentration of reactants are changed.
C) the volume of the system is changed.
D) the temperature of the system is changed.
E) a catalyst is added.

Answer: D

40) Which direction will the following reaction (in a 5.0 L flask) proceed if a catalyst is added to the system?

$$CaCO_{3\ (s)} \rightarrow CaO_{(s)} + CO_{2\ (g)} \qquad K_p = 1.9 \times 10^{-23}$$

A) to the right
B) to the left
C) The equilibrium position will not change but the concentrations of everything will increase.
D) The equilibrium position will not change but the rate will increase.
E) It is impossible to tell without more information.

Answer: D

41) The decomposition of H_2O_2 is first order with a rate constant $k = 3.66 \times 10^{-3}\ sec^{-1}$. If the initial concentration of H_2O_2 is 405 M, how long will it take, in minutes, for the concentration to drop to 134 M?

A) 0.00405 B) -302 C) 5.03 D) 2.19 E) 302

Answer: C

42) In the reaction: $2A \rightarrow B$, $\Delta[A]/\Delta t = -0.50$ M/s. What is the rate of formation of B?

A) 0.25 M/s B) -1.0 M/s C) -0.50 M/s D) -0.17 M/s E) -0.25 M/s

Answer: A

43) Which statement is incorrect?
A) The half-life of a second order reaction is inversely proportional to the initial concentration.
B) The shorter the half-life, the faster is the reaction.
C) The half-life of a first order reaction is directly proportional to the initial concentration.
D) The half-life of a first order reaction is independent of the initial concentration.
E) The half-life of a zero order reaction is directly proportional to the initial concentration (i.e., the greater the concentration the longer the half-life).

Answer: C

44) If the equilibrium concentrations of Cl_2 and $COCl_2$ are the same at 395°C, find the equilibrium concentration of CO in the reaction

$$CO_{(g)} + Cl_2\ (g) \rightleftharpoons COCl_2\ (g) \qquad K_C = 1.2 \times 10^3 \text{ at } 395°C$$

A) 4.0×10^{-4} B) 1.0×10^{-6} C) 8.3×10^{-4} D) 1.0×10^{-8}

Answer: C

45) Which statement is not correct regarding the function of a catalyst?
A) It changes the mechanism of a reaction.
B) It lowers the energy of the product causing the reaction to be more exothermic.
C) It lowers the activation energy.
D) It affects the rate of a chemical reaction.
E) None of the above are incorrect.

Answer: B

46) At equilibrium, the value of the reaction quotient, K_p, is 0.636. What will be the value of Q_p if the total volume of the reaction shown below is halfed?

$$A\ (g) \leftrightarrow 4\ B\ (g)$$

A) 0.404 B) 1.27 C) 12.6 D) 5.09 E) 10.2

Answer: D

47) A chemical system is at equilibrium
A) when the rate of the forward reaction becomes zero.
B) when the concentration of reactants and products are equal.
C) when all of the reactants have been used up.
D) when the rates of the forward reaction and the reverse reaction are equal.
E) when the rates of the forward reaction and the reverse reaction are both zero.

Answer: D

48) Initial rate data were obtained for the following reaction:

$$2\ A\ (g)\ +\ 3\ B\ (g)\ \rightarrow\ 2\ C\ (g)$$

Experiment	Initial [A], Mol/L	Initial [B], Mol/L	Initial Rate
1	0.10	0.10	1.4×10^2
2	0.20	0.10	2.8×10^2
3	0.20	0.20	5.6×10^2

What is the rate law for the reaction?

A) rate = k $[A]^2[B]$
B) rate = k [A][B]
C) rate = k $[A]^2[B]^2$
D) rate = k [A]
E) rate = k $[A][B]^2$

Answer: B

49) Which of the following is not a possible initial rate law for the following reaction?

$$2\ H_2\ +\ C_2H_2\ \rightarrow\ C_2H_6$$

A) Rate = k $[H_2]$ $[C_2H_2]$
B) Rate = k $[H_2]^2$ $[C_2H_2]$
C) Rate = k $[H_2]^2$
D) All of the above rate laws are possible.
E) None of the above rate laws are possible.

Answer: D

50) Consider the hypothetical reaction

$$A + 2B \rightarrow 3C + 2D$$

Suppose that at one point in the reaction, [A] = 0.46 M, and 100 s later [A] = 0.42 M. During this time period, what is the average (a) rate of reaction in M s^{-1} and (b) rate of formation of D, expressed in M min^{-1}.

A) 4.0×10^{-4},4.8×10^{-6} B) 4.0×10^{-6},4.8×10^{-8} C) 2.0×10^{-4}, 4.8×10^{-4} D) 4.0×10^{-4}, 4.8×10^{-2}

Answer: D