Exam One

Name_____

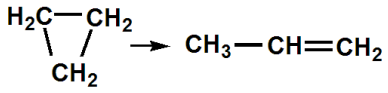
1. The equilibrium constant K_c for the reaction
$PCl_3(g) + Cl_2(g) \rightleftharpoons PCl_5(g)$
is 49 at 230°C. If 0.70 mol of PCl_3 is added to 0.70 mol of Cl_2 in a 1.00-L reaction vessel at 230°C, what is the concentration of PCl_3 when equilibrium has been established?
A. 0.049 *M* B. 0.11 *M* C. 0.30 *M* D. 0.59 *M* E. 0.83 *M*

2. The equilibrium constant, K_p, for the reaction $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ is 55.2 at 425°C. A rigid cylinder at that temperature contains 0.127 atm of hydrogen, 0.134 atm of iodine, and 1.055 atm of hydrogen iodide. Is the system at equilibrium?
A. Yes.
B. No, the forward reaction must proceed to establish equilibrium.
C. No, the reverse reaction must proceed to establish equilibrium.
D. Need to know the volume of the container before deciding.
E. Need to know the starting concentrations of all substances before deciding.

3. Write the mass-action expression, Q_c, for the following chemical reaction.
$MgO(s) + SO_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons MgSO_4(s)$
A. $\frac{[MgO]\,[SO_2][O_2]^{1/2}}{[MgSO_4]}$ B. $\frac{[MgSO_4]}{[MgO][SO_2][O_2]^{1/2}}$
C. $\frac{1}{[SO_2][O_2]^{1/2}}$ D. $[SO_2][O_2]^{1/2}$
E. None of these choices is correct.

4. Butyric acid is responsible for the odor in rancid butter. A solution of 0.25 M butyric acid has a pH of 2.71. What is the K_a for the acid?
A. 0.36 B. 2.4×10^{-2} C. 7.8×10^{-3} D. 1.5×10^{-5} E. None of these choices is correct.

5. The isomerization of cyclopropane to form propene

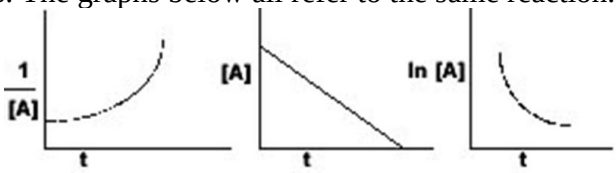


is a first-order reaction. At 760 K, 15% of a sample of cyclopropane changes to propene in 6.8 min. What is the half-life of cyclopropane at 760 K?
A. 3.4×10^{-2} min B. 2.5 min C. 23 min D. 29 min E. 230 min

6. What is the pH of a 0.75 *M* HNO_3 solution?
A. 0.12 B. 0.29 C. 0.63 D. 0.82 E. > 1.0

7. Consider this reaction: $2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$
If the rate $\Delta[H_2]/\Delta t$ is 0.030 mol L^{-1} s^{-1}, then $\Delta[NH_3]/\Delta t$ is:
A. -0.045 mol L^{-1} s^{-1} B. -0.030 mol L^{-1} s^{-1}
C. -0.020 mol L^{-1} s^{-1} D. -0.010 mol L^{-1} s^{-1}
E. None of these choices is correct.

8. The graphs below all refer to the same reaction. What is the order of this reaction?



A. zeroth order B. first order C. second order D. unable to predict

9. At high temperatures, carbon reacts with O_2 to produce CO as follows:
$C(s) + O_2(g) \rightleftharpoons CO(g)$. When 0.350 mol of O_2 and excess carbon were placed in a 5.00-L container and heated, the equilibrium concentration of CO was found to be 0.060 *M*. What is the equilibrium constant, K_c, for this reaction?
A. 0.010 B. 0.072 C. 0.090 D. 0.17 E. 1.2

10. The radioactive isotope tritium decays with a first-order rate constant *k* of 0.056 $year^{-1}$. What fraction of the tritium initially in a sample is still present 30 years later?
A. 0.19 B. 0.60 C. 0.15 D. 2.8×10^{-38}
E. None of these choices is correct.

11. Select the pair of substances which is not a conjugate acid-base pair.
A. H_3O^+, H_2O B. HNO_2, NO_2^- C. H_2SO_4, HSO_4^-
D. H_2S, S^{2-} E. NH_3, NH_2^-

12. At 450°C, tert-butyl alcohol decomposes into water and isobutene.
$(CH_3)_3COH(g) \rightleftharpoons (CH_3)_2CCH_2(g) + H_2O(g)$
A reaction vessel contains these compounds at equilibrium. What will happen if the volume of the container is reduced by 50% at constant temperature?
A. The forward reaction will proceed to reestablish equilibrium.
B. The reverse reaction will proceed to reestablish equilibrium.
C. No change occurs.
D. The equilibrium constant will increase.
E. The equilibrium constant will decrease.

13. The substance NH_3 is considered
A. a weak acid. B. a weak base. C. a strong acid.
D. a strong base. E. a neutral compound.

14. When the reaction $A \rightarrow B + C$ is studied, a plot of $\ln[A]_t$ vs. time gives a straight line with a negative slope. What is the order of the reaction?
A. zero B. first C. second D. third E. More information is needed to determine the order.

15. What is the pH of a 0.0125 *M* NaOH solution?
A. 0.972 B. 1.903 C. 12.097 D. 13.028 E. None of these choices is correct.

16. The decomposition of hydrogen peroxide is a first-order process with a rate constant of 1.06×10^{-3} min^{-1}. How long will it take for the concentration of H_2O_2 to drop from 0.0200 *M* to 0.0120 *M*?
A. < 1 min B. 7.55 min C. 481 min D. 4550 min E. 31,400 min

17. Based on the initial rate data below, what is the value of the rate constant?
$2NOBr(g) \rightarrow 2NO(g) + Br_2(g)$

[NOBr](mol L^{-1})	Rate (mol $L^{-1}s^{-1}$)
0.0450	1.62×10^{-3}
0.0310	7.69×10^{-4}
0.0095	7.22×10^{-5}

A. 0.0360 L $mol^{-1}s^{-1}$ B. 0.800 L $mol^{-1}s^{-1}$ C. 1.25 L $mol^{-1}s^{-1}$
D. 27.8 L $mol^{-1}s^{-1}$ E. 0.0360 s^{-1}

18. For the reaction $A(g) + 2B(g) \rightarrow 2C(g) + 2D(g)$, the following data were collected at constant temperature. Determine the correct rate law for this reaction.

Trial	Initial [A] (mol/L)	Initial [B] (mol/L)	Initial Rate (mol/(L·min))
1	0.125	0.200	7.25
2	0.375	0.200	21.75
3	0.250	0.400	14.50
4	0.375	0.400	21.75

A. Rate = k[A] [B] B. Rate = $k[A]^2$ [B] C. Rate = k[A] $[B]^2$
D. Rate = k[A] E. Rate = $k[A]^3$

19. What is the pH of a 0.050 M triethylamine, $(C_2H_5)_3N$, solution?
K_b for triethylamine is 5.3×10^{-4}.
A. 11.69 B. 8.68 C. 5.32 D. 2.31 E. < 2.0

20. The reaction system $POCl_3(g) \rightleftharpoons POCl(g) + Cl_2(g)$ is at equilibrium. Which of the following statements describes the behavior of the system if the partial pressure of chlorine is reduced by 50%?
A. $POCl_3$ will be consumed as equilibrium is established.
B. POCl will be consumed as equilibrium is established.
C. Chlorine will be consumed as equilibrium is established.
D. The partial pressure of POCl will decrease while the partial pressure of Cl_2 increases as equilibrium is established.
E. The volume will have to decrease before equilibrium can be reestablished.

21. If one starts with pure NO_2(g) at a pressure of 0.500 atm, the total pressure inside the reaction vessel when $2NO_2(g) \leftrightharpoons 2NO(g) + O_2(g)$ reaches equilibrium is 0.674 atm. Calculate the equilibrium partial pressure of NO_2.
A. 0.152 atm B. 0.174 atm C. 0.200 atm D. 0.326 atm
E. The total pressure cannot be calculated because K_p is not given.

22. What is the [OH^-] for a solution at 25°C that has pH = 4.29?
A. 1.4×10^{-2} *M* B. 5.1×10^{-5} *M* C. 1.9×10^{-10} *M* D. 7.3×10^{-13} *M* E. 9.71 *M*

23. Which one of the following pairs is not a conjugate acid-base pair?
A. H_2O, OH^- B. H_2O_2, HO_2^- C. OH^-, O^{2-} D. $H_2PO_4^-$, HPO_4^{2-} E. HCl, H^+

24. Formic acid, which is a component of insect venom, has a $K_a = 1.8 \times 10^{-4}$. What is the [H_3O^+] in a solution that is initially 0.10 *M* formic acid, HCOOH?
A. 4.2×10^{-3} *M* B. 8.4×10^{-3} *M* C. 1.8×10^{-4} *M*
D. 1.8×10^{-5} *M* E. 1.8×10^{-6} *M*

25. Which one of the following is a strong acid?
A. H_2CO_3 B. H_2SO_3 C. H_2SO_4 D. H_3PO_4 E. CH_3COOH

Exam One Key

Version #1

1. *(p. 755)* B

2. *(p. 750)* C

3. *(p. 746)* C

4. *(p. 800)* D

5. D

6. *(p. 792)* A

7. *(p. 690)* C

8. A

9. *(p. 752)* C

10. *(p. 702)* A

11. *(p. 779)* D

12. *(p. 764)* B

13. *(p. 788)* B

14. *(p. 701)* B

15. *(p. 792)* C

16. *(p. Sec. 16.4)* C

17. *(p. 697)* B

18. *(p. 697)* D

19. *(p. 807)* A

20. *(p. 761)* A

21. A

22. *(p. 792)* C

23. *(p. 779)* E

24. *(p. 801)* A

25. *(p. 788)* C

Exam One Summary

Category	*# of Questions*
Difficulty: Medium	3
Raymond - 014 Chemical...	2
Raymond - 015 Chemical...	1
Silberberg - 016 Chapter...	6
Silberberg - 017 Chapter...	6
Silberberg - 018 Chapter...	10