Chemistry 142 A Name_____ Section No.____
Final Trial, Autumn 2007 J. B. Callis, Instructor

Rules for this exam:

1. Do not open this exam book until told to do so by the instructor.
2. Sit in your assigned seat. You must remain in your seat until the end of the exam. If you finish early, you may not leave or take a book out.
3. This is a closed book exam.
4. Circle the one correct answer.
5. You may use a calculator, but not a PDA or laptop. You may not have a connection open to the internet or to a phone.
6. You may not have any extra sheets of paper out.
7. Place all books, packs, purses, etc. underneath your seat.
8. Be sure to put your name on every sheet of paper. You will not be permitted to do this after the exam ends.
9. This exam ends promptly at the end of the class period. Please put down your pencil when the bell rings and pass your exam to the outside isle.
10. This trial exam has 22 questions limited to Ch 6-8. All count equally. A periodic table and 2 blank sheets will be attached to the final exam.
11. Do not talk to any other student for any reason. If you have a question, raise your hand and a TA will come to you.

Please sign below to indicate that you understand these rules and that you arrived at your answers without help.

Signed_____ Date _____

For the reaction $j\,A + k\,B = l\,C + m\,D$, $K_p = K_C(RT)^{\Delta n}$

Where Δn is the sum of coefficients of the gaseous products minus the sum of coefficients of the gaseous reactants.

The roots of a quadratic: $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$; $PV = nRT$

$pH = -\log_{10}([H^+])$; $pOH = -\log_{10}([OH^-])$; $P_1V_1/T_1 = P_2V_2/T_2$

$$pH = pK_a + \log\left(\frac{[\text{base}]}{[\text{acid}]}\right); \quad \frac{\text{effusion rate gas 1}}{\text{effusion rate gas 2}} = \sqrt{\frac{M_2}{M_1}}; \quad u_{rms} = \sqrt{\frac{3RT}{M}}$$

$R = .08206$ L atm/(mol K)$= 8.3145$ J K^{-1} mol; $T(K) = T(^\circ C) + 273.15$
1 atm = 760 torr = 101.35 kPa; $N_A = 6.022 \times 10^{23}$

Chem 142 B Name_____ Sec. No.____
Final Trial, Au-07 J. B. Callis, Instructor

1. Indicate the mass action expression for the following reaction:
$2X(g) + Y(g) \rightleftharpoons 3W(g) + V(g)$

[A] $[X]^2[Y][W]^3[V]$

[B] $\frac{[W]^3[V]}{[X]^2[Y]}$

[C] $\frac{[3W][V]}{[2X][Y]}$

[D] $\frac{[X]^2[Y]}{[W]^3[V]}$

2. For the reaction $2H_2(g) + O_2(g) \rightleftharpoons 2H_2O(g)$, what is the relationship between K and K_p at temperature T?

[A] $K = K_p(RT)$

[B] $K_p = K(RT)^2$

[C] $K_p = K(RT)$

[D] $K = K_p$

[E] $K = K_p(RT)^2$

3. Consider the following equilibrium:
$H_2(g) + I_2(s) \rightleftharpoons 2HI(g)$ $\Delta H = +68.0$ kJ/mol (endothermic)
Which of the following statements about the equilibrium is false?

[A] This is a heterogeneous equilibrium.

[B] If the pressure on the system is increased by changing the volume, the left side is favored.

[C] Removing HI as it forms forces the equilibrium to the right.

[D] If the system is heated, the right side is favored.

[E] Adding more $H_2(g)$ increases the equilibrium constant.

4. The following reaction is investigated (assume an ideal gas mixture):
$2N_2O(g) + N_2H_4(g) \rightleftharpoons 3N_2(g) + 2H_2O(g)$
Initially there are 0.10 moles of N_2O and 0.25 moles of N_2H_4, in a 10.0-L container. If there are 0.06 moles of N_2O at equilibrium, how many moles of N_2 are present at equilibrium?

[A] 0.9 [B] 0.06 [C] 0.04 [D] 0.02 [E] none of these

5. Consider the following reaction:
$2HF(g) \rightleftharpoons H_2(g) + F_2(g)$ ($K = 1.00 \times 10^{-2}$)
Given 1.00 mole of HF(g), 0.500 mole of $H_2(g)$, and 0.750 mole of $F_2(g)$ are mixed in a 5.00-L flask, determine the reaction quotient, Q, and the net direction to achieve equilibrium.

[A] $Q = 0.150$; the equilibrium shifts to the right.

[B] $Q = 0.375$; the equilibrium shifts to the left.

[C] $Q = 0.375$; the equilibrium shifts to the right.

[D] $Q = 0.150$; the equilibrium shifts to the left.

[E] $Q = 0.150$; the system is at equilibrium.

6. Consider the following equilibrium:
$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
with $K = 2.3 \times 10^{-6}$, 1.00 mole of all reactants and products are placed in a 1.00-L container.
Calculate the equilibrium concentration of N_2.

[A] 0.5 M [B] 2.0 M [C] 1.0 M [D] 1.5 M [E] 2.5 M

7. Given the equation $2A(g) \rightleftharpoons 2B(g) + C(g)$. At a particular temperature, $K = 1.6 \times 10^4$. If you start with 2.0 M of chemical A, calculate the equilibrium concentration of chemical C.

[A] 2.0 M [B] 8.3×10^{-3} M [C] 0.99 M

[D] 6.25×10^{-5} M [E] none of these

8. Which of the following does not represent a conjugate acid-base pair?

[A] HCN and NH_3 [B] HF and F^- [C] $C_5H_5NH^+$ and C_5H_5N

[D] H_3O^+ and H_2O [E] none of these

9. A monoprotic weak acid when dissolved in water is 0.92% dissociated and produces a solution with pH = 3.42. Calculate K_a of the acid.

[A] 3.5×10^{-6} [B] 1.4×10^{-7} [C] 2.8×10^{-3}

[D] need to know the initial concentration of the acid [E] none of these

10. Calculate the pH of a solution that is 7.22×10^{-4} M $C_6H_5NH_2$. K_b is 3.8×10^{-10}.

[A] 7.72 [B] 7.50 [C] 6.50 [D] 6.28 [E] none of these

11. Which of the following aqueous solutions will have the highest pH? For NH_3, $K_b = 1.8 \times 10^{-5}$; for $C_2H_3O_2^-$, $K_b = 5.6 \times 10^{-10}$.

[A] 2.0 M HCl [B] 2.0 M NaOH [C] 2.0 M NH_3

[D] 2.0 M $HC_2H_3O_2$ [E] all the same

12. HOAc: $K_a = 1.8 \times 10^{-5}$

H_2CO_3 : $K_{a1} = 4.3 \times 10^{-7}$

$K_{a2} = 5.6 \times 10^{-11}$

Which of the following 0.01 M solutions has the highest pH?

[A] Na_2CO_3 [B] HOAc [C] $NaHCO_3$ [D] NaOAc [E] H_2CO_3

13. If the following substance is dissolved in pure water, will the solution be acidic, neutral, or basic?
    a) acidic
    b) neutral
    c) basic

    solid potassium chloride (KCl)

14. Calculate the pH of a solution made by a mixture of the following acids: 0.40 M $HC_2H_3O_2$ ($K_a = 1.8 \times 10^{-5}$), 0.10 M HOCl ($K_a = 3.5 \times 10^{-8}$), and 0.20 M HCN ($K_a = 6.2 \times 10^{-10}$).

    [A] 3.49 [B] 2.57 [C] 4.95 [D] 4.23 [E] 3.92

15. Calculate the pH of a solution that contains 3.25 M HCN ($K_a = 6.2 \times 10^{-10}$), 1.00 M NaOH and 1.50 M NaCN.

    [A] 9.25 [B] 7.46 [C] 8.28 [D] 8.86 [E] none of these

16. What is the molarity of a sodium hydroxide solution if 25.0 mL of this solution reacts exactly with 22.30 mL of 0.253 M sulfuric acid?

[A] 0.284 M [B] 0.113 M [C] 0.567 M [D] 0.226 M [E] 0.451 M

17. A solution contains 10. mmol of H_3PO_4 and 5.0 mmol of NaH_2PO_4. How many milliliters of 0.10 M NaOH must be added to reach the second equivalence point of the titration of the H_3PO_4 with NaOH?

[A] 2.0×10^2 [B] 150 [C] 50 [D] 1.0×10^2 [E] 250

18. In the titration of a weak acid HA with 0.100 M NaOH, the stoichiometric point is known to occur at a pH value of approximately 11. Which of the following indicators would be best to use to mark the endpoint of this titration?

[A] an indicator with $K_a = 10^{-10}$ [B] an indicator with $K_a = 10^{-14}$

[C] an indicator with $K_a = 10^{-8}$ [D] an indicator with $K_a = 10^{-11}$

[E] an indicator with $K_a = 10^{-12}$

19. A 100.0 mL sample of the weak acid H_3A (0.100 M) titrated with 0.200 M NaOH. What are the major species at the following point in the titration (water is always assumed to be a major species).
After 0 mL of 0.200 M NaOH is added.

[A] H_3A, H_2A^- [B] H_3A [C] H_2A^-, HA^{2-}

[D] H_3A, H_2A^-, HA^{2-}, A^{3-} [E] H_2A^-

20. It is observed that 7.5 mmol of BaF_2 will dissolve in 1.0 L of water. Use these data to calculate the values of K_{sp} for barium fluoride.

[A] 1.7×10^{-6} [B] 4.2×10^{-7} [C] 2.1×10^{-12} [D] 5.6×10^{-5} [E] 7.5×10^{-3}

21. The solubility of $La(IO_3)_3$ in a 0.10 M KIO_3 solution is 1.0×10^{-7} mol/L. Calculate the K_{sp} for $La(IO_3)_3$.

[A] 1.0×10^{-8} [B] 1.0×10^{-10} [C] 2.7×10^{-9}

[D] 2.7×10^{-27} [E] none of these

22. The following three equations represent equilibria that lie far to the right.

$HNO_3(aq) + CN^-(aq) \rightleftharpoons HCN(aq) + NO_3^-(aq)$

$HCN(aq) + OH^-(aq) \rightleftharpoons H_2O(l) + CN^-(aq)$

$H_2O(l) + CH_3O^-(aq) \rightleftharpoons CH_2OH(aq) + OH^-(aq)$

Identify the strongest acid.

[A] HCN [B] CH_3OH [C] H_2O [D] OH^- [E] HNO_3