CHE 107 **EXAMINATION I** **12 February 1998**

University of Kentucky Department of

Name: _____ SID: _____ Seat No.: _____ Room:

	1.	When the partial pressure of $O_2(g)$ is 1.00 atm, it is found that 7.0×10^{-4} moles of O_2 will dissolve in 2.00 liters of H_2O at 25 °C. What is the **concentration** of O_2 dissolved in H_2O at 25 °C when the partial pressure of $O_2(g)$ is 0.01 atm?
		A. 3.5×10^{-4} M B. 7.0×10^{-4} M C. 3.5×10^{-6} M D. 7.0×10^{-6} M

	2.	Which one of the following statements is <u>true</u>?
		A. An increase in temperature **always** leads to an increased solubility of an ionic compound in water. B. An increase in temperature increases the solubility of a gas in water. C. An increase in the partial pressure of a gas over a liquid increases the solubility of the gas in the liquid. D. The addition of a nonvolatile solute to a solvent increases the vapor pressure of the solution compared to the pure solvent.

	3.	What is the freezing point of a solution made by dissolving 14.6 g of NaCl in 350.0 g of water? The freezing point depression constant for water is 1.86 °C/m.
		A. –7.76 °C B. –2.66 °C C. –0.155 °C D. –1.33 °C.

	4.	Which aqueous solution would have the **highest** boiling point?
		A. 0.30 M CH_3OH C. 0.25 M NaCl B. 0.40 M CH_3CH_2OH D. 0.20 M MgF_2

	5.	When 0.700 g of an unknown molecular compound **dissolves** in 20.0 g of acetic acid, the freezing point of acetic acid is lowered by 1.24 °C. Calculate the molar mass of the unknown. (K_f (acetic acid) = 3.90 °C/m)
		A. 51.3 g/mol B. 110.0 g/mol C. 216 g/mol D. 318 g/mol

	6.	What is the equilibrium expression for the following reaction? $2\ A(g) + B(g) \rightleftharpoons 3\ C(g) + D(s)$
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	7.	Which statement is **false** concerning chemical equilibria?
		A. Once equilibrium is established, the concentration of each substance remains constant. B. The equilibrium constant's value changes with temperatures. C. Once equilibrium is established, the reaction stops. D. A catalyst added to the reaction at equilibrium will not effect the equilibrium.

	8.	At a certain temperature $K_c = 8.0$ for the equilibrium: $A(g) + B(g) \rightleftharpoons C(g)$ What is K_c at the same temperature for $2\ C(g) \rightleftharpoons 3\ A(g) + B(g)$?
		A. 2 B. 0.375 C. 1.95×10^{-3} D. 512

	9.	At 200 °C, $K_c = 2.5 \times 10^{17}$ for the reaction $2\ Br(g) \rightleftharpoons Br_2(g)$ If one starts with 0.10 mol of $Br(g)$ in a 2.0 L flask at 200 °C, which of the following statements about the system, once equilibrium has been reached, is correct?
		A. The flask will contain five times as much $Br(g)$ as $Br_2(g)$. B. The flask will contain five times as much $Br_2(g)$ as $Br(g)$. C. The flask will contain mostly $Br_2(g)$. D. The flask will contain mostly $Br(g)$.

	10.	For the equilibrium $PH_3(g) + BCl_3(g) \rightleftharpoons PH_3BCl_3(s)$ $K_p = 19.2$ at 60 °C. Calculate K_c for this reaction at 60 °C.
		A. 2.57×10^{-2} B. 525 C. 466 D. 1.44×10^{4}

	11.	K_c for the following reaction is 36 at 1200 K. $H_2(g) + I_2(g) \rightleftharpoons 2\ HI(g)$ If 1.0 mol each of hydrogen and iodine are sealed in a 2.0 L flask at 1200 K, calculate the concentration of HI at equilibrium. A. 0.12 M B. 0.38 M C. 0.50 M D. 0.75 M

	12.	380 torr of $NO_2(g)$ was introduced into a sealed vessel and allowed to reach equilibrium. The total pressure at equilibrium was 556 torr. Calculate K_p for this reaction. (1 atm = 760 torr) $2\ NO_2(g) \rightleftharpoons 2\ NO(g) + O_2(g)$ A. 0.172 B. 36.6 C. 0.642 D. 0.856

	13.	The equilibrium constant for the reaction $H_2(g) + I_2(g) \rightleftharpoons 2\ HI(g)$ is 54.3 at 430 °C. If 0.50 moles $H_2(g)$ and 0.40 moles $I_2(g)$ are placed in a 2.00 liter container at 430 °C, what is the equilibrium concentration of $H_2(g)$? A. 0.064 M B. 0.078 M C. 0.102 M D. 0.172 M

	14.	For the following reaction at equilibrium, which choice gives a change that will shift the position of equilibrium to favor products? $2\ NOBr(g) \rightleftharpoons 2\ NO(g) + Br_2(g)$ $2\ NOBr(g)$ ____ $2\ NO(g) + Br_2(g)$ $\Delta H = 30$ kJ A. lower the temperature B. decrease the total pressure by increasing the volume C. add more NO D. remove some NOBr

	15.	At 500 °C, $K_p = 4.9 \times 10^{-5}$ for the exothermic reaction $N_2(g) + 3\ H_2(g)$ ì $2\ NH_3(g)$ The value of K_p at 1000 °C is A. greater than 4.9×10^{-5} B. less than 4.9×10^{-5} C. equal to 4.9×10^{-5} D. equal to 2.0×10^{4}

16. Equilibrium is established in the reaction

$$A + B \rightleftharpoons C + D \text{ with } K_c = 10.0.$$

At this point

A. [C][D] = [A][B]

B. [A][B] = 0.10 [C][D]

C. [A] = [B] = [C] = [D] = 10.0 M

D. [A][B] = 10.0 [C][D]

17. Which of the following statements are true regarding a **strong** acid, HA, solution?

1. A^- is a strong base.
2. $[H^+] = [A^-]$
3. The ionization is assumed to be 100%.
4. $[HA] > [A^-]$

A. 2 and 3 B. 1 and 2 C. 1 and 4 D. 2 and 4

18. Which of the following pairs lists an acid with its conjugate base?

	acid	conj. base
A.	HSO	SO^-
B.	H_2PO	H_3PO_4
C.	NH_3	NH
D.	HCl	$HClO_4$

19. What is the concentration of H^+ ions in a 0.025 M $Ba(OH)_2$ solution?

A. 1.60 M B. 1.0×10^{-14} M C. 0.05 M D. 2.0×10^{-13} M

20. What is the pH of 100 ml of a 0.020 M aqueous solution of HCl?

A. 0.17 B. 1.70 C. 2.70 D. 17.0

21. Calculate the pH of a 0.15 M solution of HCN. (K_a (HCN) = 4.0×10^{-10})

A. 5.11 B. 3.78 C. 6.89 D. 9.40

22. Calculate the percent ionization of 0.020 M acetic acid, CH_3COOH.
($K_a = 1.8 \times 10^{-5}$)

A. 6.0×10^{-4}% B. 0.36% C. 3.0% D. 100%

	23.	The pH of a nitrous acid solution is 3.25. What is the **original** molarity of the HNO_2 solution given K_a for nitrous acid is 4.5×10^{-4}?
		A. 7.0×10^{-4} M B. 1.3×10^{-3} M C. 0.10 M D. 1.2 M

	24.	At 20 °C $K_a = 4.9 \times 10^{-10}$ for the reaction $HCN(aq) \rightleftharpoons H^+(aq) + CN^-(aq)$ What is K_b at 25 °C for the reaction $CN^-(aq) + H_2O(2) \rightleftharpoons HCN(aq) + OH^-(aq)$?
		A. 2.2×10^3 B. 4.5×10^{-4} C. 9.0×10^{-4} D. 2.0×10^{-5}

	25.	Four weak acids, identified by numbers 1, 2, 3, and 4, have ionization constants given below: **Acid** **K_a** 1 2.89×10^{-4} 2 3.76×10^{-6} 3 4.21×10^{-9} 4 8.37×10^{-12} A 0.1 M solution of which acid would have the lowest pH?
		A. 1 B. 2 C. 3 D. 4