CHEMISTRY 212, Lect. Sect. 001	Name	
Dr. G. L. Roberts Weatherspoon	Last,	First
Exam #1/Tuesday, February 22, 2005	G#	Lab Sec

CLOSED BOOK EXAM-No notes or books allowed. Calculators may be used. Atomic masses of interest are included on the last page. Periodic tables are not allowed for this exam. CIRCLE ALL OF YOUR ANSWERS TO THE PROBLEMS BELOW.

- 1. What is the molarity of a NaI solution that contains 6.00 g of NaI in 20 mL of solution?
  - 0.100 M (b) 0.500M (c) 1.00 M (d) 2.00 M (e) 5.00 M (a)
- 2. The number of grams of oxalic acid dihydrate,  $H_2C_2O_4 \cdot 2H_2O_3$ , that is required to prepare 250.0 mL of 1.25 M solution is
  - 281.1 g (b) 39.4 g (c) 43.6 g (a) (d) 48.2 g (e) 90.0 g
- 3. Which of the following **INCREASES** the solubility of a gas in a given solvent?
  - (a) increasing the partial pressure of the gas
  - (b) decreasing the temperature of the solvent
  - (c) decreasing the partial pressure of the gas
  - (d) increasing the temperature of the solvent and decreasing the partial pressure of the gas simultaneously
  - (e) both a & b

- Sparkling wine is bottled under a CO<sub>2</sub> pressure of 4.0 atm. The solubility of CO<sub>2</sub> at 4.0 atm is 0.68 4.  $g/100 \text{ g} H_2O$ . What is its solubility after the bottle is opened if the partial pressure of  $CO_2$  is 4.0  $x10^{-4}$  atm?
  - (a)  $1.35 \ge 10^{-5} \text{ g}/100 \text{ g H}_2\text{O}$  (b)  $6.8 \ge 10^{-5} \text{ g}/100 \text{ g H}_2\text{O}$ (d)  $2.72 \times 10^{-5} \text{ g}/100 \text{ g} \text{ H}_2\text{O}$  (e)  $5.8 \times 10^{-4} \text{ g}/100 \text{ g} \text{ H}_2\text{O}$ (c)  $5.1 \times 10^{-6} \text{ g/}100 \text{ g H}_2\text{O}$
- Which of the following are colligative properties 5.
  - 1. Osmotic pressure
  - 2. Vapor pressure
  - 3. Freezing-point depression
  - 4. Boiling-point elevation
  - (c) 3 & 4 only (a) 1 & 2 only (b) 1 & 4 only (d) 1.3.& 4 only (e) 1.2.3.&4
- If 12.8 g naphthalene ( $C_{10}H_8$ ) is dissolved in 200.0 g chloroform (d = 1.32 g/mL), what is the 6. molality of the solution?
  - (a) 0.100 (b) 0.500 (c) 1.00 (d) 2.00 (e) none of these
- 7. The vapor pressure of a solution containing a nonvolatile solute is directly proportional to the
  - (a) mole fraction of the solute
  - (b) mole fraction of the solvent
  - (c) molarity of the solvent.
  - (d) osmotic pressure of the solute
  - (e) molality of the solvent.

8. What is the freezing point of an aqueous 0.750 molal NH<sub>4</sub>I solution?. ( $K_f = 1.86^{\circ}C/m$ ).

(a)  $-1.40^{\circ}$ C (b)  $1.40^{\circ}$ C (c)  $-1.86^{\circ}$ C (d)  $1.86^{\circ}$ C (e)  $-2.80^{\circ}$ C

- 9. Based on the formulas of the following *aqueous* solutions, which compound would have the smallest van't Hoff factor?
  - (a)  $Ca(NO_3)_2$  (b)  $MgSO_4$  (c)  $Th(SO_4)_2$  (d)  $Al_2(SO_4)_3$  (e)  $K_2SO_4$
- 10. Calculate the molecular weight of a small protein if a 0.20-g sample dissolved in 100 mL of water has an osmotic pressure of 9.8 mmHg at 25.0°C?
  - (a)  $3.5 \times 10^3$  g/mol (b)  $3.8 \times 10^3$  g/mol (c)  $4.0 \times 10^4$  g/mol (d)  $4.5 \times 10^4$  g/mol (e) none of these
- 11. The reaction that takes place in a Breathalyzer for determining the alcohol level in a person's bloodstream is given below. If the rate of appearance of  $Cr_2(SO_4)_3$  is 1.24 mol/min, what is the rate of disappearance of  $C_2H_6O$ ?

 $K_2Cr_2O_7 + H_2SO_4 + C_2H_6O \rightarrow Cr_2(SO_4)_3 + K_2SO_4 + C_2H_4O_2 + H_2O_3$ 

- (a) 0.413 mol/min (b) 0.826 mol/min
- (c) 1.86 mol/min (d) 3.72 mol/min
- 12. At a constant temperature, which of the following would be expected to affect the rate of a given chemical reaction?
  - 1. The reaction temperature 2. Concentration of reactants 3. A catalyst
  - (a) 1 only (b) 2 only (c) 3 only (d) 2 & 3 only (e) 1, 2, &3
- 13. From a consideration of the following reaction system  $2H_2S(g) + O_2(g) \rightarrow 2S(s) + 2H_2O(g)$ , we can conclude that
  - (a) the reaction is second order in  $H_2S$  and first order in  $O_2$ .
  - (b) the reaction is first order in  $H_2S$  and second order in  $O_2$ .
  - (c) rate= $k[H_2S]^2[O_2]$
  - (d) rate= $[H_2S][O_2]$
  - (e) None of these conclusions are justified.
- 14. According to Collision Theory, a chemical reaction takes place if the energy of the collision between two molecules is sufficient to break chemical bonds, thereby providing a sound explanation of the role of E<sub>a</sub>.
  - (a) true (b) false
- 15. At a given temperature, a first-order reaction has a rate constant of  $2.5 \times 10^{-3} \text{s}^{-1}$ . The time required for the reaction to be 60% completed is \_\_\_\_\_.

(a) 120 s (b) 240 s (c) 370 s (d) 440 s (e) 520 s

16. A second-order reaction starts with an initial concentration of 0.100 M of the reactant. If the rate constant is  $1.0 \times 10^{-2}$  L/(mol•s), calculate the time required to decrease the initial concentration to 0.050 M.

(a) 1000 s (b) 2000 s (c) 3000 s (d) 4000 s (e) 5000 s

17. From a plot of the natural logarithm of the rate constant versus the reciprocal of the absolute temperature, one can determine

- (a) the order of the reaction.
- (b) the rate of the reaction.
- (c) the energy of activation.
- (d) the mechanism of the reaction.
- (e) the enthalpy change for the reaction.
- 18. Two substances A and B react with each other in such a way that one half of A remains after 25 minutes and one fourth of A remains after 50 minutes. Doubling the concentration of B doubles the rate of the reaction. This reaction is
  - (a) zero order in both A and B.
  - (b) first order in both A and B.
  - (c) first order in A and second order in B.
  - (d) second order in A and first order in B.
  - (e) second order in both A and B.
- 19. If a reaction is second order in a reactant, when the concentration of the reactant is decreased by a factor of 2, the reaction rate will
  - (a) remain constant
  - (b) decrease by a factor of  $\frac{1}{4}$
  - (c) decrease by a factor of  $\frac{1}{2}$
  - (d) double
  - (e) quadruple
- 20. If a reaction is zero order in a reactant, when the concentration of the reactant is decreased by a factor of 2, the reaction rate will
  - (a) remain constant
  - (b) decrease by a factor of  $\frac{1}{4}$
  - (c) decrease by a factor of  $\frac{1}{2}$
  - (d) double
  - (e) quadruple

## Potentially useful/useless information.

f.p. cyclohexane=6.55°C  $k_f$  (cyclohexane) = 20.2°C/m  $k_f(H_2O) = 1.858^{\circ}C/m$  $k_b (H_2O) = 0.512^{\circ}C/m$  $J = N \bullet m$  $N = m \bullet kg \bullet s^{-2}$ d(Hg) = 13.6 g/mL $R=0.0821 L\bulletatm/mol\bullet K$ R= 8.314 J/mol • K 1 L•atm = 101 J = 0.101 kJ 1 Pa = 1 kg/(m• s<sup>2</sup>) = 1 N/m<sup>2</sup>  $1 \text{ atm} = 1.01325 \text{ x} 10^5 \text{ Pa}$  $g = 9.807 \text{ m/s}^2$  $q = ms \Delta T$  $\mathbf{x}_{i} = \left(\frac{n_{i}}{n_{total}}\right) = \left(\frac{P_{i}}{P_{total}}\right)$  $P_i = x_i P_T$  $P_{\rm T} = \Sigma P_{\rm i}$  $\log\left(\frac{P_2}{P_1}\right) = \left(\frac{\Delta H_{vap}}{2.303R}\right) \left(\frac{1}{T_1} - \frac{1}{T_2}\right)$  $S = k_{\rm H} P$  $\mathbf{P}_A = \mathbf{P}_A^o \mathbf{X}_A$  $\Delta \mathbf{P} = \mathbf{P}_A^o \mathbf{X}_B$  $\Delta T_b = K_b c_m$  $\Delta \mathbf{T}_f = \mathbf{k}_f \mathbf{c}_m$  $\Pi = MRT$  $\ln \frac{[A]_t}{[A]_0} = -kt$  $\log \frac{[A]_t}{[A]_0} = -kt/2.303$  $\log\left(\frac{k_2}{k_1}\right) = \frac{E_a}{2.303R} \left(\frac{1}{T_1} - \frac{1}{T_2}\right)$  $t_{1/2} = 0.693/k$  k = pfZ  $f = e^{-Ea/RT}$ r.m.s. =  $\sqrt{\frac{3RT}{M_m}}$