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General Chemistry II - CHEM 112
Practice EXAM I Sept. 2016 pg. 1/8

Instructions: This test is closed book and closed notes. Calculators are also allowed, although pre-prepared programs, integration and equation solving routines are not. Credit is dependent on showing all steps in the calculation on this test. Clearly state any assumptions or approximations you use to solve the problems. (7 problems, 100 pts)

$$R = 8.31441 \text{ J/K}\cdot\text{mol}$$

$$R = 0.08206 \text{ L}\cdot\text{atm/K}\cdot\text{mol}$$

$$1 \text{ atm} = 760 \text{ Torr}$$

$$0 \text{ }^\circ\text{C} = 273.15 \text{ K}$$

$$N_A = 6.022 \times 10^{23} \text{ mol}$$

$$1 \text{ m} = 100 \text{ cm} = 1000 \text{ mm} = 10^6 \text{ } \mu\text{m} = 10^9 \text{ nm} = 10^{10} \text{ } \text{Å}$$

$$\text{density of water: } \rho = 1.00 \text{ g/ml} = 1.00 \text{ kg/L}$$

$$\text{if } ax^2 + bx + c = 0, \text{ then } x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$\text{Henry's Law: } C = kP$$

$$\text{Raoult's Law: } P_{\text{solv}} = \chi_{\text{solv}} P_{\text{solv}}^o$$

$$: \Delta P = P_{\text{solv}} - P_{\text{solv}}^o = -\chi_{\text{solute}} P_{\text{solv}}^o$$

$$\text{Boiling Point Elevation: } \Delta T_b = imk_b$$

$$\text{Freezing Point Depression: } \Delta T_f = -imk_f$$

$$\text{Osmotic Pressure: } \Pi = nRT/V = MRT$$

$$\text{Equilibrium Constant: If } aA + bB \rightleftharpoons cC + dD, \text{ then } K_{eq} = \frac{[C]^c [D]^d}{[A]^a [B]^b}$$

$$K_p = K_c(RT)^{\Delta n}$$

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1.) A 10.0 mg sample of protein is dissolved in 2.00 ml of water. Calculate the molar mass of the protein if the solution has an osmotic pressure of 8.58×10^{-4} atm at 25 °C. (15 pts)

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2.) Determine the best solvent to dissolve the given solute. Explain your answer by discussion of intermolecular forces.

A.) Which solvent is best to dissolve LiCl_2 and why? (5 points)

H_2O or hexane (C_6H_{14})

B.) Which solvent is best to dissolve methanol CH_3OH and why? (5 points)

Ammonia (NH_3) or Carbon tetrachloride (CCl_4)

C.) Which solvent is best to dissolve benzene, C_6H_6 , and why? (5 points)

Water or Carbon tetrachloride (CCl_4)

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3.) A 500 ml sealed reaction cell is kept at a temperature of 293 K. Inside the cell is a mixture of 1.2 mols of hexane (C_6H_{14}) and 0.70 mols of chloroform ($CHCl_3$). The vapor pressure of hexane is 147 torr and the vapor pressure of chloroform is 298 torr.

a. Calculate the mole fraction of hexane. (3 points)

b. Calculate the mole fraction of chloroform. (3 points)

c. What is the partial pressure of hexane? (3 points)

d. What is the partial pressure of chloroform? (3 points)

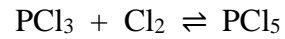
e. What is the total pressure in the reaction cell? (3 points)

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4.) Phosphorus trichloride and chlorine react to form phosphorus pentachloride. At 140 °C, K_{eq} for this reaction is 1.60.



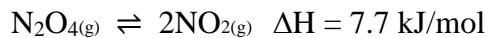
Calculate the concentration of all the chemicals at equilibrium if 0.6 mols of PCl_3 were initially mixed with 2.00 mols of Cl_2 in a 2.00 L flask at 140 °C. (15 points)

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5.) Consider the following reaction and conditions:



In a 1 L container at a temperature of 300 K you let the above reaction come to equilibrium. Does the reaction move towards products, reactants or remain unchanged (circle one) if you:

a.) remove some NO_2 (3 points)

products reactants unchanged

b.) add some N_2O_4 (3 points)

products reactants unchanged

c.) increase the temperature to 400 K (3 points)

products reactants unchanged

d.) increase the size of the container to 2 L (3 points)

products reactants unchanged

e.) add Argon, an inert gas (3 points)

products reactants unchanged

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6.) a.) Calculate the solubility of calcium hydroxide in an aqueous solution given $K_{sp} = 5.0 \times 10^{-6}$.
(10 points)

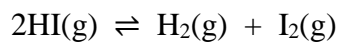
b.) Will the solubility of calcium hydroxide increase or decrease when NaOH is added to the solution. Why? (5 points)

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7.) The following equation has a $K_{eq} = 4.5 \times 10^{-1}$ at room temperature.



You walk into a lab and see an unknown 1.5 L reaction flask sitting at room temperature and you determine the flask contains 0.785 mols of HI, 0.40 mols of H₂ and 0.38 mols of I₂. Is the reaction moving towards products, towards reactants, or at equilibrium? Support your answer mathematically. (10 points)