## CHEM 3530 - Exam 3 - March 30, 2018

## **Constants and Conversion Factors**

$$N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$$

$$R = 8.31 \text{ J/mol-K} = 8.31 \text{ kPa-L/mol-K}$$

$$1 \text{ bar} = 100 \text{ kPa} = 750 \text{ torr}$$

$$1 \text{ kPa} = 7.50 \text{ torr}$$

$$1 J = 1 kPa-L$$

$$1 \text{ kcal} = 4.18 \text{ kJ}$$

Molar Masses:

Given in the individual questions on this test.

Quadratic Equation: If 
$$ax^2+bx+c=0$$
, then  $x = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$ 

NOT needed on this year's test

## CHEM 3530 - Exam 3 - March 31, 2017

## (76) PART I. MULTIPLE CHOICE (Circle the ONE correct answer)

	For #1 - #2: When density of the solution	•	se [M=180] is adde	ed to 120 grams of water [M=18], the				
1.	The Molarity of the above solution is approximately							
	(A) 1.5 Molar (I	B) 1.9 Molas	(C) 2.6 Molar	(D) 2.1 Molar				
2.	The <b>molality</b> of the above solution is approximately							
	(A) 1.5 molal (F	3) 1.9 molal	(C) 2.6 molal	D) 2.1 molal				
3.	How many grams of sucrose [M=342] are required to prepare 2.5 L of a 0.40 Molar sucrose solution?							
	(A) 342 grams	(B) 171 grams	(C) 137 grams	(D) 55 grams				
4.	The vapor pressure of a <b>solution</b> containing 90 grams of water [M=18] and 144 grams of glucose [M=180] is 79. torr at 50 °C. What is the approximate vapor pressure of <b>pure wate</b> at 50 °C?							
	(A) 211 torr	(B) 68 torr	(C) 92 torr	(D) 30 torr				
5.	The freezing point of pure CCl <sub>4</sub> is $T_f^o$ = -23.0 °C. When a sample of of napthalene, $C_{10}H_8$ [M=128], is dissolved in 750 grams of CCl <sub>4</sub> ( $K_f$ = 30 °C/m,), the freezing point of solution is -37.0 °C. Approximately how many grams of napthalene were dissolved?							
	(A) 60 g	(B) 92 g	(C) 80 g	(D) 45 g				
6.	The normal boiling point of pure benzene is $80.1$ °C When 50 grams of an unknown compound is dissolved in 700 grams of benzene ( $K_b = 2.1$ °C/m), the boiling point of the solution is $81.8$ °C. The Molar Mass of the compound is approximately							
	(A) 93 g/mol	(B) 88 g/mol	(C) 43 g/mol	(D) 62 g/mol				

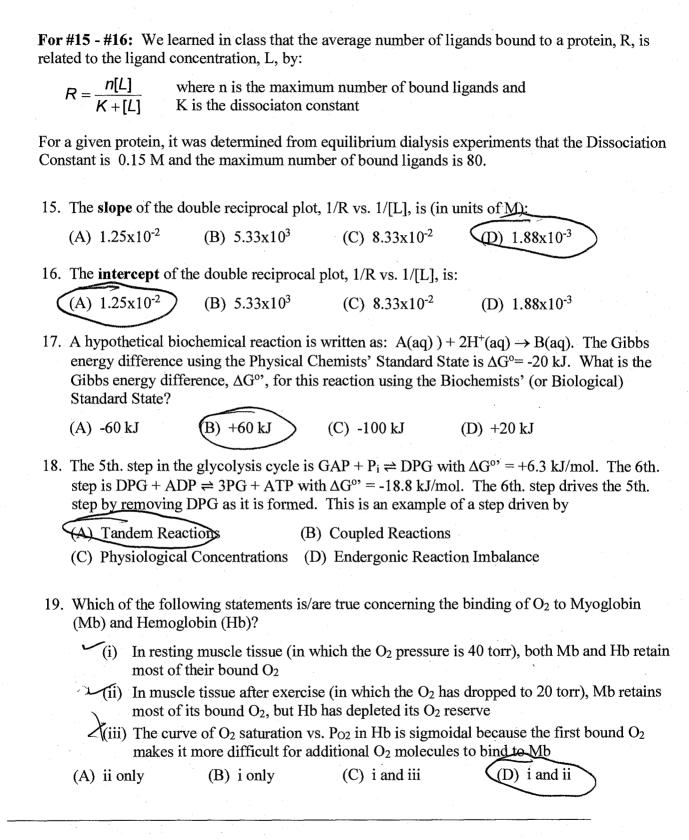
7. When 41 grams of the strong electrolyte, Na<sub>3</sub>PO<sub>4</sub> [M=164], is dissolved in 150 grams of water  $(K_b = 0.5 \, {}^{\circ}\text{C/m})$ , the boiling point of the solution is

(A) 103.3 °C (B) 96.7 °C (C) 100.8 °C (D) 102.5 °C

The osmotic pressure of an aqueous solution of sucrose (C<sub>12</sub>H<sub>22</sub>O<sub>11</sub>) is 6.40 bar at 30 °C. How many moles of sucrose are contained in 250 mL of this solution?

(A)  $3.8 \times 10^{-3}$  mol (B) 0.25 mol (D)  $6.4 \times 10^{-4}$  mol (C) 0.064 mol

	nL of aqueous solu	ution, the osmotic p	putting 15. grams of an uressure of the solution is roximately	
(A) 520 g/mol	(B) 990 g/mol	(C) 740 g/mol	(D) 100,000 g/mol	
For #10 - #13: Conside $2 \text{ NO}_2(g) + \frac{1}{2} \text{ O}_2(g) \rightleftharpoons$ equilibrium constant is	$N_2O_5(g)$ . The ent	· · · · · · · · · · · · · · · · · · ·	is reaction is -170 kJ and	1 the
10. For the above reaction	n, if N <sub>2</sub> (g) is adde	d at a constant total	pressure of 5 bar,	
(A) the equilibrium	will move to the le	eft and K will decre	ase	
(B) the equilibrium	will move to the ri	ght and K will incre	ease	
(C) the equilibrium		•		
(D) the equilibrium				
(D) the equilibrium	will move to the H	gitt and ix will tem	ani constant	
11. For the above reaction	n, if the temperatu	re is increased,		
(A) the equilibrium	will move to the le	off and K will decre	200	
(B) the equilibrium				
(C) the equilibrium				
(D) the equilibrium	will move to the ri	ght and K will remain	ain constant	
12. The standard state Gapproximately:	ibbs energy chang	e, $\Delta_r G^0$ , for the above	ve reaction at 150 °C is	
(A) -3.2 kJ (	B) -1.4 kJ	(C) -3200 kJ	(D) $+1.4 \text{ kJ}$	
13. What is K for the rea	ction, 2 N <sub>2</sub> O <sub>5</sub> (g) <del>=</del>	$\Rightarrow 4 \text{ NO}_2(g) + \text{O}_2(g)$	at 150 °C ?	
(A) 6.25	B) 0.20	(C) 0.16	(D) 0.63	
14. For the gas phase eq If one puts A and B pressure of C at equi	into a vessel with	$B(g) \rightleftharpoons 2C(g)$ , the initial pressures, $P_{ir}$	equilibrium constant is l $_{iit}(A) = P_{init}(B) = 3$ . bar, v	$\zeta = 1 \times 10^{-3}$ . what is the
NOTE: You may a	ssume that very lit	tle A and B react.		
(A) 0.045 bar	(B) 0.164 bar	(C) 0.082 bar	(D) 0.063 bar	



(06) 1. As an introduction to Parts (a) and (b) below: If one has an equilibrium:  $A \rightleftharpoons B + C$ , if  $P^{o}(A) = P^{o}(B) = 3.0$  bar,  $P^{o}(C) = 0.0$  bar and K = 10.0, one would set up the expression to solve this equilibrium as:  $10.0 = \frac{(3.0 + x)(x)}{3.0 - x}$ 

Set up the equivalent expressions for the following two equilibria. Your answer should have the numbers 10.0, 3.0 and the variable "x" (as above). As in the example above,  $P^{o}(A) = P^{o}(B) = 3.0$  bar,  $P^{o}(C) = 0.0$  bar and K = 10.

(03) (a) 
$$2A = B + 3C$$
  $k = \frac{P_B}{B} = \frac{A^3}{C^3} = \frac{(3+x)(3x)}{(3-2x)^2}$ 

(03) (b) 
$$A + 3B \neq C$$

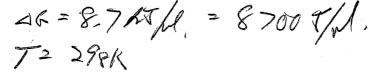
$$3 - 3 \times X$$

$$3 - 3 \times X$$

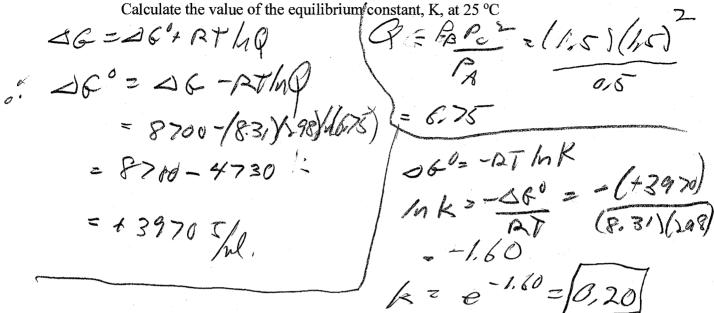
$$X = \frac{P_c}{P_A P_B^3} > \frac{X}{(3 - X)[3 - 3X]}$$

(06) 2. For an equilibrium reaction,  $A \rightleftharpoons B$ , the slope and intercept of the van't Hoff plot  $[ln(K) \text{ vs } 1/T[\text{ are: } Slope = +4850 \text{ K}, Intercept = 7.60.}]$ 

Calculate the values of  $\Delta H^0$  (in kJ/mol) and  $\Delta S^0$  (in J/mol-K) for this reaction.



For an equilibrium reaction,  $A \rightleftharpoons B + 2C$ , the the Gibbs Energy is  $\Delta G = +8.70 \text{ kJ/mol}$ (06) 3. at 25 °C when the pressures of A, B, and C are: P(A) = 0.50 bar, P(B) = P(C) = 1.50 bar



For an equilibrium reaction,  $C \rightleftharpoons D$ , The equilibrium constant is K = 50. at T = 100 °C and (06) 4. K = 2.5 at T = 150 °C. Calculate the value of the enthalpy change for the reaction,

For an equinorium reaction, 
$$C = D$$
, The equinorium constant is  $K = 50$ , at  $I = 100^{\circ}$  K = 2.5 at  $T = 150^{\circ}$ C. Calculate the value of the enthalpy change for the reaction,  $\Delta H^{\circ}$  (in kJ/mol).

 $R_{1} = 373 \text{ k}$ 
 $R_{2} = 373 \text{ k}$ 
 $R_{3} = 373 \text{ k}$