NAME:_____

Lab Section: __1(TuTh@3:30pm) __3(TuTh@9:35am)

CHM 102 | Winter 2009

20 points, 30 mins. | **Basic Competency Quiz #2** | week 4

Chemistry, 7th ed., Zumdahl & Zumdahl, sections 10.8, 11.1-11.8

Wallace | *revised 1/28/2009*

Unless otherwise specified, each question is worth 4 points.

1. Calculate the vapor pressure of water at 85°C.

Normal b.p.: $T_1 = 100°C = 373K$, $P_1 = 1 atm$

T_2 (+273 = 358K)

$$\ln\left(\frac{P_1}{P_2}\right) = \frac{\Delta H_v}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right) = \frac{40{,}700}{8.314}\left(\frac{1}{358} - \frac{1}{373}\right) = 0.550$$

$$\ln\left(\frac{1}{P_2}\right) = 0.550, \quad \frac{1}{P_2} = e^{0.550}; \quad \boxed{P_2 = 0.577 \text{ atm}}$$

2. What is the mole fraction of water in a solution that contains 8.67 g of glucose, $C_6H_{12}O_6$, dissolved in 25.2 g of water?

$$25.2 \text{ g } H_2O \times \frac{1 \text{ mol}}{18.02 \text{ g}} = 1.40 \text{ mol } H_2O \qquad 8.67 \text{ g Glu} \times \frac{1 \text{ mol}}{180.16 \text{ g}} = 0.0481 \text{ mol}$$

$$\chi_{H_2O} = \frac{1.40}{1.40 + 0.0481} = \boxed{0.967}$$

3. A solution is made by dissolving 2.515 g of solid naphthalene ($C_{10}H_8$) in 60.8 g of chloroform, $CHCl_3$. Calculate the vapor pressure of this solution at 20°C if the vapor pressure of pure chloroform at 20°C is 156 mmHg. Naphthalene can be assumed to be nonvolatile compared with chloroform.

$$P_V(\text{soln}) = P^\circ_{CHCl_3} \times \chi_{CHCl_3}$$

$$2.515 \text{ g } C_{10}H_8 \times \frac{1 \text{ mol}}{128.17 \text{ g}} = 0.0196 \text{ mol}$$

$$60.8 \text{ g } CHCl_3 \times \frac{1 \text{ mol}}{119.38 \text{ g}} = 0.509 \text{ mol}$$

$$\frac{0.509}{0.509 + 0.0196} = 0.963$$

$$0.963 \times 156 = \boxed{150. \text{ mmHg}}$$

Unless otherwise specified, each question is worth 4 points.

4. How many grams of ethylene glycol, CH_2OHCH_2OH, must be added to 37.8 g of water to give a freezing point of -0.150°C?

$\Delta T_f = 0.150 = K_f \times m = 1.86 \times m$; $m = 0.0806 \frac{mol}{kg}$

$0.0806 \frac{mol}{kg} \times 0.0378\ kg = 0.00305\ mol$ E.G.

$0.00305\ mol \times \frac{62.07\ g}{mol} =$ **0.189 g $CH_2OH\,CH_2OH$**

5. Calculate the freezing point of a 0.10 *m* aqueous solution of aluminum sulfate, $Al_2(SO_4)_3$. Assume the value of *i* based on the formula of the compound, which is water soluble.

$\Delta T_f = i \times K_f \times m = 5 \times 1.86 \times 0.10 = 0.93$

T_f (soln) = −0.93°C

Basic Competency Quiz #2
Chemistry, 7th ed., Zumdahl & Zumdahl, sections 10.8, 11.1-11.8

Unless otherwise specified, each question is worth 4 points.

Abbreviated **Periodic Table of the Elements**

1 1A																	18 8A
1 H 1.01	2 2A											13 3A	14 4A	15 5A	16 6A	17 7A	2 He 4.00
3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31	3 3B	4 4B	5 5B	6 6B	7 7B	8 8B	9 8B	10 8B	11 1B	12 2B	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	71 Lu 175.0	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226	103 Lr (262)	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Uun	111 Uuu	112 Uub	113	114	115			

57 La 138.9	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61	62	63	64	65	66	67	68	69	70
89 Ac (227)	90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97	98	99	100	101	102

POSSIBLY HELPFUL INFORMATION:

equations:

$K = {}^{\circ}C + 273$

$\ln(P_1/P_2) = (\Delta H_{vap}/R) \times (1/T_2 - 1/T_1)$

constants:

$R = 8.3145 \left[{}^{joule}/_{mol\,K}\right]$

for water:

normal freezing point =	0.00°C	normal boiling point =	100.00°C
ΔH_{fus} =	6,020 $\left[{}^{J}/_{mol}\right]$	ΔH_{vap} =	40,700 $\left[{}^{J}/_{mol}\right]$
heat capacity of ice =	2.0 $\left[{}^{J}/_{g\cdot{}^{\circ}C}\right]$	heat capacity of water =	4.2 $\left[{}^{J}/_{g\cdot{}^{\circ}C}\right]$
K_f =	1.86 $\left[{}^{{}^{\circ}C\cdot kg}/_{mol}\right]$	K_b =	0.51 $\left[{}^{{}^{\circ}C\cdot kg}/_{mol}\right]$