Chem 210 – Exam 1a
Spring 2009

Name: _____

Chemistry 210 Exam 1

Be sure to put your name on each page. This page can be removed from your exam so that you will have a Periodic Table handy throughout the exam, it does not need to be turned in. Show all your work for problems which require any sort of calculation, no credit will be given for answers without work shown. If you have shown a significant amount of work or multiple drawings for a problem, draw a box around what you consider your final answer.

Avogadro's Number = 6.022×10^{23} $^{\text{units}}/_{\text{mol}}$
$32.00^{\circ}\text{F} = 0.000^{\circ}\text{C} = 273.15\text{K}$
Density of Water = $1.000\ ^{\text{g}}/_{\text{mL}}$
$R = 0.08206\ ^{\text{L}\cdot\text{atm}}/_{\text{mol}\cdot\text{K}} = 8.314\ ^{\text{J}}/_{\text{mol}\cdot\text{K}}$
$PV = nRT$
$\Delta T_{fp/bp} = k_{fp/bp} \cdot m \cdot i$
For water: $k_{fp} = -1.86\ ^{^{\circ}\text{C}}/_{\text{m}}$
$k_{bp} = 0.512\ ^{^{\circ}\text{C}}/_{\text{m}}$
$P_1 = X_1 P_1^{\circ}$
$\Pi = cRTi$
$C_1V_1 = C_2V_2$

Quadratic formula:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Integrated Rate Laws:

$$\ln[A]_t = -kt + \ln[A]_o$$
$$1/[A]_t = kt + 1/[A]_o$$
$$[A]_t = -kt + [A]_o$$

$k = Ae^{-Ea/RT}$

$$\ln(k) = \left(\frac{-E_a}{R}\right)\left(\frac{1}{T}\right) + \ln(A)$$

$$\ln\left(\frac{k_1}{k_2}\right) = \frac{E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

$$pH = pK_a + \log\left(\frac{[\text{conjugate base}]}{[\text{conjugate acid}]}\right)$$

$E_{cell} = E^{\circ}_{cell} - {}^{RT}/_{nF}\ ln Q$
$E^{\circ}_{cell} = {}^{RT}/_{nF}\ ln K^{\circ}$
$K^{\circ} = e^{\wedge}({}^{nF}/_{RT}\ E^{\circ}_{cell})$
$F = 96485\ ^{\text{J}}/_{\text{V}\cdot\text{mol of electrons}}$
$\Delta G^{\circ} = \Delta H^{\circ}_{system} - T\Delta S^{\circ}_{system}$
$\Delta G^{\circ} = -nFE^{\circ}_{cell} = -RT ln K^{\circ}$
$\Delta G = \Delta G^{\circ} + RT ln Q$
$F = 96485\ ^{\text{C}}/_{\text{mol electrons}}$
1A = 1 C / sec

1 **H** 1.0079																	2 **He** 4.0026
3 **Li** 6.941	4 **Be** 9.0122											5 **B** 10.811	6 **C** 12.011	7 **N** 14.007	8 **O** 15.999	9 **F** 18.998	10 **Ne** 20.180
11 **Na** 22.990	12 **Mg** 24.305											13 **Al** 26.982	14 **Si** 28.086	15 **P** 30.974	16 **S** 32.066	17 **Cl** 35.453	18 **Ar** 39.948
19 **K** 39.098	20 **Ca** 40.078	21 **Sc** 44.956	22 **Ti** 47.88	23 **V** 50.942	24 **Cr** 51.996	25 **Mn** 54.938	26 **Fe** 55.847	27 **Co** 58.933	28 **Ni** 58.69	29 **Cu** 63.546	30 **Zn** 65.39	31 **Ga** 69.723	32 **Ge** 72.61	33 **As** 74.922	34 **Se** 78.96	35 **Br** 79.904	36 **Kr** 83.80
37 **Rb** 85.468	38 **Sr** 87.62	39 **Y** 88.906	40 **Zr** 91.224	41 **Nb** 92.906	42 **Mo** 95.94	43 **Tc** (98)	44 **Ru** 101.07	45 **Rh** 102.91	46 **Pd** 106.42	47 **Ag** 107.87	48 **Cd** 112.41	49 **In** 114.82	50 **Sn** 118.71	51 **Sb** 121.76	52 **Te** 127.60	53 **I** 126.90	54 **Xe** 131.29
55 **Cs** 132.91	56 **Ba** 137.33	57 **La** 138.91	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.84	75 **Re** 186.21	76 **Os** 190.23	77 **Ir** 192.22	78 **Pt** 195.08	79 **Au** 196.97	80 **Hg** 200.59	81 **Tl** 204.38	82 **Pb** 207.2	83 **Bi** 208.98	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** 226.03	89 **Ac** 227.03	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (263)	107 **Bh** (262)	108 **Hs** (265)	109 **Mt** (266)	110 (269)	111 (272)	112 (277)		114		116		

58 **Ce** 140.12	59 **Pr** 140.91	60 **Nd** 144.24	61 **Pm** (145)	62 **Sm** 150.36	63 **Eu** 151.97	64 **Gd** 157.25	65 **Tb** 158.93	66 **Dy** 162.50	67 **Ho** 164.93	68 **Er** 167.26	69 **Tm** 168.94	70 **Yb** 173.04	71 **Lu** 174.97
90 **Th** 232.04	91 **Pa** 231.04	92 **U** 238.03	93 **Np** 237.05	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (258)	101 **Md** (258)	102 **No** (259)	103 **Lr** (260)

Score

Multiple Choice (5pts each): Circle the letter of the most correct response.

1. Which of the following is ***not*** a correct ideal gas relationship?
   a. $T_1n_1=T_2n_2$
   b. $V_1/T_1=V_2/T_2$
   c. $T_1/P_1=T_2/P_2$
   d. $PV=nRT$
   e. $P_1n_1=P_2n_2$

2. Rank the 3 states of matter from lowest kinetic energy to highest kinetic energy.
   a. Gas, liquid, solid
   b. Solid, liquid, gas
   c. Gas, solid, liquid
   d. Liquid, gas, solid
   e. Solid, gas, liquid

3. Which of the following statements is most correct about colligative properties of an ideal solution?
   a. The presence of a solute lowers the vapor pressure of a solution.
   b. The presence of a solute raises the boiling point of a solution.
   c. The presence of a solute lowers the freezing point of a solution.
   d. Colligative properties depend upon the number of solute particles, not on the identity of the solute particles.
   e. These statements are all correct.

4. All of the following concentration units require that you use the molar mass of the solute except:
   a. Molarity
   b. Mass percent
   c. Mole fraction
   d. Normality
   e. Molality

5. When dissolving a solid in a liquid:
   a. Formation of solvent-solute interactions is endothermic
   b. The boiling point of the solution will be higher than that of the pure solvent
   c. Energy is released (exothermic) by breaking solvent-solvent and solute-solute interactions
   d. The enthalpy of solution is always positive
   e. The freezing point of the solution will be higher than that of the pure solvent

6. The volume of a gas:
   a. Increases as the pressure increases
   b. Decreases as the kinetic energy increases
   c. Is always a constant
   d. Increases as the temperature increases
   e. Remains constant as the amount of gas is increased

7. Carbon dioxide (CO_2) has a lower boiling point than sulfur dioxide (SO_2) because:
   a. The bonds in SO_2 are polar but the bonds in CO_2 are not
   b. CO_2 has stronger London dispersion forces than SO_2
   c. SO_2 is a polar molecule but CO_2 is not
   d. SO_2 forms stronger hydrogen bonds than CO_2
   e. CO_2 sublimes

Score

8. A laboratory technician prepares a solution by weighing out 39.225g of potassium bromide and dissolving it in enough water to make 150.00mL of solution. The technician labels the solution "1.3m KBr(aq)". Why is this not correct? What should the laboratory technician do to correct the error? Calculate a correct concentration for this solution. (10pts)

9. You have prepared a solution by dissolving 21.918g of potassium phosphate in enough water to make 500.0mL of solution. What is the *molarity* of this solution? (10pts)

10. You have prepared a solution by dissolving 9.986g of ammonium iodide in 100.0g of water. What is the *molality* of this solution? (10pts)

11. You have prepared a solution by diluting 50.00mL of a 2.312M aqueous solution of sugar ($C_6H_{12}O_6$) to a total volume of 200.0mL. What is the *molarity* of this solution? (10pts)

Score

12. A 2.00L cylinder contains helium gas at 18.93ºC and 2.64atm pressure. How many grams of He are in the cylinder? (10pts)

13. What is the freezing point of a solution made by dissolving 22.734g of lithium nitrate in 200.0g of water? (15pts)

14. Each of the following solids is dissolved in separate beakers containing 500.0mL of water. Rank the solutions from lowest vapor pressure to highest vapor pressure and explain your answer. (15pts)
    a. 0.4mols magnesium phosphate
    b. 0.6mols sodium chloride
    d. 0.7mols ammonium phosphate
    c. 0.5mols calcium nitrate

Score

15. You have a 63.926g sample of steam (gaseous water) at 142.19°C. Describe what happens to this sample when it is cooled to 38.63°C and calculate the amount of energy transferred during cooling. (15pts)
{C_s(ice) = 2.09 $^{J}/_{g.K}$; C_s(water) = 4.184 $^{J}/_{g.K}$; C_s(steam) = 2.01 $^{J}/_{g.K}$; ΔH_{fusion}(water) = 6.02 $^{kJ}/_{mol}$; $\Delta H_{vaporization}$(water) = 40.7 $^{kJ}/_{mol}$}

16. A newly discovered protein has been isolated from seeds of a tropical plant and needs to be characterized. A total of 0.137g of this protein was dissolved in enough water to produce 2.00mL of solution. At 31.68°C the osmotic pressure produced by the solution was 0.134atm. What is the molar mass of the protein? (20pts)

Score