Name: _____

Chemistry 210 {style=left}   **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 = $6.022 \times 10^{23}\ \text{units}/\text{mol}$

$32.00^{\circ}F = 0.000^{\circ}C = 273.15K$

Density of Water = $1.000\ \text{g}/\text{mL}$

$R = 0.08206\ \text{L·atm}/\text{mol·K} = 8.314\ \text{J}/\text{mol·K}$

$PV = nRT$

$\Delta T_{fp/bp} = k_{fp/bp} \cdot m \cdot i$

For water: $k_{fp} = -1.86\ ^{\circ}C/m$

           $k_{bp} = 0.512\ ^{\circ}C/m$

$P_1 = X_1 P_1^{\circ}$

$\Pi = cRTi$

$C_1 V_1 = C_2 V_2$

Quadratic formula:

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

Integrated Rate Laws:

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

$$1/[A]_t = kt + 1/[A]_o$$

$$[A]_t = -kt + [A]_o$$

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

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

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

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

$E_{cell} = E^{\circ}_{cell} - \frac{RT}{nF}\ lnQ$

$E^{\circ}_{cell} = \frac{RT}{nF}\ lnK^{\circ}$

$K^{\circ} = e^{\wedge}(\frac{nF}{RT}\ E^{\circ}_{cell})$

$F = 96485\ \text{J}/\text{V·mol of electrons}$

$\Delta G^{\circ} = \Delta H^{\circ}_{system} - T\Delta S^{\circ}_{system}$

$\Delta G^{\circ} = -nFE^{\circ}_{cell} = -RT lnK^{\circ}$

$\Delta G = \Delta G^{\circ} + RT lnQ$

$F = 96485\ \text{C}/\text{mol electrons}$

$1A = 1\ C/sec$

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 (6pts each): Circle the letter of the most correct response.

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

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

3. Which of the following statements is most correct about colligative properties of an ideal solution?
    a. The presence of a solute raises the boiling point of a solution.
    b. The presence of a solute lowers the freezing point of a solution.
    c. The presence of a solute lowers the vapor pressure 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 lower 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 lower than that of the pure solvent

6. Carbon tetrabromide (CBr_4) has a higher boiling point than carbon tetrafluoride (CF_4) because:
    a. The bonds in CF_4 are polar but the bonds in CBr_4 are not
    b. CBr_4 has a higher molecular weight than CF_4
    c. CF_4 is a polar molecule but CBr_4 is not
    d. CF_4 has stronger intermolecular forces than CBr_4
    e. CF_4 is a gas at room temperature

Score

7. You have prepared a solution by dissolving 21.918g of sodium phosphate in enough water to make 400.0mL of solution. What is the *molarity* of this solution? (12pts)

8. You have prepared a solution by dissolving 12.537g of ammonium perchlorate in 100.0g of water. What is the *molality* of this solution? (12pts)

9. You have prepared a solution by diluting 15.00mL of a 1.268M aqueous solution of iron(II) sulfate to a total volume of 125.0mL. What is the *molarity* of this solution? (12pts)

10. What is the boiling point of a solution made by dissolving 26.734g of sodium nitrate in 200.0g of water? (15pts)

11. Each of the following solids is dissolved in separate beakers containing 500.0mL of water. Rank the solutions from highest boiling point to lowest boiling 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

12. How much energy is required to heat 1.285kg of water from 65.29°C to 115.62°C? {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 $^{kJ}/_{mol}$ } (25pts)

13. Some salts have enough covalent bond character that they do not completely dissociate when dissolved in water. You have performed an experiment in which you have made a solution by dissolving 29.531g of bismuth(III) chloride in 150.00mL of water. The observed freezing point of this solution is –2.32°C. Which of the following equations is most consistent with your observed freezing point? Explain your answer with explicit calculations. (25pts)

$$BiCl_3(s) \rightarrow Bi^{3+}(aq) + 3\ Cl^-(aq)$$
$$BiCl_3(s) \rightarrow [BiCl]^{2+}(aq) + 2\ Cl^-(aq)$$
$$BiCl_3(s) \rightarrow [BiCl_2]^+(aq) + Cl^-(aq)$$
$$BiCl_3(s) \rightarrow BiCl_3(aq)$$

Score