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} $^{\text{units}}/_{\text{mol}}$
$32.00^{o}F = 0.000^{o}C = 273.15K$
Density of Water = $1.000^{g}/_{mL}$
$R = 0.08206$ $^{L \cdot atm}/_{mol \cdot K} = 8.314$ $^{J}/_{mol \cdot K}$
$PV=nRT$
$\Delta T_{fp/bp} = k_{fp/bp} \cdot m \cdot i$
For water, $k_{fp} = -1.86$ $^{\circ C}/_{m}$; $k_{bp} = 0.52$ $^{\circ C}/_{m}$
$P_1 = X_1 P_1^{o}$
$\Pi = MRTi$
$C_1V_1 = C_2V_2$
Quadratic formula:

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

Integrated Rate Laws:

0^{th} order	$[A]_t = -kt + [A]_o$
1^{st} order	$\ln[A]_t = -kt + \ln[A]_o$
2^{nd} order	$1/[A]_t = kt + 1/[A]_o$

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

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

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

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

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

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

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

3. Under which of the following conditions is a gas ***least*** "ideal"?
   a. Low temperature, low pressure
   b. High temperature, low pressure
   c. Room temperature, 25ºC
   d. High temperature, high pressure
   e. Low temperature, high pressure

4. Which of the following is ***not*** a correct gas law relationship?
   a. $PV = nRT$
   b. $n_1T_1 = n_2T_2$
   c. $V_1n_1 = V_2n_2$
   d. $P_1V_1 = P_2V_2$
   e. $P_1 / T_1 = P_2 / T_2$

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

6. Which of the following does ***not*** affect the rate of a reaction?
   a. The frequency of collisions between reacting particles
   b. The orientation of colliding particles
   c. The coefficients of the reactants in the balanced equation
   d. The temperature of the system
   e. The energy of collisions between reacting particles

7. If the rate of a reaction increases by a factor of 9 when the initial concentration of reactant "A" is increased by a factor of 9, the reaction must be:
   a. 0^{th} order with respect to $[A]_o$
   b. 1^{st} order with respect to$[A]_o$
   c. 2^{nd} order overall
   d. 2^{nd} order with respect to $[A]_o$
   e. The order of the reaction depends on the balanced chemical equation

Score

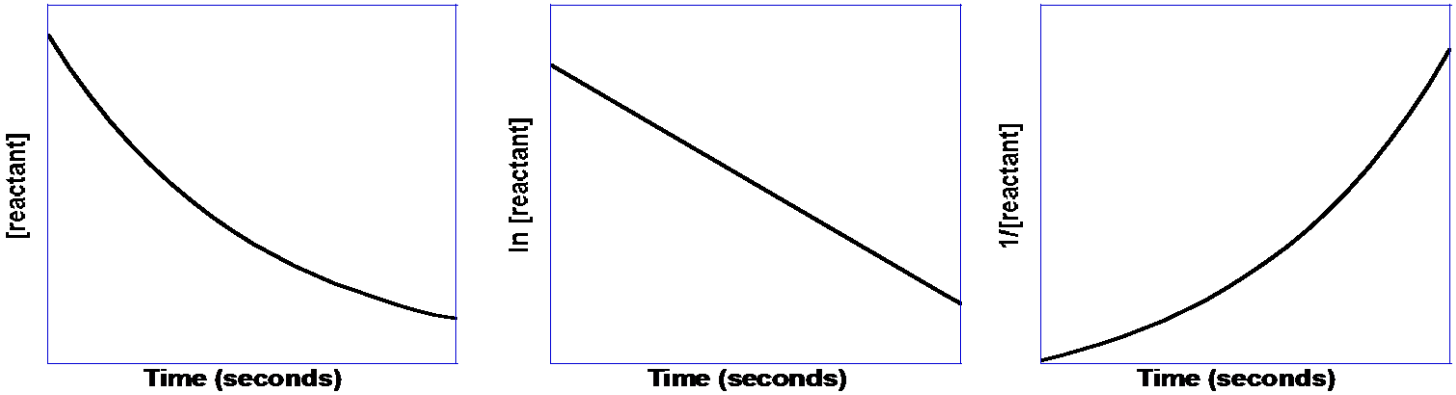
8. For the generic equation:

$$aA + bB \rightarrow cC + dD$$

Which of the following is a correct expression of the rate of the reaction:

a. $^{1}/_{a}\ ^{\Delta[A]}/_{\Delta t}$
b. $-^{1}/_{b}\ ^{\Delta[B]}/_{\Delta t}$
c. $k[A]^{a}[B]^{b}$
d. $-^{1}/_{d}\ ^{\Delta[D]}/_{\Delta t}$
e. $k[C]^{c}[D]^{d}$

9. For a second order reaction:
   a. The slope of the integrated rate law plot is equal to $(-E_a/R)$
   b. The slope of the integrated rate law plot is equal to k
   c. The intercept of the integrated rate law is equal to the *ln* of the initial concentration
   d. The intercept of the integrated rate law plot is equal to the initial concentration
   e. The slope of the integrated rate law is equal to the frequency factor, A.



10. The reaction represented by the plots above:
    a. Is zero order
    b. Is first order
    c. Is second order
    d. Is third order
    e. The order can't be determined by these graphs

Problems:

11. What is the volume of 1.593mols of ideal gas at 19.61ºC and 3.162atm pressure? (10pts)

12. You have a 27.94L sample of gas at 41.29°C. What is the volume of this gas if the temperature is decreased to 22.61°C? (10pts)

Score

13. A 3.00kg sample of water is initially at 14.23ºC and 1 atm pressure. This sample is heated to 28.19ºC at constant pressure. How much energy was required to heat the sample? (10pts)
{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 $^{kJ}/_{mol}$ }

14. What is the boiling point of a solution made by dissolving 24.923g of potassium sulfate in 150.0g of water? (12pts)

15. A reaction is found to be first order with respect to reactant A and second order with respect to reactant B. If $[A]_o$ = 0.592M, $[B]_o$ = 0.339M and k = 4.42×10^{-4} $M^{-2}sec^{-1}$, what is the initial rate of the reaction? (12pts)

16. A reaction is found to be zero order with respect to methane, a reactant. If $[CH_4]_o$ = 2.58M and k = 0.103 $M \bullet min^{-1}$, what will the concentration of methane be after 6.13minutes have passed? (12pts)

17. Triiodoamine (NI_3) reacts with oxygen to form nitrogen dioxide and iodine. Under some set of conditions at some point in time, you find that 0.206mols of oxygen react every minute in a 750.0mL vessel. (16pts)
    a. What is the rate of oxygen consumption?
    b. What is the rate of NI_3 consumption?
    c. What is the rate of nitrogen dioxide production?
    d. What is the rate of iodine production?
    e. What is the rate of the *reaction*?

Score

18. For the reaction:

$$2\ CH_3I(g) + F_2(g) \rightarrow 2\ CH_3F(g) + I_2(g)$$

You have collected the following data at 38.42ºC:

Experiment	$[CH_3I]_o$	$[F_2]_o$	Initial Rate
1	0.214	0.397	$4.91 \times 10^{-3}\ M/_{sec}$
2	0.428	0.397	$9.82 \times 10^{-3}\ M/_{sec}$
3	0.214	0.794	$4.91 \times 10^{-3}\ M/_{sec}$

What are the rate law and the value of the rate law constant, k, for this reaction?
If you redo Experiment 3 at 22.68ºC, the rate slows to $2.37 \times 10^{-3}\ M/_{sec}$. What is the activation energy for this reaction? (18pts)

Score