Equations & Constants

$$[A] = -kt + [A]_0 \quad \frac{1}{[A]} = kt + \frac{1}{[A]_0} \quad \ln[A] = -kt + \ln[A]_0 \quad t_{1/2} = \frac{0.693}{k}$$

$$t_{1/2} = \frac{[A]_0}{2k} \quad t_{1/2} = \frac{1}{k[A]_0} \quad k = Ae^{-E_a/RT} \quad \ln(k) = -\frac{E_a}{R}\left(\frac{1}{T}\right) + \ln(A) \quad K_P = K(RT)^{\Delta n}$$

$$F = ma \quad P = F/A \quad P_1V_1 = P_2V_2 \text{ or } P_iV_i = P_fV_f \quad \frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \quad PV = nRT$$

$$D = \frac{MP}{RT} \quad P_{total} = P_1 + P_2 + \cdots \quad X_x = \frac{n_x}{n_{total}} \quad P_x = X_x P_{total} \quad P_{\text{total}} = \sum_i X_i P_i$$

$$C_{gas} = k_H P_{gas} \quad u_{rms} = \sqrt{\frac{3RT}{M}} \quad \frac{u_x}{u_y} = \sqrt{\frac{M_y}{M_x}} \quad \frac{r_x}{r_y} = \sqrt{\frac{M_y}{M_x}} \quad P = \frac{nRT}{V - nb} - \frac{n^2 a}{V^2}$$

$$\pi = iMRT \qquad \Delta T_b = iK_b m \qquad \Delta T_f = iK_f m \quad 8.314 \tfrac{J}{mol \cdot K} \quad 0.0821 \tfrac{L \cdot atm}{mol \cdot K}$$

$$\Delta S_{univ} = \Delta S_{sys} + \Delta S_{surr} \qquad \Delta S_{surr} = -\frac{\Delta H}{T} \qquad \Delta G = \Delta H - T\Delta S \qquad \Delta G^\circ = -RT \ln K$$

$$\Delta G = \Delta G^\circ + RT \ln Q \qquad \Delta G = -nFE_{cell} \qquad \Delta G^\circ = -nFE^\circ_{cell} \qquad E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$$

$$E_{cell} = E^\circ_{cell} - \frac{0.0592}{n}\log Q \qquad ax^2 + bx + c = 0 \qquad x = \frac{-b \pm \sqrt{b^2 + 4ac}}{2a}$$

1 H 1.008																2 He 4.003
3 Li 6.941	4 Be 9.012											5 B 10.811	6 C 12.011	7 N 14.007	8 O 15.599	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 47.867	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.845	27 Co 58.933	28 Ni 58.693	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.59	33 As 74.922	34 Se 78.96	35 Br 79.904	36 Kr 83.30
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 102.906	46 Pd 106.42	47 Ag 107.868	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.760	52 Te 127.60	53 I 126.904	54 Xe 131.29
55 Cs 132.902	56 Ba 137.327	57 La 138.906	72 Hf 178.49	73 Ta 180.948	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.217	78 Pt 195.078	79 Au 196.967	80 Hg 200.59	81 Tl 204.383	82 Pb 207.2	83 Bi 208.980	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (268)	110 Ds (271)	111 Rg (272)	112 Uub	113 Uut	114 Uuq	115 Uup			

58 Ce 140.116	59 Pr 140.908	60 Nd 144.908	61 Pm (145)	62 Sm 150.36	63 Eu 151.964	64 Gd 157.25	65 Tb 158.925	66 Dy 162.50	67 Ho 164.930	68 Er 167.26	69 Tm 168.934	70 Yb 173.04	71 Lu 174.967
90 Th 232.038	91 Pa 231.036	92 U 238.029	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)

Chemistry 1212 Name_____
February 24, 2012
Exam #2

Write very clearly and **show all of your work** for partial credit. A list of equations and constants as well as a periodic table are on the last two pages of your exam.

1.(20 points) Fill in the space with the correct response.

(a) Write the equilibrium expression for: $2HgO_{(s)} + H_2O_{(l)} + 2Cl_{2(g)} \rightarrow 2HOCl_{(aq)} + HgO{\bullet}HgCl_{2(s)}$

_____

(b) If K_p for the reaction above at 25°C is 20 what is K_c?

_____

(c) What is the half-life if the rate constant is 1.7×10^{-3} s^{-1} and $[A]_0 = 1.00$ M?

_____

(d) If the units on the k constant are $M^{-19}s^{-1}$ what is the overall order of the reaction?

_____

(e) If the rate for the consumption of oxygen gas is 2 M/s what is the rate of production of H_2O?

$$4NH_{3(g)} + 5O_{2(g)} \rightarrow 4NO_{(g)} + 6H_2O_{(g)}$$

_____

(f) What is the order of the reaction if you get a linear plot from concentration versus time?

_____

(g) How does K_c change if we reverse the reaction and multiple it by 3/2?

_____

(h) Which side of the equation is favored if $K_c > 10^3$?

_____

(i) What is the name we give to the number of successful collisions?

_____

(j) If Q > K, then the reaction must proceed in the _____ direction to re-establish equilibrium.

2. (20 points) The following data were obtained for the reaction:

$$A + B \rightarrow C$$

T (K)	[A]	[B]	Initial Rate (M/s)
298	0.100	0.100	5.00
298	0.200	0.100	40.00
298	0.350	0.200	428.8

(a) Determine the rate law. Show your work.

(b) What is the overall order of the reaction?

(c) Determine the rate constant (with correct units).

(d) What would be the initial rate for an experiment with $\left[C_2H_4Br_2\right]$ = 0.0508 M and $\left[I^-\right]$ = 0.0844 M?

3. (10 points) For the reaction mechanism below draw the reaction profile showing each elementary step, the transition state(s), and the E_a(s). Make sure to properly place each species.

$$\textit{Step}\,1: \quad 2A \rightarrow D \;(\textit{fast})$$

$$\textit{Step}\,2: \quad D \rightarrow E \;(\textit{slow})$$

$$\textit{Step}\,3: \quad E \rightarrow 2C \;(\textit{fast})$$

4. (18 points) When 1.000 mol of $C_5H_{11}N$ is introduced into a 1.000 L container at 500 K, only 3.63% will dissociate to give an equilibrium mixture. What is the equilibrium constant? In which direction would we go to re-attain equilibrium if we have the following concentrations: $\left[C_5H_{11}N_{(aq)}\right] = 0.100M$, $\left[OH^-_{(aq)}\right] = 0.100M$, and $\left[C_5H_{11}NH^+_{(aq)}\right] = 0.0100M$?

$$C_5H_{11}N_{(aq)} + H_2O_{(l)} \rightleftharpoons C_5H_{11}NH^+_{(aq)} + OH^-_{(aq)}$$

5. (12 points) Will the amount of $NaHCO_3$ increase, decrease or remain the same when the equilibrium below is disturbed by one of the following stressors?

$$2NaHCO_{3(s)} \rightleftharpoons Na_2CO_{3(s)} + CO_{2(g)} + H_2O_{(g)} \quad \Delta H^\circ = +136\ kJ$$

(a.) a decrease in volume _____

(b.) an increase in temperature _____

(c.) an addition of water vapor _____

(d.) an addition of a catalyst _____

(e.) an addition of Ne _____

(f.) an increase in pressure _____