Chem 210 – Exam 3a *Name:* _____
Summer 2012

Chemistry 210 Exam 3

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} $^{\text{units}}/_{\text{mol}}$
$32.00^{\circ}F = 0.000^{\circ}C = 273.15K$
Density of Water = $1.000\ ^{g}/_{mL}$
$R = 0.08206\ ^{L \cdot atm}/_{mol \cdot K} = 8.314\ ^{J}/_{mol \cdot K}$
1atm = 760torr = 760mmHg = 101.325kPa
$PV=nRT$
$\Delta T_{fp/bp} = k_{fp/bp} \cdot m \cdot i$
For water: $k_{fp} = -1.86\ ^{\circ C}/_{m}$
$k_{bp} = 0.512\ ^{\circ C}/_{m}$
$P_1 = X_1 P_1^{\circ}$
$\Pi = MRTi$
$C_1V_1 = C_2V_2$
$E = C_s \cdot g \cdot \Delta T$
Quadratic formula:

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

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

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

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

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

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

$E_{cell} = E^{o}_{cell} - {}^{RT}/_{nF}\ lnQ$
$E^{o}_{cell} = {}^{RT}/_{nF}\ lnK^{o}$
$K^{o} = e^{\wedge}({}^{nF}/_{RT}\ E^{o}_{cell})$
$F = 96485\ ^{J}/_{V \cdot mol\ of\ electrons}$
$\Delta G^{o} = \Delta H^{o}_{system} - T\Delta S^{o}_{system}$
$\Delta G^{o} = -nFE^{o}_{cell} = -RTlnK^{o}$
$\Delta G = \Delta G^{o} + RTlnQ$
$F = 96485\ ^{C}/_{mol\ electrons}$
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

1. Complete each row of the following tables for aqueous solutions at 25ºC (4pts per box):

$[H_3O^+]$	$[OH^-]$	pH	pOH	Acidic, Basic or Neutral?
$5.63x10^{-5}$				
			4.337	

2. Complete each row of the following tables for aqueous solutions at 25ºC (4pts per box):

Conjugate Acid	K_a @25ºC	Conjugate Base	K_b @25ºC
HClO			$1.5x10^{-7}$
	$1.6x10^{-9}$	SeO_3^{2-}	

3. A labmate has prepared a bromite/bromous acid buffer solution at pH=3.5, but does not write much information down in a lab notebook. You know that the concentration of the buffer is 0.995M and pK_b=10.92 for BrO_2^{-1}(aq). Is the concentration of conjugate acid higher in this buffer or is the concentration of conjugate base in this buffer higher? Over what pH range would bromite/bromous acid make an effective buffer? Explain your answers. (10pts)

4. How many milliliters of 0.294M $HClO_4$(aq) must be added to 25.00mL of 0.308M $Mg(OH)_2$(aq) to reach the equivalence point? What is the pH of this solution at the equivalence point? Explain any assumptions. (10pts)

Score

5. What is the expected pH of a 0.713M aqueous solution of hypobromous acid? {$K_a(HBrO) = 2.51x10^{-9}$} (10pts)

6. What is the expected pH of a 0.518M aqueous solution of potassium cyanide? {$K_b(CN^{-1})=3.0x10^{-5}$} (10pts)

7. You have prepared a buffer solution by combining 0.238mols of benzoic acid ($HC_7H_5O_2$, $K_a = 6.4x10^{-5}$) and 0.394mols of sodium benzoate in enough water to make 400.0mL of solution. What is the pH of this buffer solution? (12pts)

8. What is the K_b of a weak base if 500.0mL of a solution containing 0.368mol of the base and 0.308mol of its conjugate acid has a pH of 8.372? Over what pH range would this conjugate acid/ conjugate base pair make an effective buffer? (15pts)

Score

9. You have titrated 25.00mL of 0.773M phosphorous acid solution with an unknown sodium hydroxide solution. You reach the second equivalence point when 44.17mL of base is added. What is the concentration of the original stock sodium hydroxide solution?
{$K_{a1}(H_3PO_3) = 2.42x10^{-2}$, $K_{a2} = 2.89x10^{-7}$, $K_{a3} = 1.96x10^{-11}$} (15pts)

10. You have titrated 20.00mL of an unknown sulfurous acid {H_2SO_3(aq), pK_{a1}=1.770, pK_{a2}=7.201} solution to the second equivalence point with 38.27mL of 0.492M potassium hydroxide. Sketch the titration curve and label all equivalence points and all sulfurous acid-based species in solution in all portions of the curve. What is the concentration of the unknown sulfurous acid solution? How many milliliters were required to reach the *first* equivalence point in this titration? (20pts)

Score