Name: _____

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 = $1.000^{\text{g}}/_{\text{mL}}$
$R = 0.08206$ $^{\text{L•atm}}/_{\text{mol•K}} = 8.314$ $^{\text{J}}/_{\text{mol•K}}$
$PV=nRT$
$\Delta T_{fp/bp} = k_{fp/bp} \bullet m \bullet i$
For water, $k_{fp} = -1.86$ $^{\circ C}/_{m}$; $k_{bp} = 0.52$ $^{\circ C}/_{m}$
$P_1 = X_1 P_1^{\circ}$
$P = cRTi$
$C_1V_1 = C_2V_2$
Quadratic formula:

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

Integrated Rate Laws:

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

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

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

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

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

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

Name: _____

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?
$3.19x10^{-4}$				
		4.319		

Conjugate Acid	K_a @25ºC	Conjugate Base	K_b @25ºC
H_2CO_3			$2.4x10^{-8}$
	$1.2x10^{-2}$	SO_4^{2-}	

2. Does the combination listed result in an effective buffer solution? (4pts each)

Yes *No* 0.38mol HCl(aq) + 0.38mol NaOH(aq)

Yes *No* 0.90mol Na_3PO_4(aq) + 1.35mol HNO_3(aq)

Yes *No* 1.28mol Na_2CO_3(aq) + 0.64mol HCl(aq)

Yes *No* 2.14mol CH_3COOH(aq) + 1.96mol CH_3COOK(aq)

Yes *No* 0.06mol HCN(aq) + 0.98mol LiCN(aq)

3. How much 1.131 M NaOH(aq) must be added to 45.00mL of 0.984 M HCl(aq) to reach the equivalence point? What is the pH of this solution at the equivalence point? (12pts)

Score

4. You have prepared a buffer solution by combining 0.164mols of nitrous acid (HNO_2, $K_a = 4.5x10^{-4}$) and 0.186mols of sodium nitrite in enough water to make 500.0mL of solution. What is the pH of this buffer solution? (12pts)

5. Sketch the titration curve (pH vs. volume added) for the titration of 1 M potassium sulfite (K_2SO_3, $K_{b1}=1.6x10^{-7}$) and 1 M $HClO_4$(aq). Label all the axes (including approximately accurate numbers) and the major sulfite-based species present in solution at each point in the titration curve. Indicate the equivalence point(s) on the curve. (17pts)

Score

6. What is the K_b of a base if 750.0mL of a solution containing 0.153 mol of the base and 0.141 mol of its conjugate acid has a pH of 4.165? Over what pH range would this conjugate acid/ conjugate base pair make an effective buffer? (16pts)

7. You have titrated 25.00mL of a monoprotic acid ($K_a = 3.4 \times 10^{-5}$) with 0.613 M KOH(aq). If thymol blue (endpoint 7.8-9.5) is used as an indicator, you reach the endpoint when 31.37mL of base is added. Based on this data, what is the concentration of the acid? Would your result change if ethyl red (endpoint 4.0-5.8) was used as an indicator? If so, how? Which indicator (thymol blue or ethyl red) more correctly indicates the equivalence point in this titration? (Explain your answers!) (25pts)

Score