Name _____ Rec. TA/time _____

Show **ALL** your work or **EXPLAIN** to receive full credit. R = 0.08206 L•atm/mol•K = 8.314 J/mol•K

1.   (3 pts) Which of the following is the **weakest** acid? **Explain!**

a) H_2TeO_3 b) H_2TeO_4 c) H_2SeO_3 d) H_2SeO_4

2.   (2 pts) Based on their structure and composition, select the member of the following pair of acids that is the **stronger acid**. Briefly **explain** (but more than just any periodic trends).

a) H_2S b) H_2Se c) PH_3 d) SiH_4

3.   (2 pts) Identify the Lewis acid and Lewis base in the following reactions. **Explain!**

a) $CN^-(aq)$ + $H_2O(l)$ $\longrightarrow$ $HCN(aq)$ + $OH^-(aq)$

b) $SO_2(g)$ + $H_2O(l)$ $\longrightarrow$ $H_2SO_3(aq)$

4.   (2 pts) Which of the following solutions would be a common-ion system?

a) HCN and NaCl

b) HF and NaF

c) NH_3 and NaF

d) HCl and NaBr

e) HNO_2 and KCl

5.   (3 pts) What change will occur for the following reaction if NaCH3CO2 is added to a solution of CH_3CO_2H?   **Explain!**

$$CH_3CO_2H \ + \ H_2O \ \rightleftarrows \ CH_3CO_2^- \ + \ H_3O^+$$
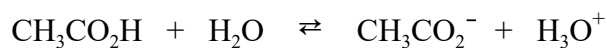
a) a decrease in the fraction of acid dissociated
b) an increase in the fraction of acid dissociated
c) no change in the fraction of acid dissociated

6.   (2 pts) Which of the following would be the best choice to make a buffer system around a pH of 4.3?

a) $HClO_2/NaClO_2$ K_a for $HClO_2 = 1.1 \times 10^{-2}$

b) HF/NaF K_a for $HF = 6.8 \times 10^{-4}$

c) $HC_2H_3O_2/NaC_2H_3O_2$ K_a for $HC_2H_3O_2 = 1.8 \times 10^{-5}$

d) $HNO_2/NaNO_2$ K_a for $HNO_2 = 4.5 \times 10^{-4}$

e) $H_2CO_3/NaHCO_3$ K_a for $H_2CO_3 = 4.3 \times 10^{-7}$

7.   (8 pts) You have a 0.20 M solution of acetic acid, $HC_2H_3O_2$. You add enough sodium acetate, $NaC_2H_3O_2$, to make the solution 0.010 M in $NaC_2H_3O_2$. What is the **pH** of the solution? $(HC_2H_3O_2$: $K_a = 1.8 \times 10^{-5})$ (**Show all work**, including ICE tables, assumptions & check for % error.)

8.   (11 pts) A buffer solution is 0.15 M in HNO_2 and 0.10 M in $NaNO_2$. (HNO_2: $K_a = 4.5 \times 10^{-4}$) **Explain or show work!**

a) (3 pts) What is the **pH** of this buffer solution?

b) (8 pts) You have 100.0 mL of this buffer solution. What is the **pH** of the buffer solution after adding 15.0 mL of 0.30 M of NaOH? (**Show all work, including ICE tables, assumptions & check for % error.**)

9.   (11 pts) A buffer solution is 0.10 M in HCN and 0.15 M in NaCN. (HCN: $K_a = 4.9 \times 10^{-10}$)

a) (3 pts) What is the **pH** of this buffer solution?

b) (8 pts) You have 100.0 mL of this buffer solution. What is the pH of the buffer solution after adding 15.0 mL of 0.200 M of HCl?   (**Show all work**, including ICE tables, assumptions & check for % error.)

10.   (6 pts) You have 0.101 L of a 1.367 M solution of NH_3. How many grams of an NH_4Cl salt should be added to prepare a buffer solution with a pH = 10.05? Neglect the small volume change that occurs when the NH_4Cl salt is added. (Molar Mass of NH3 = 17.03 g/mol and NH_4Cl = 53.49 g/mol; K_b for NH_3 = 1.80 x 10^{-5}).

USEFUL INFORMATION

R = 0.08206 L-atm/mol-K = 8.3145 J/mol-K

	IA	IIA	IIIB	IVB	VB	VIB	VIIB		VIIIB		IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
1	1.008 **H** 1																	4.003 **He** 2
2	6.941 **Li** 3	9.012 **Be** 4											10.811 **B** 5	12.011 **C** 6	14.007 **N** 7	15.999 **O** 8	18.998 **F** 9	20.179 **Ne** 10
3	22.990 **Na** 11	24.305 **Mg** 12											26.98 **Al** 13	28.09 **Si** 14	30.974 **P** 15	32.06 **S** 16	35.453 **Cl** 17	39.948 **Ar** 18
4	39.098 **K** 19	40.08 **Ca** 20	44.96 **Sc** 21	47.88 **Ti** 22	50.94 **V** 23	52.00 **Cr** 24	54.94 **Mn** 25	55.85 **Fe** 26	58.93 **Co** 27	58.69 **Ni** 28	63.546 **Cu** 29	65.38 **Zn** 30	69.72 **Ga** 31	72.59 **Ge** 32	74.92 **As** 33	78.96 **Se** 34	79.904 **Br** 35	83.80 **Kr** 36
5	85.47 **Rb** 37	87.62 **Sr** 38	88.91 **Y** 39	91.22 **Zr** 40	92.91 **Nb** 41	95.94 **Mo** 42	98 **Tc** 43	101.07 **Ru** 44	102.91 **Rh** 45	106.42 **Pd** 46	107.87 **Ag** 47	112.41 **Cd** 48	114.82 **In** 49	118.69 **Sn** 50	121.75 **Sb** 51	127.60 **Te** 52	126.90 **I** 53	131.39 **Xe** 54
6	132.91 **Cs** 55	137.33 **Ba** 56	138.91 **La** 57	178.39 **Hf** 72	180.95 **Ta** 73	183.85 **W** 74	186.21 **Re** 75	190.23 **Os** 76	192.22 **Ir** 77	195.08 **Pt** 78	196.97 **Au** 79	200.59 **Hg** 80	204.38 **Tl** 81	207.2 **Pb** 82	208.98 **Bi** 83	209 **Po** 84	210 **At** 85	222 **Rn** 86
7	223 **Fr** 87	226.03 **Ra** 88	227.03 **Ac** 89	261 **Rf** 104	262 **Ha** 105	263 **Sg** 106	262 **Ns** 107	265 **Hs** 108	266 **Mt** 109	269 110	272 111	277 112						

Lanthanide Series	140.12 **Ce** 58	140.91 **Pr** 59	144.24 **Nd** 60	145 **Pm** 61	150.36 **Sm** 62	151.96 **Eu** 63	157.25 **Gd** 64	158.93 **Tb** 65	162.50 **Dy** 66	164.93 **Ho** 67	167.26 **Er** 68	168.93 **Tm** 69	173.04 **Yb** 70	173.04 **Lu** 71
Actinide Series	232.04 **Th** 90	231.04 **Pa** 91	238.03 **U** 92	237.05 **Np** 93	**Pu** 94	**Am** 95	**Cm** 96	**Bk** 97	**Cf** 98	**Es** 99	**Fm** 100	**Md** 101	**No** 102	**Lr** 103

A PERIODIC CHART OF THE ELEMENTS
(Based on ^{12}C)