Dr. Zellmer | Chemistry 1250 | T, R
Time: 7 PM Sun. | Spring Semester 2022 | April 24, 2022
40 min | Quiz XII

Name _____ Rec. TA/time _____

Show **ALL** your work or **EXPLAIN** to receive full credit.

1. (3 pts) Given the following K_a values, determine which species is the **strongest base**. **Explain!**

   HSO_3^- 6.3×10^{-8} HPO_4^{2-} 4.8×10^{-13} HCO_3^- 4.7×10^{-11}

2. (2 pts) Would you expect the following solutions to be acidic, neutral, or basic? **Explain or show work!**

   a) $KBrO_4$

   b) $PbCl_2$

3. (8 pts) What is the **pH** of a 0.30 M $NaCHO_2$ solution at 25°C? ($HCHO_2$: $K_a = 1.8 \times 10^{-4}$, at 25°C) (**Show the ICE table, state any assumptions made and check your percent error.**) **Explain or show work!**

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

5. (3 pts) Calculate the ΔS (J/mol•K) of fusion for a compound which melts at -183.0 °C. The heat of fusion is 2.86 kJ/mole.

6. (4 pts) Predict the **sign** of ΔS of the system **or** if it's **approximately zero** for the following reactions and **explain** your choices.

a) $CaCO_3\,(s) + 2\,HCl\,(g) \rightarrow CaCl_2\,(s) + CO_2\,(g) + H_2O\,(\ell)$

b) $Al_2O_3(s) + 3\,H_2\,(g) \rightarrow 2\,Al\,(s) + 3\,H_2O\,(g)$

7. (5 pts) Determine the entropy of reaction (ΔS°) (in J/mol-K) for the following reaction at 25°C.

	$2\,CH_3OH\,(\ell)$	+	$3\,O_2\,(g)$	→	$2\,CO_2\,(g)$	+	$4\,H_2O\,(\ell)$
S° (J/mol•K)	126.8		205.0		213.6		69.91

8. (3 pts) Write the reaction for the formation of NH_4NO_3 (s) which corresponds to ΔH_f° and ΔG_f° **and** explain why you've written it the way you have.

9. (3 pts) Given ΔG° = -3217.4 kJ/mol and the listed ΔG°_f values calculate ΔG°_f for $SO_2(g)$..

$$4\ FeS_2(s) + 11\ O_2(g) \longrightarrow 2\ Fe_2O_3(s) + 8\ SO_2(g)$$

ΔG°_f (kJ/mole)	-166.7	0.0	-740.9	?

10. (5 pts) For the following reaction ΔH° is −150.5 kJ/mol, ΔS° is −293.1 J/K•mol at 25 ºC. Assuming these don't change with temperature what is the value of ΔG° (kJ/mol) at 141.0 ºC?

$$A_2\ (g) + 2\ B_2\ (g) \longrightarrow 2\ AB_2\ (g)$$

11. (13 pts) Given $\Delta H^\circ = -71.75$ kJ and $\Delta S^\circ = -268.0$ J/mol•K for the following reaction at 25°C,

$$3\ NO_2\ (g) \quad + \quad H_2O\ (\ell) \quad \rightarrow \quad 2\ HNO_3\ (\ell) \quad + \quad NO\ (g)$$

a) (2 pts) Calculate the ΔG° of the reaction at 25°C. Is the reaction spontaneous or nonspontaneous at this temperature under standard state conditions? **Show all work and explain.**

b) (4 pts) If the reaction is nonspontaneous, at what temperature would it be spontaneous. If the reaction is spontaneous, at what temperature would it be nonspontaneous. If the reaction will always be spontaneous at all temperatures or never be spontaneous at any temperature state that. **Show ALL work & explain!**

c) (2 pts) What is the equilibrium constant at 25°C? **Show all work and explain.**

d) (1 pt) This ΔG° and K corresponds to an equilibrium that is: (choose one from below & explain)

1) closer to products
2) closer to reactants
3) midway between reactants and products (significant amounts of both at equilibrium)

e) (4 pts) Is the reaction spontaneous or nonspontaneous at 25 °C when the pressures of NO_2 and NO are 2.50 atm and 0.50 atm, respectively? **Show all work and explain.**

USEFUL INFORMATION

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

$$K_w = [H_3O^+][OH^-] = 1.0 \times 10^{-14} \quad (at\ 25°C)$$

$$pH = -\log[H_3O^+]\ ; \quad pOH = -\log[OH^-]\ ; \quad pK_w = -\log[K_w]$$

$$for\ \ ax^2 + bx + c = 0, \qquad x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$S = k \bullet \ln W$$

	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)