

Chem 1142—Exam 4A
Spring 2011

Name: _____

Multiple Choice. [4 pts. Each]

Circle the best response.

Q1. A certain chemical reaction has $\Delta H^\circ = +32 \text{ kJ/mol}$ and $\Delta S^\circ = 78.0 \text{ J/mol}\cdot\text{K}$. When does this reaction proceed spontaneously?

- a) The reaction is never spontaneous b) The reaction is only spontaneous at low temperatures
c) The reaction is always spontaneous d) The reaction is only spontaneous at high temperatures

Q2. An example of a reaction that is likely to have a large and positive value of ΔS° is:

- a) $\text{Ag}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \longrightarrow \text{AgCl}(\text{s})$ b) $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \longrightarrow 2\text{NH}_3(\text{g})$
c) $\text{CaCO}_3(\text{s}) \longrightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$ d) $2\text{O}_3(\text{g}) \longrightarrow 3\text{O}_2(\text{l})$
e) $\text{CO}_2(\text{g}) + \text{H}_2(\text{g}) \longrightarrow \text{CO}(\text{g}) + \text{H}_2\text{O}(\text{g})$

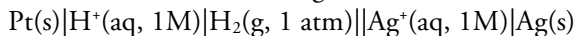
Q3. Methanol has a freezing point of -94°C . Pick the correct set of values for ΔH , ΔS , and ΔG at a temperature of -91°C for the process: $\text{methanol}(\text{s}) \longrightarrow \text{methanol}(\text{l})$

	ΔH	ΔS	ΔG
a	+	−	0
b	−	−	+
c	+	+	−
d	+	+	+
e	−	−	−

Q4. What is the equilibrium constant of a reaction with $\Delta G^\circ = -3.2 \text{ kJ/mol}$ at a temperature of 298 K?

- a) 3.64 b) 0.275 c) 950 d) 0.990 e) 0.288

Q5. Calculate E°_{cell} for the following electrochemical cell:



- a) 1.60 V b) 0.80 V c) 0.00 V d) -0.80 V e) -1.60 V

Q6. Where does oxidation occur in an electrochemical cell?

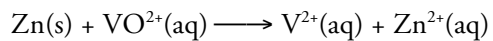
- a) Anode b) Salt Bridge c) Voltmeter d) Cathode e) Faraday

Q7. How many moles of electrons flow when an electrical current of 13.0 A flows for 2.00 minutes?

- a) 26.0 mol b) 6.50 mol c) $1.5 \times 10^8 \text{ mol}$ d) 0.108 mol e) 0.0162 mol

Short Response Questions. Show ALL work to receive credit.

Q8. [15 pts.] Balance the following redox reaction using the $\frac{1}{2}$ reaction method. Be sure to clearly identify the oxidation numbers of all atoms/ions in this reaction.



Q9. [10 pts.] The chemical reaction: $3\text{H}_2(\text{g}) + \text{N}_2(\text{g}) \longrightarrow 2\text{NH}_3(\text{g})$ has a value of ΔG° equal to -33.2 kJ/mol at a temperature of 25°C . If the partial pressures of H_2 , N_2 , and NH_3 are 0.0320 atm , 0.290 atm , and 48.0 atm respectively, then calculate ΔG for this reaction. What does this value of ΔG tell you about the reaction?

Q10. [10 pts.] How many grams of Al(s) can be formed from the electrolysis of molten aluminum bromide, using a current of 182 A for a time period of 432 minutes?

Q11. [13 pts.] A chemical reaction has a value of ΔG° equal to -12.0 kJ/mol at a temperature of 23°C , and a value of ΔG° equal to -9.90 kJ/mol at a temperature of 48°C . Calculate ΔS° for this reaction.

Q12. [10 pts.] Write formulas for the following compounds:

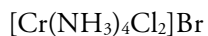
- a) lithium phosphate: _____
- b) ammonium sulfate: _____
- c) calcium sulfate trihydrate: _____
- d) perchloric acid: _____
- e) heptanitrogen disulfide: _____

Q13. [10 pts.] What is the molar solubility of lead(II) fluoride in a solution of 0.10 M NaF(aq)?
 $K_{sp}(\text{PbF}_2) = 4.1 \times 10^{-8}$.

BONUS QUESTIONS. (Show all work to receive full credit.)

1. [2 pts.] Polonium-210 (Po) undergoes alpha decay. Write out the balanced nuclear reaction for this process.

2. [3 pts.] Name the following coordination compound:



3. [3 pts.] Strontium-90 is a beta-emitter, with a half-life of 30. years. How many grams of strontium-90 will remain out of a 32 g sample that is 120 years old?

4. [2 pts.] What is meant by the term: **bidentate ligand**? Be as specific as you can.

Useful Information

$\Delta G = -nFE_{\text{cell}}$
$$E_{\text{cell}} = E_{\text{cell}}^{\circ} - \frac{RT}{nF} \ln Q$$
 $R = 8.3145 \text{ J mol}^{-1} \cdot \text{K}^{-1}$ $\Delta S = q/T$

$\Delta G^{\circ} = -nFE_{\text{cell}}^{\circ}$
$$E_{\text{cell}}^{\circ} = E_{\text{cathode}}^{\circ} - E_{\text{anode}}^{\circ}$$
 $Q \text{ (charge)} = I \cdot t$ $\Delta G = \Delta G^{\circ} + RT \ln Q$

$E_{\text{cell}}^{\circ} = \frac{RT}{nF} \ln K$
$$F = 96,500 \text{ C/mol e}^{-}$$
$$\Delta G = \Delta H - T\Delta S$$
$$\Delta G^{\circ} = -RT \ln K$$

Periodic Table of the Elements																		
IA	IIA											IIIA	IVA	VA	VIA	VIIA	VIIIA	
1 H 1.01																		18 He 4.00
3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18	
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95	
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92160	34 Se 78.96	35 Br 79.90	36 Kr 83.80	
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	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	71 Lu 174.97	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 207.20	83 Bi 208.98	84 Po [210]	85 At [210]	86 Rn [222]	
87 Fr [223]	88 Ra** [226]	103 Lr [262]	104 Rf [261]	105 Db [262]	106 Sg [266]	107 Bh [264]	108 Hs [265]	109 Mt [268]	110 [269]	111 [272]	112 [277]	113 [284]	114 [285]	115 [286]	116 [289]	117 [290]	118 [293]	
		* 57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm [145]	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04			
		** 89 Ac [227]	90 Th 232.04	91 Pa 231.04	92 U 238.03	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]			