

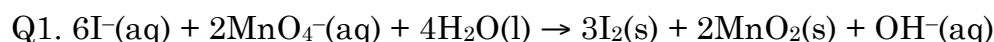
Exam 4

Chem 1142

Fall 2008

Name: _____

MULTIPLE CHOICE. [4 pts ea.]



Which of the following statements regarding the reaction represented by the equation above is correct?

- a) Iodide ion is oxidized by hydroxide ion.
- b) MnO_4^- is oxidized by iodide ion.
- c) The oxidation number of manganese changes from +7 to +2.
- d) The oxidation number of manganese remains the same.
- e) The oxidation number of iodine changes from -1 to 0.



When the equation for the half reaction above is balanced with the lowest whole-number coefficients, the coefficient for H_2O is

- a) 2
- b) 4
- c) 6
- d) 7
- e) 14

Q3. Which of the following must be true for a reaction that proceeds spontaneously from initial standard state conditions?

- a) $\Delta G^\circ > 0$ and $K_{\text{eq}} > 1$
- b) $\Delta G^\circ > 0$ and $K_{\text{eq}} < 1$
- c) $\Delta S^\circ < 0$ and $K_{\text{eq}} > 1$
- d) $\Delta G^\circ < 0$ and $K_{\text{eq}} > 1$
- e) $\Delta G^\circ = 0$ and $K_{\text{eq}} = 1$

Q4. Which of the following produces an INCREASE in entropy of the system?

- a) $\text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_2\text{O}(\text{s})$
- b) $2\text{O}_2(\text{g}) + 2\text{SO}(\text{g}) \rightarrow 2\text{SO}_3(\text{g})$
- c) $2\text{CH}_3\text{OH}(\text{g}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) + 4\text{H}_2\text{O}(\text{l})$
- d) $\text{I}_2(\text{s}) \rightarrow \text{I}_2(\text{l})$
- e) None of the above.

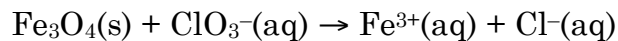
Q5. When a reaction is at equilibrium, which of the following statements is TRUE?

- a) $\Delta G = \Delta G^\circ$ b) $\ln K_{eq} = 0$ c) $\Delta G^\circ = 0$ d) $Q = 0$ e) $\Delta G = 0$

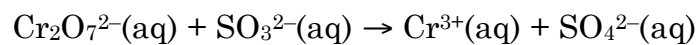
Q6. Which of the following statements about a salt bridge in a voltaic cell is TRUE?

- a) Free electrons flow through the salt bridge to maintain electrical neutrality in the two half-cells.
- b) The salt bridge allows the ions present in the two half-cells to mix extensively.
- c) The wire must be connected directly to the salt bridge in order for the salt bridge to be able to maintain electrical neutrality in the two half-cells.
- d) In some cases, a salt bridge functions as the anode.
- e) Ions from the electrolyte in the salt bridge flow into each half-cell to maintain

Q7. [10 pts.] Balance the following redox reaction in acidic solution using the half-reaction method:



Q8. [10 pts.] Balance the following redox reaction in basic solution using the half-reaction method:



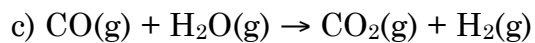
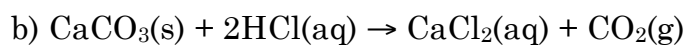
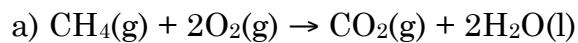
Q9. [10 pts.] Molten NaCl is electrolysed for 3.0 hours using an electrical current of 120 A. How many moles of $\text{Cl}_2(\text{g})$ are formed?

Q10. [6 pts.] Calculate E° for the following cell: $\text{Mg}(\text{s}) | \text{Mg}^{2+}(\text{aq}) || \text{Ag}^+(\text{aq}) | \text{Ag}(\text{s})$

Q11. [10 pts.] Write the cell reaction for the following cell:
 $\text{Mg(s)} \mid \text{Mg}^{2+}(\text{aq}) \parallel \text{Ag}^{+}(\text{aq}) \mid \text{Ag(s)}$

Q12. [10 pts.] A reaction has $\Delta H^{\circ} = +30.3 \text{ kJ/mol}$ and $\Delta S^{\circ} = + 320 \text{ J/mol} \cdot \text{K}$. Calculate ΔG° at 25°C , and 75°C . At what temperature will the reaction become spontaneous?

Q13. [10 pts.] Predict the sign of ΔS° (+ve, -ve, ≈ 0) for the following chemical reactions:



Q14. [10 pts.] Determine the cell voltage produced by the following cell (*where the reactants and products are not in their standard states!*) at 298 K:

Useful Information: $E^\circ_{\text{Cr}^{3+}, \text{Cr}} = -0.74 \text{ V}$, $E^\circ_{\text{Cu}^{2+}, \text{Cu}} = +0.34 \text{ V}$



BONUS QUESTION: A chemical reaction has $\Delta G^\circ = -3.4 \text{ kJ/mol}$ at 25 °C. What is its equilibrium constant?

Useful information

$$\Delta G = -nFE_{\text{cell}}$$

$$\Delta G^{\circ} = -nFE^{\circ}_{\text{cell}}$$

$$E^{\circ}_{\text{cell}} = \frac{RT}{nF} \ln K$$

$$E_{\text{cell}} = E^{\circ}_{\text{cell}} - \frac{RT}{nF} \ln Q$$

$$E^{\circ}_{\text{cell}} = E^{\circ}_{\text{cathode}} - E^{\circ}_{\text{anode}}$$

$$F = 96,500 \text{ C/mol e}^{-}$$

$$h = 6.626 \times 10^{-34} \text{ J s}$$

$$R = 8.3145 \text{ J mol}^{-1} \cdot \text{K}^{-1}$$

$$Q (\text{charge}) = I t$$

$$E = h\nu \quad c = \nu\lambda$$

$$c = 2.998 \times 10^8 \text{ m s}^{-1}$$

$$N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$$

Periodic Table of the Elements

1 H 1.00794																	2 He 4.002602
3 Li 6.941	4 Be 9.012182											5 B 10.811	6 C 12.0107	7 N 14.00674	8 O 15.9994	9 F 18.998403	10 Ne 20.1797
11 Na 22.989770	12 Mg 24.3050											13 Al 26.981538	14 Si 28.0855	15 P 30.973762	16 S 32.066	17 Cl 35.4527	18 Ar 39.948
19 K 39.0983	20 Ca 40.078	21 Sc 44.95591	22 Ti 47.867	23 V 50.9415	24 Cr 51.9961	25 Mn 54.938049	26 Fe 55.845	27 Co 58.9332	28 Ni 58.6934	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.92160	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.4678	38 Sr 87.62	39 Y 88.90585	40 Zr 91.224	41 Nb 92.90638	42 Mo 95.94	43 Tc [98]	44 Ru 101.07	45 Rh 102.9055	46 Pd 106.42	47 Ag 107.8682	48 Cd 112.411	49 In 114.818	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90447	54 Xe 131.29
55 Cs 132.90545	56 Ba* 137.327	71 Lu 174.967	72 Hf 178.49	73 Ta 180.9479	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.217	78 Pt 195.078	79 Au 196.96655	80 Hg 200.59	81 Tl 204.3833	82 Pb 207.2	83 Bi 208.98038	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 [285]	114 [285]	115 [289]	116 [289]	117 [293]	118 [293]
		57 La 138.9055	58 Ce 140.116	59 Pr 140.90765	60 Nd 144.24	61 Pm [145]	62 Sm 150.36	63 Eu 151.964	64 Gd 157.25	65 Tb 158.92534	66 Dy 162.50	67 Ho 164.93032	68 Er 167.26	69 Tm 168.93421	70 Yb 173.04		
		89 Ac [227]	90 Th 232.0381	91 Pa 231.03588	92 U 238.0289	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]		