Brooklyn College Chemistry Department

Second Lecture test in chemistry 2. Spring 2003. Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Part I: Multiple Choice and fill -in questions. These must be answered in the spaces provided with the questions. (1 and 1/3 pts each)

For the following questions, 6 to 13, the answers are +, –, or 0.

\_\_\_0\_\_\_\_6. ℰ̊, the standard reduction potential, for the half reaction 2 H+(aq) + 2 e– ➞ H2(g)

\_\_\_\_0\_\_\_7. ΔGof , the free energy of formation, of N2(g)

\_\_\_\_\_-\_\_8. ΔH̊f, the standard enthalpy of formation, of CO2(s)

\_\_\_\_\_-\_9. ℰo for the reaction 2 Ag(s) + 2 H+(aq) ➞ H2(g) + 2 Ag+(aq), given that the equilibrium constant for this reaction is 9.4 x 10**–**28 .

\_\_\_-\_\_\_\_10. ΔGof of NH3(g), given that the equilibrium constant for the reaction

 N2(g) + 3 H2(g) ➞ 2 NH3(g) is 6.7 x 105

\_\_\_\_+\_\_\_11. S̊ , the standard molar entropy of NaCl(s) at 298 K.

\_\_\_\_\_-\_\_12. ΔS̊ for the reaction 2 Na(s) + Cl2(g) ➞ 2 NaCl(s)

\_\_\_\_0\_\_\_13. ℰ, the cell potential, for the reaction Zn(s) + Cu2+(aq) ➞ Zn2+(aq) + Cu(s) **at equilibrium.**

14 to 16 are fill ins.

\_\_0.63v\_\_\_\_\_\_14. What is the standard potential, ℰ̊, for the reaction Zn(s) + Pb2+(aq) ➞ Zn2+(aq) + Pb(s) ?

\_\_Pb2+\_\_\_\_\_\_15. Identify the oxidizing agent in the reaction given in question 14.

\_\_\_\_\_B\_\_16. A voltaic cell uses the reaction above. Which of the following would ***decrease*** the voltage output of the cell? A) the [Pb2+] is increased B) the [Zn2+] is increased. C) the mass of Zn(s) is increased D) the mass of Pb(s) is decreased

\_\_\_\_\_\_C\_\_17. When set up as shown in the diagram to the right, the cell produces a voltage of A) 0.76 V B) 0.42 V C) 1.10 V D) 0.34 V

\_\_\_\_\_A\_\_\_18. Electrons flow in this cell

A) from Zn to Cu B) from Cu to Zn C) from Zn to Zn2+ D) from Cu2+ to Cu

\_\_\_\_\_\_B\_\_19. Assume that the salt bridge

contains a solution of KNO3. Which choice correctly describes the flow of the ions in the salt bridge? A) The K+ flows toward the zinc half cell, while the NO3– flows toward the copper half cell. B) The K+ flows toward the copper half cell, while the NO3– flows toward the zinc half cell. C) Both ions flow toward the zinc half cell D) Both ions flow toward the copper half cell.

\_\_\_\_D\_\_\_20. In this cell, the copper strip is best described as A) the negative pole, and the anode B) the positive pole, and the anode C) the negative pole, and the cathode

D) the positive pole, and the cathode.

\_\_\_\_\_B\_\_21. As this cell produces electricity, the intensity of the color in the copper half cell will A) increase B) decrease C) stay the same.

\_\_\_\_A\_\_\_22. If the initial concentration of Zn2+ ion in the cell had been 0.010 M instead of 1.0 M, the initial voltage in the cell would have been A) greater than ℰ̊ B) less than ℰ̊ C) the same as ℰ̊

\_\_\_\_D\_\_\_23. For which of the following processes are ΔG̊ , ΔH̊, and ΔS̊ all positive in

 sign at 25̊C ? A) melting of ice B) condensation of water vapor

 C) freezing of water D) decomposition of liquid water to hydrogen and oxygen gas.

\_\_\_\_B\_\_24. Reactions for which the signs of ΔH and ΔS are **both** negative will be spontaneous

A) at high temperatures B) at low temperatures C) at all temperatures D) at no temperatures

\_\_22 J/mol K\_\_\_\_\_\_\_25. ΔH̊ for the melting of ice at 0̊C, (the heat of fusion) is 6.0 kJ/mole.

 What is ΔS̊ for the melting of ice at that temperature?

\_\_\_\_A\_\_\_\_\_28. Based on the reduction potentials provided, which is the strongest reducing agent of the following? A) Mg(s) B) Pb(s) C) Zn(s) D) Cu(s

\_\_\_A\_\_\_\_\_\_29. Based on the reduction potentials provided, which is the strongest oxidizing agent of the following? A) Fe3+ B) Mg C) Cu2+ D) Pb

\_\_\_\_+4\_\_\_\_\_30. What is the **oxidation state** of the tin in the complex with the name hexacyanostannate (IV) ?

Problems: I. Complete and balance the following equation in acidic solution:

 Cr2O72–(aq) + Fe2+(aq) ➞ Fe3+(aq) + Cr3+

 Cr2O72- + 14 H+ + 6 e- → 2 Cr3+ + 7 H2O

 6x ( Fe2+(aq) ➞ Fe3+(aq + e -)

Cr2O72–(aq) + 6 Fe2+(aq) +14 H+ ➞ 6 Fe3+(aq) + 2 Cr3+ + 7 H2O

(8 pts, 3,2,3)

 B. For the balanced redox equation above, what is the value of ℰ̊ ?

1.33 - .77 = 0.56 v

 C. What is the equilibrium constant for the balanced equation above?

 **n = 6 0.56 = 0.0592/6 log K. K = 5.7 x 1056**

 II. Balance in basic solution: CN–(aq) + MnO4–(aq) ➞ CNO–(aq) + MnO2(s)

 3 CN- + 2 MnO4- + H2O → 2 MnO2 + 3 CNO- + 2 OH-

(3 pts)

III. For the reaction 2 Cr(s) + 3 Pb2+(aq) ➞ 3 Pb(s) + 2 Cr3+(aq)

(10 pts, 2,3,5)

 A. Find ℰ̊ ( should say ℰ̊o ) Cr is not on chart I gave you. Cr3+ + 3 e- →Cr, Eo = -0.74

 You also need Pb2+ + 2 e- → Pb, Eo = - 0.13

 Eo = -.13 + 0.74 = 0.61v

B. Find ΔG̊ = - 6 x 96500 x 0.61 = - 353 kJ. ( or -353000J )

 C. Find the values of ΔG **and**  ℰ for the reaction when the [Cr3+] is 2.00 molar,

 and the [Pb2+] is 0.0200 molar.

 E = 0.61 - 0.0592/6 log ( 22)/ 0.02)3 = 0.55 volts

VI. For the combustion of liquid ethanol, C2H5OH(*l*) + 3O2(g) ➞ 2 CO2(g) + 3 H2O(*l*)

 A. Find ΔG̊, ΔH̊, and ΔS̊ at 298.15 K. -1324.47 kJ -1366.85 kJ -142 J/K

(10 pts, 2,2,2,4)

 B. Find the standard molar entropy, S̊, of O2(g) .

 -142 = 2 x 213.6 + 3 x 69.96 - 160.7 - 3 x.

 X = 206 J/mol K

VIII. Use the thermodynamic data given to calculate the normal boiling point of C2H5OH.

 (assume that ΔH̊ and ΔS̊ of vaporization are not significantly affected by temperature

 change)

 At boiling point there is equilibrium, so DG is 0, and DH = T DS.

 T = DH/DS = boiling point. But the data for C2H5OH(g) is missing.

 (3 pts)

IX. A. Draw the structures of **two** isomers of dichlorobis(ethylenediamine)iron (III).

 (you may represent the ethylenediamine with the abbreviation “en.”

(12 pts)

 B. Which of these isomers, if any, is optically active? The cis.

 C. What is the charge on the complex ion you have drawn? **1+**

 D. Give the correct names of the compounds.

 1. Na4[CoCl6] Sodium hexachlorocobaltate(II)

 2. [Ag(NH3)2]Cl Diamminesilver (I) chloride.

Extra credit, 1 pt each. Give the first names of Faraday, Gibbs, Volta, and Galvani.