Study Guide for chapter 7

1. Electrolysis involves both oxidation (at anode) and reduction (at cathode) reactions. The anode is hooked up to the positively charged electrode and the cathode is hooked up to the negatively charged electrode (where excess electrons are).

2. In the electrolysis of water, what is the reaction at cathode and what is the reaction at anode? What is the net reaction?

3. What are strong and weak electrolytes? What is a nonelectrolyte?

4. Molar conductivity decrease with concentration. Use a hand-waving argument to explain it.

5. Compare Debye-Huckel-Onsager equation for strong electrolyte solutions with the Arrhenius theory and Ostwald dilution law for weak electrolyte solutions (7.11 and 7.20). As to the latter, what is the relationship between Λ/Λ^0 and c? Which solution has a more pronounced falls of Λ vs c: weak or strong electrolytes? Why? Hint: Compare the derivative of Λ/Λ^0 with respect to c.

6. Ion-pair formation (also known ion association) lowers conductivity of the solution. The molar conductivity of NaCl in benzene is greater or smaller than that in water? Is the molar conductivity of NaCl in ethanol greater or smaller than that in benzene? Does heating increase or decrease the conductivity? How about adding another salt?

7. Debye-Hueckel theory explains the dependence of conductivity

on concentration for a dilute solution of strong electrolytes. What are the two effects that the theory is accounting for?

8. Debye-Hueckel-Onsager theory offers a quantitative relation between the molar conductivity and concentration for strong electrolyte solutions. Contrast it with Arrhenius theory for weak electrolyte solutions. Notice that both theories are only valid for dilute solutions.

9. If we dilute the solutions to infinity, the solution becomes water only. What is the molar conductivity of such solution? Is it the same as Λ^0? Explain.

10. Hydration (also known as solvation) of ions. $\Delta_{hydr}G$ is the free energy of transferring an ion from vacuum to water. a) What is the sign of the absolute $\Delta_{hydr}G$ for an ion? b) $\Delta_{hydr}G$ for an ion can be predicted using the Born model (understand Eq.7.89 and Eq. 7.90). How does it depend on the charge and size of the ion? Born model is most accurate for what type of ions?

11. Activity coefficients.

a) Why is it useful? Allows one to use the equations for ideal solutions by replacing the concentration *c* with activity *a* ($a_i=c_i\gamma_i$).

b) Definition of ionic strength? How do you calculate it?

c) How to calculate or predict the activity coefficient and mean activity coefficient? See Debye-Huckel limiting law. See Eq. 7.103 and Eq. 7.111. What is the limitation of the law?