

Problem Set PS12

ISSUED: 12/10/02 Due: 12/12/02

Prof. Darin J. Ulness

Name _____

Instructions. Complete all questions before class on the due date. You are encouraged to work together. Be sure to struggle with the problem before seeking help. Many of the exercises are very similar to problems in the book. Understanding the solution to these problems will be helpful in completing the assigned exercises.

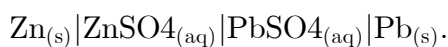
Exercises

1. Derive expressions for the entropy and enthalpy of ion transfer from the α phase to β phase using the Born model.
2. When an ion is distributed between two immiscible phases a Galvani potential is developed between the phases. The standard state Galvani potential is related to the partition coefficient via

$$\Delta_o^w \phi^\ominus = \frac{RT}{zF} \ln P^{w/o},$$

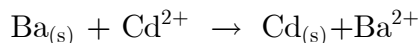
where z is the charge of the ion and F is Faraday's constant.

- (a) Derive the relation between the Galvani potential and $\Delta_o^w G^\ominus$.
 - (b) $\Delta_o^w \phi^\ominus = -168\text{mV}$ for Ph_4As^+ in a water/acetophenone system. What is $P^{w/o}$ for Ph_4As^+ ?
 - (c) $\Delta_o^w \phi^\ominus = 168\text{mV}$ for Ph_4B^- in a water/acetophenone system. What is $P^{w/o}$ for Ph_4B^- ?
3. Write down the redox reaction and cell potential for



Also give the maximal amount of work this cell can produce and K_a for the reaction.

4. Write

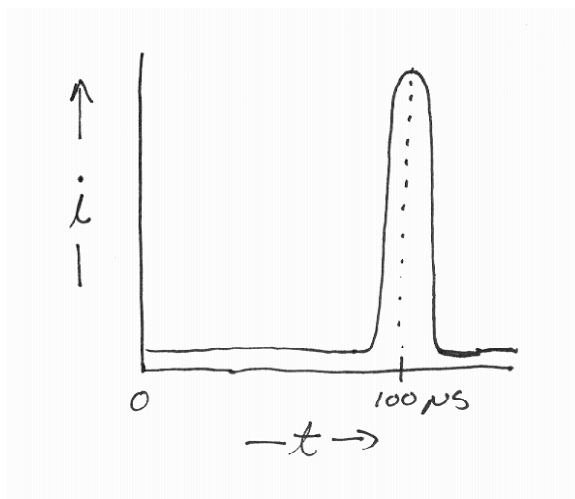


in shorthand cell notation. Also give the maximal amount of work this cell can produce and K_a for the reaction.

Conceptual Problems

5. Will a salt become more soluble or less soluble in water if you add methanol? Explain why in terms of the Born model.
6. In your own words, explain the electrophoretic and relaxation effects as they apply to ion mobility.

7. In a photoconductivity experiment a pulsed laser is focused into a 5 cubic millimeter region of a solution of para-benzoquinone (pbq) in *n*-hexane contained between two parallel metal plates (1 cm apart). The voltage difference between the plates is 5000 V. The pulsed laser acts to ionize the pbq molecules by ejecting an electron. An amp meter timed with the pulsed laser (the pulse occurs at $t = 0$) yields the trace shown below.



- (a) Assuming the laser is focused exactly between the two plates what is the velocity of the pbq^+ ion?
- (b) What is the mobility of the pbq^+ ion?

Reflective Exercises

8. I say that taking PChem makes one a better person. What do I mean by that?
9. Considering the field of physical chemistry (not necessarily this particular course)
- (a) Can you list at least one *fact* you learned that you think you might need to know in the future?
- (b) Can you list at least one *skill* that you have learned or developed that you think might be of use to you in the future?
10. It is quite likely that over time you will forget how to derive Maxwell relations and that you will never need to derive them ever again. Was there any point in learning how to derive them in the first place?