Homework 6
Due Tuesday, February 19th

Instructions: write up solutions to all problems below. Neatness counts: be sure to follow guidelines for homework in the syllabus.

Reading Assignment: 5.4, 5.2, 5.3.

Solving the Diffusion equation. Recall that we modeled the diffusion of a chemical across a cell membrane with the following idea:

The rate of change of the concentration is proportional to the difference between the concentration and the ambient concentration.

This homework assignment aims to tie together many of the concepts we've encountered already.

1. Express this idea as a differential equation. [Hint: we did this on day 1.]

2. Identify which quantities are variables (state and independent) and which are *parameters*.

3. Find the equilibria for this differential equation, and make a phase line. Are the equilibria stable, unstable, or half-stable? [Since you have parameters instead of actual numbers, you must explain how you come up with your phase line.]

4. Find the general solution using the method of separation of variables.

5. Show mathematically that these solutions tend to the equilibrium value, thus confirming your answer to part (3). [Note: you actually observed this numerically back in homework 2. This time you found the actual formulas for the solutions, and you should argue using limits as $t \to \infty$.]