Mixing Problem: Compartment Model

Math 210

February 2, 2011

A tank with 100 $m^3$ of water contains pollutant at a concentration of 0.6 $gm/m^3$. Cleaner water with a pollutant concentration of 0.15 $gm/m^3$ is pumped into the tank at a rate of 5 $m^3/sec$. Water flows out of the tank at the same rate it is pumped in. The tank remains well mixed through out.

Part I: WHAT TO DO WHEN YOU DO NOT KNOW WHAT TO DO? Make a list with your team the steps you might take to get started on the problem. Do not actually start doing the steps yet.

Part II.

a. Determine the amount of pollutant in the tank as a function of time.

b. What is the long term behavior of the system?

c. At what time will the concentration in the tank be .3 $gm/m^3$?
WHAT TO DO WHEN YOU DO NOT KNOW WHAT TO DO? 1. Make a diagram illustrating the problem.

2. Link the information given in the problem to the diagram. Have you used all the information that was stated in the problem?

3. Decide which variables and perhaps constants you will need in the problem. Look at what the problem is asking you to find for clues as to what variables you might want to use.

4. Set up a differential equation involving the rate of change of the variable. In a compartment problem, there is usually a rate of change in and a rate of change out.

5. Solve the differential equation to get a general solution.

6. Use the data from the problem (such as initial conditions) to find the values of constants that appear in the general solution. In this way, one gets the particular solution.