Mathematics 116 Name: _____
Professor Alan H. Stein
Due Wednesday, March 5, 2008 This problem set counts for half the first exam.

Make sure that you check the course website for instructions, fill out the pledge form and hand it in with your paper. The instructions for problem sets and take-home examinations along with the pledge form are available from the *General Policies* portion of the web site. *No paper will be accepted without a signed pledge form.* Remember that your paper may be handed in before the deadline but that no late papers will be accepted regardless of the reason. The course website also includes an explanation of how your average will be calculated if you fail to complete this assignment.

Note that, since most of the calculations involved can be done routinely using either a calculator or a symbolic manipulation program such as Maple or Mathematica, it will obviously be necessary to show, through your work, exactly how you came up with your solutions.

1. Consider the Barkhamsted-New London Landfill, which is on the EPA's National Priorities List. Locate the site on a map and obtain driving directions to it. Briefly describe the site and the reasons it is on the NPL. Describe the remediation steps taken and the current status of the site.

2. (*Note: This is an artificial problem and the results obtained will not necessarily seem reasonable.*) Consider an underground sand aquifer 50 feet thick and 75 feet wide. Suppose the hydraulic head at one point is 110 feet while the hydraulic head 100 feet downstream is 90 feet.
   (a) Determine the hydraulic gradient.
   (b) Determine the minimum and maximum possible values for the flux.
   For the rest of this question, assume that the flux is the average of the two values you obtained in the first part.
   (c) Determine the volumetric flow rate.
   (d) Based on the range of possible porosities for gravel, determine the maximum possible interstitial velocity.
   For the rest of this question, assume the value you just obtained is the actual interstitial velocity.
   (e) Approximately how long will it take for water to travel from the place where the hydraulic head is 110 feet to where the head is 90 feet?
   (f) Suppose it is discovered that approximately 20 pounds of a toxic chemical has been leeching into the aquifer per week. Find the long term average concentration of the chemical, measured in both pounds per cubic foot and parts per million.

3. Consider an aquifer where the water moves from point A to point B along a path that may be divided into four segments. The hydraulic conductivity is 40 feet per day, the porosity is 0.2, the hydraulic heads go from 100 feet to 95 feet to 90 feet to 85 feet to 80 feet and the segment lengths are 200 feet, 400 feet, 300 feet and 100 feet.
   (a) Determine how long, measured in days, it takes for water to travel the length of each segment along with the time it takes to travel the entire path.
   (b) What can you say about the variation in the cross-sectional area of the aquifer?

4. Consider the following one-dimensional di□usion problem. Fifteen (15) grams of a contaminant is released into a liquid which fills a long tube. The di□usion constant is D = 0.14 cm^2/sec. Calculate the concentration of the contaminant 0.25, 0.5, 1, 1.5 and 2 cm from the point of release of the contaminant 1, 5 and 10 seconds after the release of the contaminant.

5. Research the February 12 tractor-trailer accident involving the release of compressed hydrogen gas. Find the time and location of the accident. Describe the weather conditions, including the temperature, and precipitation and wind conditions. Find the amount of hydrogen gas released and the number of homes evacuated. Critique the response of the emergency services.