Math 242 **Group Project # 1** **Spring, 1995**

These problems are to be solved collaboratively in your outside groups. It will be due in class Tuesday March 14. You may use other books, computers, and calculators. You grade will will depend on the correctness of the solution, quality of the exposition, and evidence of collaboration. In particular there should be detailed explanations of why the differential equations you use are the correct ones.

Consider a very tall cylindrical tank whose base is a disk of one meter. The bottom of the tank has a circular hole of radius 10cm which is plunged with a piece of plastic. (Recall that one liter is .001m^3). With the tank empty we start to pump water into it at a rate of .2m^3/sec=200L/sec. When the water reaches a height of 5m the plastic plug comes out and water starts to come out of the bottom according to Torricelli's law (but there is still a flow of 200L/sec coming into the tank). Use for the value of acceleration due to gravity $g := 9.8\text{m/sec}^2$. Answer the following

1. How long before the plug comes out?
2. When the plug comes out does the water level continue to increase, or does it start to go down?
3. Is there a limiting depth for the water as time increases? Does the depth ever become as large as 100m?
4. Can you find a formula for the depth t seconds after the plug comes out? Is it possible to answer the questions above without using the formula?
5. What happens to the final level of the water if the radius of the base if doubled?
6. What happens to the final level of the water if the radius of the hole in the bottom is doubled?