M331 Problem Set Number 1

1. Suppose that the Society for the Promotion of Studies of Societies starts at time $t = 0$ with x_0 charter members. The members are avid recruiters and, except for one sad circumstance, the membership would doubtless increase at a rate proportional to the membership. The sad fact is that the world contains only M persons who can be induced to join and the society grows slowly when the membership is near M because it is not easy to find recruits. The Society proposes to study itself and seeks a model for its membership growth. Following the steps outlined in class:

   a) Formulate the problem in the proper variables.

   b) Write down a satisfactory model.

   c) Solve the model equation.

   d) Verify either using the result in part c), or by a qualitative analysis of the model itself, that the model satisfies the Societies predicted growth pattern.

   e) How long does your model predict that it will take the Society to recruit all potential members? (Modified from Agnew, 1960).

2. Text, page 31 problem no. 11

3. Text, page 31 problem no. 15

4. Text, page 34 problem no. 30. Select 2 forms for $A(h)$, the area of the upper surface of the water. For example, consider the basin to be a cylinder, a sphere or a cone. Compare your results.

5. Text, page 35 problem no. 34

6. Text, page 35 problem no. 37