Problem Set 4
Applied Mathematics I, MA 531
Due December 8, 2010

Do the following problems from the text, *Advanced Engineering Mathematics*, 2nd edition, by M. Greenberg.

Section 7.2: 4b, 5d,f
Section 7.3: 1b,c,f, 9c,e,j, 11b,e,f
Section 7.4: 2b,f,h, 4b, 7a
Section 7.5: 4b,c
Section 7.6: 4

In addition, answer the following question.

1. Consider the following predator-prey model:

$$\frac{dx}{dt} = 200x - 4xy, \qquad \frac{dy}{dt} = -150y + 2xy$$

where x represents the prey and y the predator population.
a) Find the critical points of the system and classify them according to their type. Notice that the populations of both species oscillate about an equilibrium.
b) Suppose that x is a pest and that you introduce a pesticide that kills both x and its natural predator y indiscriminately at a rate $k > 0$. The new equations are

$$\frac{dx}{dt} = 200x - 4xy - kx, \qquad \frac{dy}{dt} = -150y + 2xy - ky, \qquad k > 0.$$

Find and classify the critical points associated to this system. Compare the equilibrium here to the one you found in part (a) - how has it changed? Comment on the irony.