M331 Problem Set Number 2

1. Text, page 34 problem no. 29.

2. Text, page 35 problem no. 33. Solve this problem via the integrating factor method. Plot $i(t)$ for large t and interpret the solution, or output (effect), in terms of the driving force, or input (cause).

3. Recompute the solution to the above circuit problem by computing a general solution of the form

$$i(t) = i_p(t) + i_h(t)$$

where $i_p(t)$ is a particular solution to the non-homogeneous problem and $i_h(t)$ is a general solution to the homogeneous problem. Assume $i_p(t) = A\cos(\omega t) + B\sin(\omega t)$ and determine the coefficients (constants) A and B in terms of the circuit parameters.

4. Recall the differential equation derived for the *parabolic mirror*

$$\frac{y}{x} = \frac{2y'}{1-(y')^2}$$

Go through the details of the steps required to make y' the subject of the formula. Let $w = x^2 + y^2$ and reformulate the ode in terms of w', w and x. Solve the resulting differential equation presenting your answer as a function of the original variable $y(x)$.

5. Consider the drifting boat problem as discussed in class with a the velocity of the river and b the speed of the boat. By considering the cases $a = b, a > b$ and $a < b$ discuss the conditions under which the boat actually reaches the opposite bank.