Unified Engineering Fall 2007
Signals & Systems Problems

Assigned: Friday, November 9
Due: Friday, November 16

Problem S5.1: Look-ahead to Lectures 11 and 12 (10 points)

Reference: Prof. Hall's linear algebra primer, available on the Signals & Systems webpage; your 18.03 notes.

(a) Consider the differential equation

$$\frac{d^2y}{dt^2} + y = 0.$$

(i) Write this differential equation as a system of first-order differential equations in the form

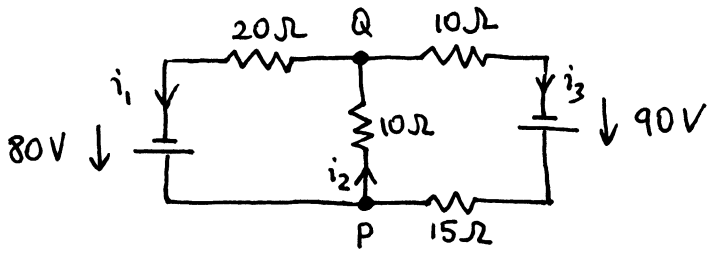
$$\dot{\vec{x}} = A\vec{x}.$$

(ii) Compute the eigenvalues and eigenvectors of your resulting system matrix A.

(iii) To determine the response of the system, how many and what initial conditions must be specified?

(iv) What will be the general form of the system response $y(t)$?

(b) For the following circuit:



currents i_1, i_2, i_3

(i) Apply Kirchoff's current law to Node P and Node Q (using the notation and current directions given in the figure).

(ii) Apply Kirchoff's voltage law to the left loop and the right loop.

(iii) Write your four equations as a matrix system of the form $A\vec{x} = \vec{b}$, where the unknowns are the currents i_1, i_2, and i_3.

(iv) Apply Gauss elimination to your matrix system to convert it to upper triangular form. Then use back substitution to determine the values of the currents.