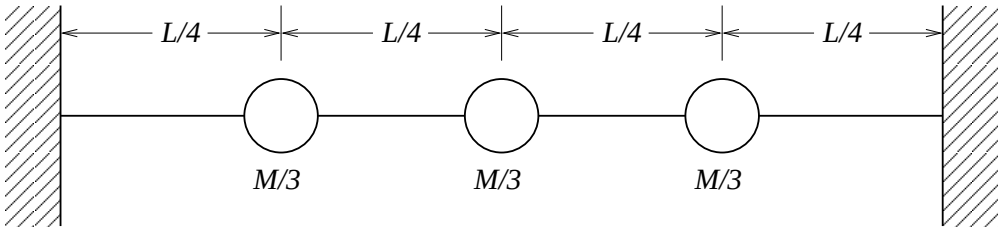
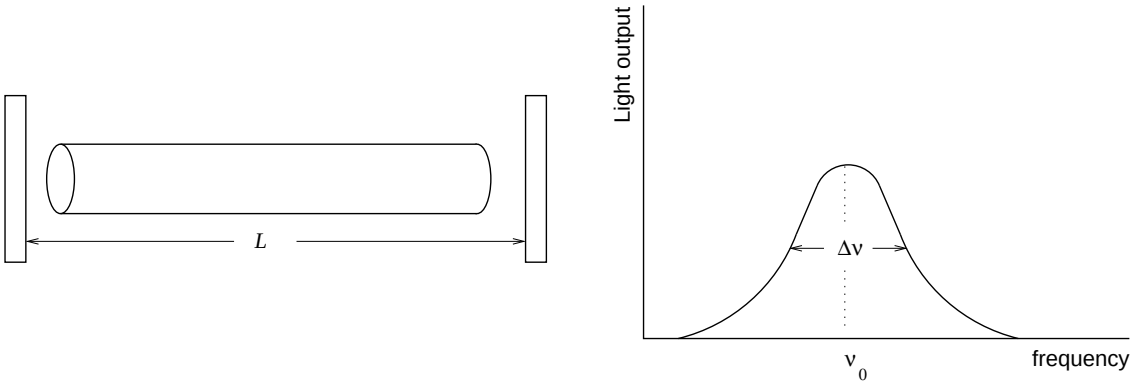
Physics 422 - Spring 2013 - Assignment #5, Due February 15st

1. (*French, 6-2*) A string of length L and total mass M is stretched to a tension T. What are the frequencies of the three lowest normal modes of oscillation of the string for transverse oscillations? Compare these frequencies with the three normal mode frequencies of three masses each of mass $M/3$ spaced at equal intervals on a massless string of tension T and total length L as shown:



2. (*French, 6.10*) A laser can be made by placing a plasma tube in an optical resonant cavity formed by two reflecting flat mirrrors, which act like rigid walls for light waves (see figure). The purpose of the plasma tube is to produce light by exciting normal modes of the cavity.



(a) What are the normal mode frequencies of the resonant cavity? Express your answer in terms of the distance L between the mirrors and the speed of light, c.

(b) Suppose that the plasma tube emits light centered at frequency $\nu_0 = 5 \times 10^{14}$ Hz with a spectral width $\Delta\nu$, as shown in the figure on the right. The value of $\Delta\nu$ is such that all normal modes of the cavity whose frequency is within $\pm 1.0 \times 10^9$ Hz of ν_0 will be excited by the plasma tube.

(1) How many modes will be excited if $L = 1.5$ m?

(2) What is the largest value of L such that only one normal mode will be excited, so that the laser will have only one output frequency? Use $c = 3 \times 10^8$ m/s.