

Physics 422 - Spring 2013 - Assignment #2, Due January 25<sup>th</sup>

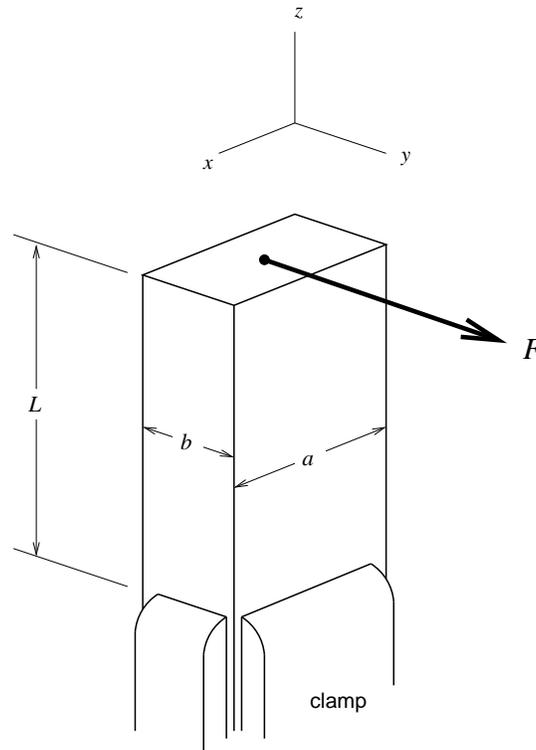
1. (*French 3-10*) A metal rod, 0.5 m long, has a rectangular cross section of area  $2 \text{ mm}^2$ .

(a) With the rod vertical and a mass of 60 kg hung from the bottom, there is an extension of 0.25 mm. What is Young's modulus in  $\text{N/m}^2$  for the material of the rod?

(b) The rod is firmly clamped at the bottom as shown in the figure below, and at the top a force  $F$  is applied in the  $y$ -direction as shown (parallel to the edge of length  $b$ ). The result is a static deflection,  $y$ , given by

$$y = \frac{4L^3}{Yab^3}F$$

If the force  $F$  is removed and a mass  $m$ , which is much greater than the mass of the rod, is attached to the top end of the rod, what is the ratio of the frequencies of vibration in the  $y$  and  $x$  directions (*i.e.*, parallel to the edges of length  $b$  and  $a$ )?



2. The differential equation that describes damped, harmonic motion can be written

$$m\ddot{x} + b\dot{x} + kx = 0$$

If the frequency of free oscillations is written  $\omega_0 = \sqrt{k/m}$ , what value of  $b$  will reduce the oscillation frequency to  $\omega = \omega_0/2$ ?