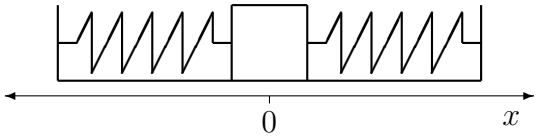
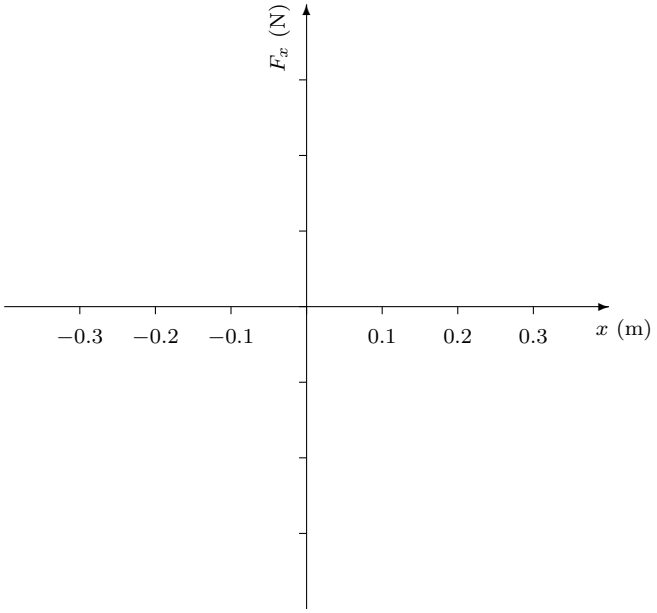
Assignment 1; Phys 186 Name _____

Note: You can ask me for help; for example, have me check if an answer is correct. Talk to me: you'll learn some physics, and that's the point of the course.

1. (30 points) You have a 0.32 kg object attached to two identical springs, each with spring constant 10.0 N/m, at each end as shown in the diagram. The mass oscillates back and forth horizontally on a frictionless surface.



(a) Using the axes given, draw a graph of the total force on the mass F_x vs. the displacement from equilibrium x. Take care to indicate the force direction with appropriately positive or negative quantities. Write in the appropriate numbers on the tick marks on the F_x axis on your graph.



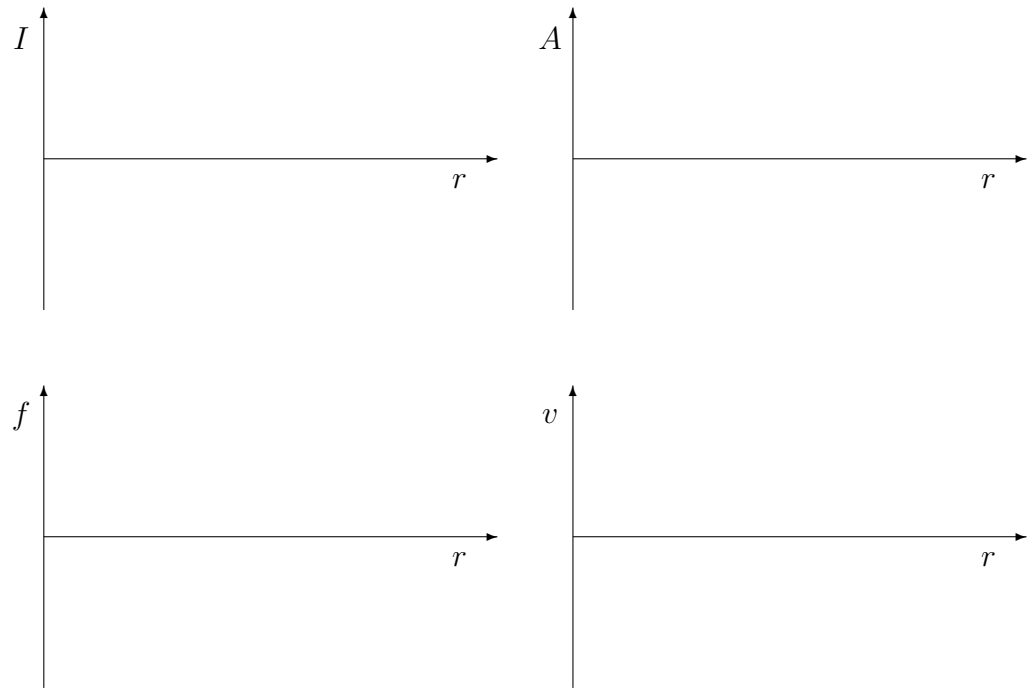
(b) The oscillations of a single spring have an angular frequency $\omega = \sqrt{k/m}$. What is the angular frequency for the oscillations of this double spring setup? Explain.

2. (20 points) You're given a spring, a known mass m_0, and an unknown mass m_1. The only measuring device you have is a stopwatch. Describe an experiment you would design in order to determine m_1. Provide an equation that expresses m_1 in terms of m_0 and quantities you can measure with your stopwatch.

3. (20 points) We characterize waves by their frequency, wavelength, and amplitude. Audible sound has a frequency range of 20 Hz to 20 kHz, wavelengths between 1.7 cm and 17 m, and a minimum intensity of 10^{-12} W/m^2. *Ultrasound* can be used for medical imaging, where it can resolve structures with sizes considerably less than 1 cm. The "ultra" in ultrasound must therefore refer to higher than audible frequency, wavelength, or amplitude—which one? Explain. For the range of values in question, you can take the speed of sound to be constant.

4. (30 points) You have a radio beacon set up in outer space, broadcasting with equal and constant power in all directions.

(a) *Qualitatively* sketch the following graphs of the broadcast waves' intensity, amplitude, frequency, and wave speed vs. the distance r from the beacon.



(b) Give the r-dependence of all four variables. The answer for each should be one of r^2, r^1, r^0 (constant), r^{-1}, or r^{-2}. (*Note:* the symbol "$\propto$" means "proportional to.")

$I \propto$

$A \propto$

$f \propto$

$v \propto$