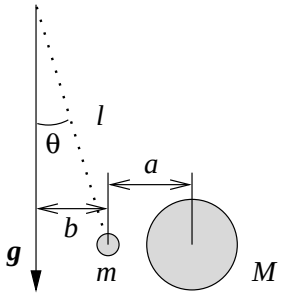
PHY 202 Homework 1

Due Friday, January 24 at SE 316 at noon.

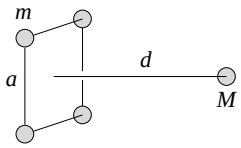
1. Consider a ball-and-string pendulum of length $l = 2\,\mathrm{m}$ and mass $m = 100\,\mathrm{g}$. I have a Lead ball of mass $M = 50\,\mathrm{kg}$ and I bring it to within a distance $a = 10\,\mathrm{cm}$ of the pendulum:



   How far—due to the gravitational attraction of the Lead ball—does the pendulum ball move from its equilibrium position? Compare the distance it moves with the size of a typical atom (about $10^{-10}\,\mathrm{m}$).

   To solve this problem, you should draw a nice big picture, introduce a coordinate system, and express the various force vectors in terms of their components. Be sure to define any symbols you introduce and include a sentence or two explaining what you are doing. In your solution, you can assume that $a \gg b$ (a is much larger than b).

2. Four masses, each of mass m, are arranged in a square of size a,



   Perpendicular to the center of this square, at a distance d, is a fifth mass M.

   (a) Identify any reflectional symmetries of the four masses m, ignoring the fifth mass M. Later on in this class, we will use such symmetries to help us solve problems.

   (b) Find the total gravitational force acting on M from the small masses.

   (c) Sketch a graph of the force as a function of d. Include both positive and negative d on your graph.

3. A test mass m is placed in the *interior* of a spherical shell of mass M. Find the total gravitational force acting on the test mass. You can solve this problem by following the derivation presented in class; the main difference is that the limits of integration are somewhat modified.