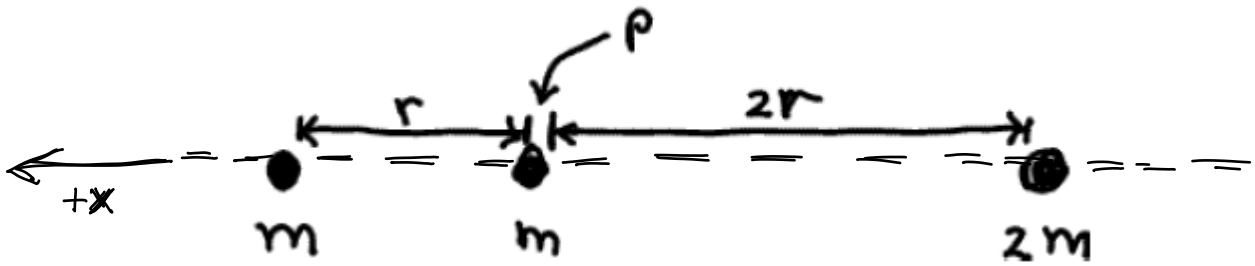
Physics 113 - Fall 2013 – Problems for workshop 6

1. Two objects, each of mass M, lie on the y-axis a distance R away from the x-axis. One mass is at y = +R and the other mass is at y = -R (both at x = 0). A mass m is centered on the x-axis at a distance +x. Find an expression that describes the net force on the mass m (in terms of x, R, M, m, G). Once you have found this expression, convince yourself that it simplifies to what you would expect if x is much larger than R.

2. Three masses lie in a line far away from all other masses, as shown in the sketch below. The middle mass lies at point P.
   a) What is the net gravitational force on the mass located at point P due to the other masses?
   b) What is the net gravitational field at point P? (For simplicity, assume the mass at point P is not present for this part.)



3. A satellite orbits the Earth in a circular geosynchronous orbit. How far is that object from the center of the Earth? How fast is the object moving as it circles the Earth? (Geosynchronous means the satellite appears to be stationary with respect to a point on the Earth's surface.)

4. A machine gun is fired at a steel plate. Is the force on the plate from the bullet impact greater if the bullets bounce off or if they are squashed and stick to the plate? Why?

5. At the big basketball arena, a maintenance man tried out a new type of floor wax that rendered the floor of the court *completely frictionless*. Shaquille O'Neal was standing in the middle of the court dreaming of another NBA championship during the waxing process, and became stranded there. Luckily, he was carrying his NBA Most Valuable Player trophy, which weighs 50 pounds. If O'Neal, who weighs 300 pounds, hurled the trophy away from himself at 6 m/s, how long did it take him to reach the unwaxed edge of the court, 30 meters away?

6. An important thing to learn in the process of becoming a physicist is how to be spacey. So here's a spacey question for you. In a zero-gravity environment, can a rocket-propelled spaceship ever attain a speed greater than the relative speed with which the burnt fuel is exhausted?