1. a,b. Kepler's First Law states that the planets follow elliptical orbits with the sun at one focus. Give prose statements of Kepler's other two laws.

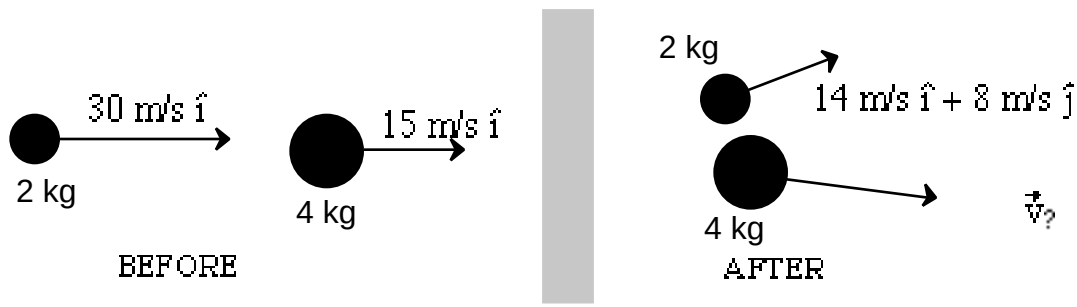
   c. Give an equation that can be used to compute the location of the center of mass of a collection of three point masses

   d. Give a prose statement of any form of the Work-Energy theorem

2. $G = 6.67 \times 10^{-11}\ N\ m^2/kg^2$; $M_E = 5.98 \times 10^{24}$ kg; $r_E = 6.37 \times 10^6$ m

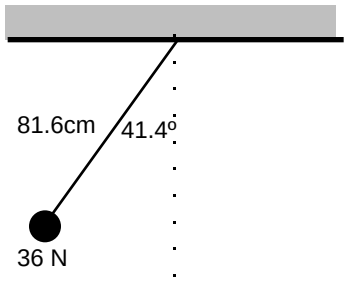
   a. A 1000 kg spacecraft is in orbit 6370 km **above the earth's surface.** Compute the magnitude of the gravitational force on the spacecraft due to the earth.
   b. Give an equation for the gravitational potential energy of the spacecraft.
   c. Assume the spacecraft is in a circular orbit. Write down F = ma and relations about the period of the orbit to derive a relation between the radii of circular orbits about the earth and their periods T.

3.)



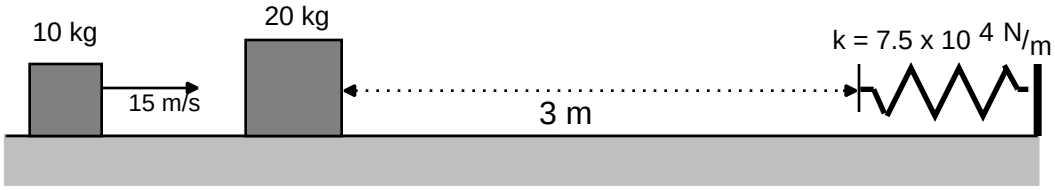
a.) For the collision above, find the unknown final velocity of the 4 kg mass.
b.) Is the collision elastic ? Explain.

4.



A rock with a weight of 36 N is hung from a string of length 81.6 cm. The rock is pulled to one side until the string makes and angle of 41.4° w.r.t. the vertical.
a. It is released. Find its speed as it passes through the low point.
b. Find the string tension as the rock passes through the low point.

over



5. The 10 kg block is sliding at 15 m/s to the right, and it collides with and sticks to a 20 kg block initially at rest. The combo then slides over and compresses the spring until it comes to rest.

   a. How fast is the two block combo moving right after the collision ?

   b. How far is the spring compressed when the combo comes to rest.

   c. Now assume that kinetic friction acts over just the three meters before the blocks hit the spring and that $\mu_k = 0.2721$. How fast will the blocks be moving just as they reach the spring ?

Extra Credit Find the kinetic energy and total mechanical energy of the spacecraft in circular orbit in problem 2.