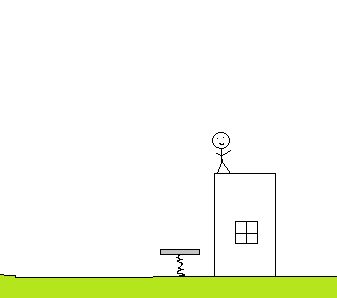
**Homework 4 Due 2/27**

**Problem 1**. Suppose you (mass m = 70kg) step off an 5m tall platform, onto 2m tall spring (k = 2000N/m). Starting time from when you hit the spring…



(a) What will be the new equilibrium position about which you oscillate? This would be the position (y = 0 at ground level) at which the forces on you (spring and gravity) balance.

(b) And what will be your period of oscillation?

(c) What will be the lowest point you reach? Energy conservation?

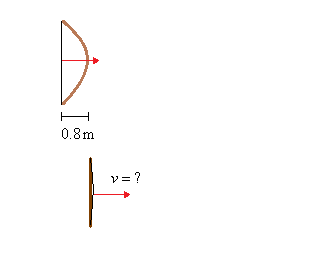
(d) What will be the highest point you reach?

(e) So what will be the amplitude of your oscillation about the equilibrium point?

(f) What is your speed as you pass through the equilibrium point (not of the spring alone, which is at y = 2, but ‘your’ equilibrium point from part a)?

(g) what will be your acceleration at the top of your oscillation? Would you stay on the spring, if you weren’t, say, velcroed on?

**Problem 2.** Say we have an arrow, which has a mass of approximately 100 grams. Then we put it on a bow, and pull it back with an ever increasing force (because bow acts like a spring) until we’ve stretched it to a displacement of 80cm, via force F = 500N.



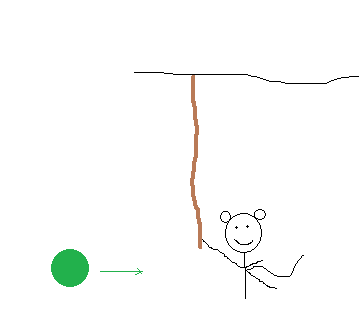
(a) What is the ‘spring constant’ of the bow?

(b) How much spring potential energy does the arrow possess?

(c) How fast will the arrow be going once it’s cleared the bow?

(d) How long does it take for the arrow to be released? Consider how this relates to a ‘period’.

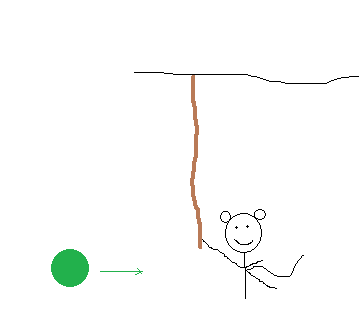
**Problem 3.** A monkey (m = 10kg) hangs on a vine (can treat as a uniform board with mass m = 6kg) of length ℓ = 5m. You throw a watermellon (m = 3kg) horizontally at speed v = 18m/s, which the monkey catches. Remember the formula for center of mass ℓcm = (m1y1center + m2y2center + … + mnyncenter)/(m1 + m2 + …. + mn).



(a) What will be the monkey’s period of oscillation? Don’t think too hard – just hard enough.

(b) What would be the period if the speed of the watermelon were doubled?

**Problem 4.** A monkey (m = 10kg) hangs on a massless vine of length ℓ = 5m. You throw a watermellon (m = 3kg) horizontally at speed v = 18m/s, which the monkey catches. Supposing the catch happens instantaneously….



(a) What will be the monkey’s initial velocity after catching the watermelon? \*Hint: gotta use conservation of something here!

(b) What maximum angle will the monkey reach?

(c) When will the monkey reach this spot? Consider how it relates to a period.