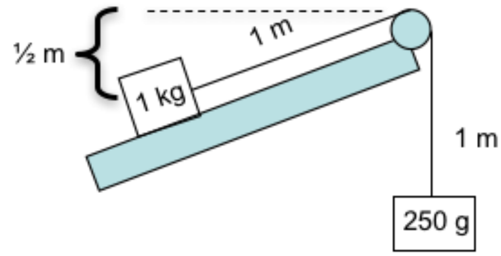
Problem Set #6 due beginning of class, Tuesday, Feb. 20.

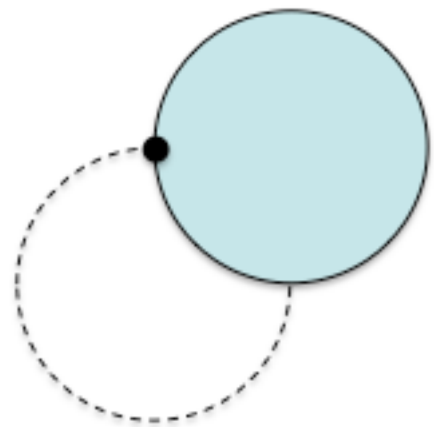
1) Chapter 5.3, Do exercise 1 and 2, but don't hand it in.
2) Chapter 5.3, Exercise 4, Loop the loop
3) Chapter 5.3, Exercise 6, Driving up and down hills in a car
4) Chapter 5.3, Exercise 7, Do you weigh the same at the equator?
5) Chapter 5.4, Exercise 3
6) Chapter 6.0, carefully consider Examples 1, 2, and 3. Then do the following:
   What if there is a coefficient of friction $\boxed{(\mu_d = 0.1)}$ on the 1 kg mass as is slides across the horizontal surface?
   a) How would this change the energy considerations in Example 1? Find the new speed of the system as it hits the ground 1 m below. Then find the time to fall and the acceleration.
   b) How would this change the dynamics considerations of the system? Find the new acceleration directly (is it the same as you found above?) and tension in the string.
7) Consider the system at right where the 1 kg box is on a very slippery table inclined such that if the system moves one meter, the box changes elevation by half a meter.
   a) How does all this change the energy balance equations you set up in Chapter 6.0?
   b) Can you tell me which way the system will acceleration (if at all)? How can you be sure?



8) Chapter 6.1 Example 1
9) Chapter 6.1 Example 2
10) Chapter 6.1 Example 3
11) You won't need to integrate to find center of mass on midterms or final exam. What if the diving board in chapter 6.2 was *not* of uniform thickness, but was thicker at the left end that attaches to pylon A (see image). Imagine that the board smoothly increases from the free end at right, and is three times the thickness (and linear mass density in kg/m) at left than at right. Then where would be the center of mass of the 6 *m* board? You'll use some calculus for this.

   - The first conceptual step will be to put the thickness of the board (and therefore the mass density) as a function of displacement. With the pylon at x = 0, what linear function would define the thickness of the board to be h_o at the origin and $h_o/3$ at x = 6 *m*?
   - How far from pylon A is the center of mass of the board?
   - What about the design of the board tells you that "A" exerts a downward force and "B" exerts only an upward force?
12) Chapter 6.3 Example 1
13) Infamous Tow Truck Problem: A 2-ton Tow Truck pulls a 1-ton car on a smooth level road, with a rope that has a tension of 3000 N on it. If the wheels of the car are free to roll, what coefficient of friction is necessary between the Tow Truck's wheels and the ground? This is a multi-step problem that will require some thought and some drawing.

14) Please thoroughly read 6.3 first. A disk of uniform mass distribution, total mass m_o, and radius R, is secured to a wall with a low friction pivot that allows rotation as shown at right. The disk is started in the higher position where its center is the same height as the pivot and is allowed to drop and swing.

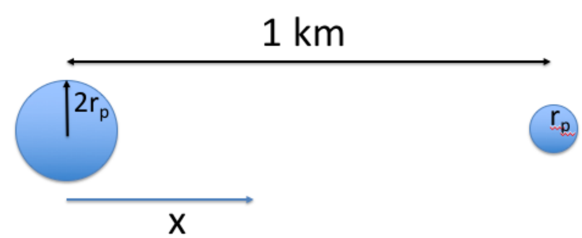


- The moment I let the disk go from the upper position the center of mass accelerates downward. Is a <, =, or > g?
- Please find the angular acceleration of the disk the moment I let it go and from this information find the downward acceleration of the center of mass of the disk.
- Please find the force the pivot point provides to the disk the moment I let go of the disk.
- Does the angular acceleration of the disk remain constant as the disk falls to the lower position? How do you know?

We want to find the force on the pin when the disk is at the bottom location. In order to solve this complicated, multidimensional problem, please consider:

- What is the complete energy transition happening as the disk rotates from top to bottom?
- What is the complete dynamics going on when the disk is at the bottom of the swing? Is the force on the pivot just equal to mg? Why or why not?
- Find the force on the pivot when the disk is in full swing at the bottom. Include direction.

15) You want to put yourself in a place between two planets (1 km apart) where you will not feel any gravitational force. The planets are made of the same substance, but one has twice the radius of the other.



a) How far from the larger planet should you put yourself?
b) Find the position of the center of mass of this two-planet system.
c) Comment on how realistic this scenario is.