PHY121 Summer 2018
Problem Set #5
Due Tuesday 6/5

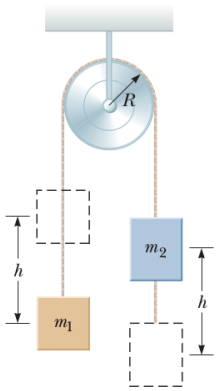
1. We now have the tools to analyze Atwood's machine for a (slightly) more realistic case, by including the mass of the pulleys. Find the accelerations of the following systems:

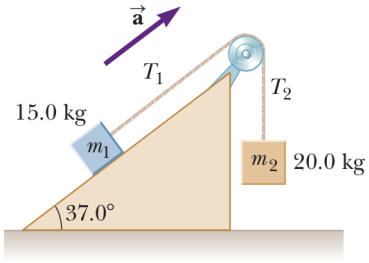
   (a) The standard Atwood machine. (Hint: Start with conservation of energy.)

   (b) Compare the acceleration in part a to the case when the pulley is massless.

   (c) The Atwood machine modified by an inclined plane. (Hint: Find the tensions in each part of the string. You should have a system of three equations with three unknowns.)

   (d) Compare this with the case of a massless pulley.





2. A car drives over a piece of bubblegum, which sticks to the back right tire. The car is initially moving at 55 m/s. The driver then accelerates at a constant rate for 5 s. The final translational speed of the car is 60 m/s. If the driver began his acceleration at $t = 0$ s, determine the full equation of motion for the bubblegum.

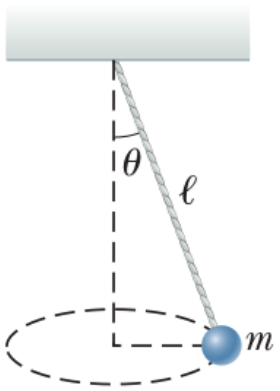
3. The combination of an applied force and friction produces a constant net torque of 42 N·m on a wheel rotating about a fixed axis. The applied force acts for 10 s. During this time, the angular speed of the wheel increases from 0 to 13 rad/s. The applied force is then removed, and the wheel comes to rest in 65 s.

   (a) Find the moment of inertia of the wheel.

   (b) Find the magnitude of the torque due to friction.

   (c) Find the total number of revolutions that the wheel completes during the entire interval of rotation.

4. A conical pendulum is a pendulum wherein the bob makes a circular path in the horizontal plane, with a constant angle to the vertical. Here, a bob of mass m is suspended from a wire of length l and follows the path described. Find the magnitude of the angular momentum of the bob about the vertical axis.



5. We believe that at the end of its lifetime the Sun will become a white dwarf, in the process shrinking to $\frac{1}{100}$ its current radius while maintaining its current mass.

   (a) Determine the ratio of the initial rotation rate to the final rotation rate of the Sun.

   (b) The sun currently rotates once every 26 days. At what rate will the white dwarf be rotating?