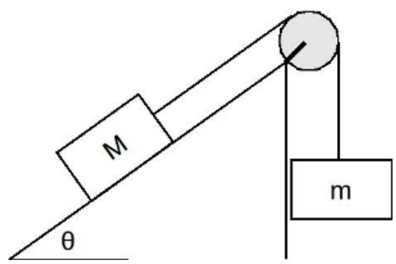
Assignment VI, PHYS 111 (General Physics I)
Fall 2018
Due 10/12/18 at start of class

As always, please put your clearly written answers on separate paper.

1. The figure below should look familiar (from the last homework). The setup to the problem is a bit different this time, though, so read carefully. A triangle wedge of elevation angle $\theta = 50°$ supports a mass M. Connected to mass M via a (massless) string is a second mass m that hangs freely from a frictionless pulley as shown. As was the case last time, the wedge is firmly attached to the Earth (it can't move). This time, however, the interface between mass M and the wedge has friction. Let the coefficient of static friction between the wedge and mass M be given by μ. Let $M = 20.0$ kg and $\mu = 0.10$.

   a) What is the minimum mass m that will prevent mass M from sliding down the slope? (I'm looking for a number here).

   b) What is the maximum mass m that will prevent mass M from sliding up the slope? (Again, I'm looking for a number here).



2. A 7.50-kg block is pushed up an incline that is raised 35° above the horizontal (much like the above picture, but without the hanging block and pulley). The kinetic coefficient between the block and the incline is 0.15. The block is pushed with a purely horizontal force (parallel to the floor, *not* parallel to the contact interface between the wedge and the block). The resulting acceleration of the block is 1.3 m/s^2 up the incline, and – for all parts of this problem – the block is already moving up the slope.

   a) What was the magnitude of the applied force?

   b) How large is the normal force supplied by the wedge on the block? (What is its magnitude)?

MORE ON BACK!

3. Jupiter has a mass of about 1.898×10^{27} kg. The sun has a mass of about 1.989×10^{30} kg. The average Jupiter-Sun distance varies a bit during Jupiter's orbit, but averages about 7.785×10^{11} m.

   a) There is a point somewhere between the sun and Jupiter where the gravitational pull from the Sun is exactly balanced by the gravitational pull from Jupiter in the opposite direction. How far from the center of Jupiter is this point? (where the Sun and Jupiter's gravitational pulls are equal and opposite?)

   b) There is another point – somewhere on the other side of Jupiter (further from the sun) where the gravitational pull from the Sun is exactly the same magnitude AND the same direction as the gravitational pull from Jupiter. (Essentially, Jupiter and the Sun pull objects at this point towards Jupiter with the same force). At that position, how far would an object released from rest at that point fall towards Jupiter in 1 minute?

4. Titan is Saturn's largest moon. It has a mass of about 1.345×10^{23} kg and a radius of about 2.58×10^{6} m.

   a) If Titan is a homogeneous sphere (e.g. if its density is constant), then what is its mass density ρ?

   b) What is the gravitational acceleration near the surface of Titan (a.k.a. what is g_{Titan})?

   c) Let's say a hole is bored 1 million meters from the surface of Titan directly towards its center. A mass $m = 50$ kg is released from rest 999,990 meters below the surface of the planet and falls the remaining 10 meters to the bottom of the hole. How long does it take to fall? (You can assume the gravitational acceleration towards the center of Titan is constant for this fall, but it is *not* the same as the gravitational acceleration you calculated in part (b).)