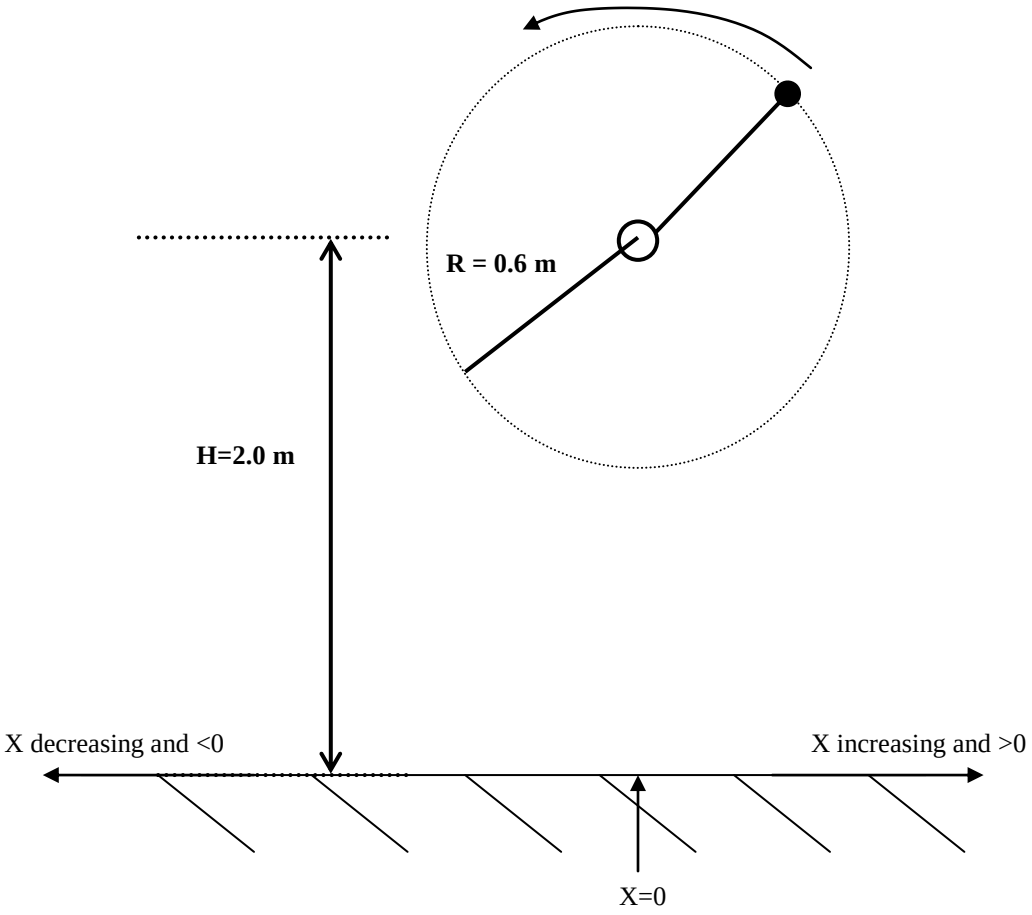
Physics 113 - Fall 2013 - workshop module 4
Circular motion, work

1. A steel ball of mass M=1.2 kg is tethered to the end of a massless cable. The ball is attached to a spinning axle that causes the ball and cable to rotate in a vertical circle as shown below. The ball moves in a circle of radius 0.6 m centered at a height of 2.0 m above a flat surface. The rate of rotation increases VERY SLOWLY until the cable snaps. The cable snaps when the tension in the cable reaches 100 Newtons. Relative to the position of the axle over the floor (x=0 in the sketch), where does the ball hit the floor?



2. A traffic engineer claims that traffic lights timed so motorists can travel long distances between stops will improve air quality in a city. Do you believe this? Why or why not?

3. A car is stopped by a constant friction force that is independent of the car's speed. By what factor is the stopping distance changed if the car's initial speed is doubled?

4. A block of mass M=5 kg is released from rest and slides down a frictionless ramp of height h above the floor. The ramp makes an angle of 30 degrees with the horizontal. At the bottom of the track the block slides along the horizontal floor, around a vertical loop (loop-the-loop). The loop in the track has a radius of 0.2 meters. As the block passes the top of the loop, it never loses contact with the track. Once past the loop, the block encounters a region in the track where there is a rough surface (friction). μ_k between the block and the track in this region is 0.15.

(a) What is the minimum value for h, the starting height of the block above the floor?
(b) Assuming the value of h in part (a), what is the speed of the block at the bottom of the ramp?
(c) How far does the block travel along the part of the track with friction before it comes to a stop?