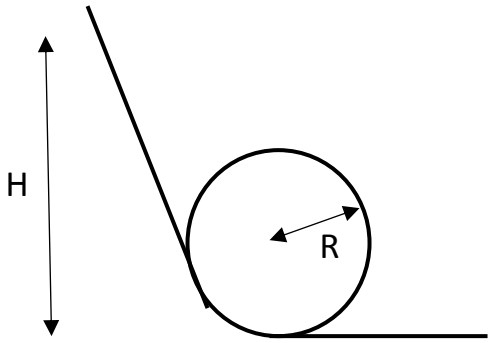
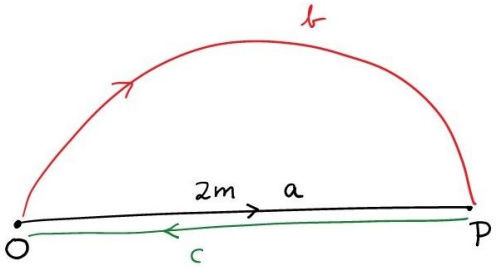
Physics 1135: Homework for Recitation 11: Potential energy

1. In an amusement park ride, a car rolls on the frictionless track depicted in the figure. It starts from rest at height *H* above the ground. Find the minimum value for *H* necessary so that the car moves around the circular loop of radius *R* without falling off. Treat the car as a point mass and express *H* in terms of *R*.

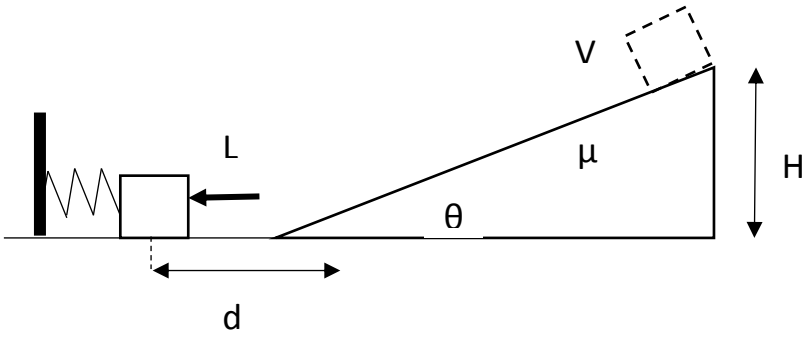


2. A 2kg box is sliding along a horizontal table. The coefficient of kinetic friction between box and table is 0.3. Point P is 2m to the right of the origin O, as shown in the figure (top view of the table). Calculate the work done by friction on the box when it slides

a) from O straight to point P.
b) from O in a half-circle of radius 1m to point P.
c) from O straight to point P then straight back to O.
d) Based on the results of your calculation, is kinetic friction a conservative force or not?



3. A block of mass *M* is pushed against a spring with unknown spring constant, compressing it a distance *L*. When the block is released from rest, it travels a distance *d* on the **rough** horizontal surface and then up a **rough** incline (**both** surfaces have a coefficient of kinetic friction μ with the box). The incline makes an angle θ above the horizontal. When the block reaches height *H* on the incline, its speed is *V*.
Derive an expression for the force constant *k* of the spring in terms of system parameters.



4. A block of mass *m* is on a frictionless incline that makes an angle θ with the vertical. A light string attaches it to another block of mass *M* that hangs over a massless, frictionless pulley. The blocks are released from rest. The block of mass *M* falls onto a vertical spring of spring constant *k* that was a distance *H* below the block at release.

Derive an expression for the speed of the blocks when the spring has been compressed a distance *D*, in terms of system parameters.