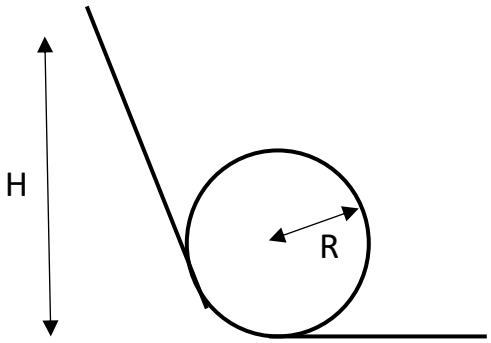
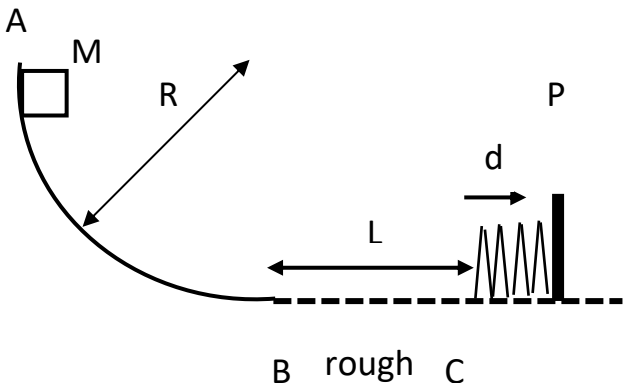
Physics 1135: Homework #11: Potential energy

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*.

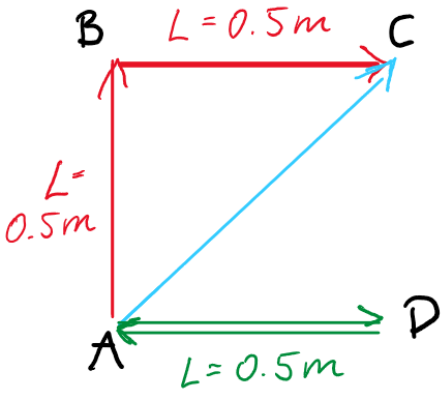


2. A small block of mass *M* is released from rest at point A at the top of a frictionless quarter-circular slide of radius *R*. It slides down to point B and across a rough horizontal surface. After sliding a distance *L* to point C, the block encounters a spring of spring constant *k*, and compresses it a distance *d* before coming to rest at point P. The surface is rough all the way from point B to point P.

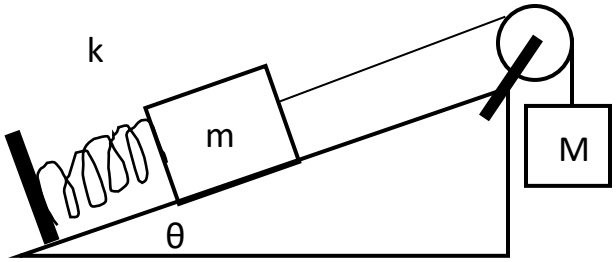
Derive an expression for the coefficient of kinetic friction between the floor and the block, in terms of relevant system parameters.



3. A 2kg box is sliding along a horizontal table. The coefficient of kinetic friction between box and table is 0.3. The figure shows a top view of the table. Calculate the work done by friction on the box when it slides
a) from A straight to B and then to C (red path).
b) from A directly to C (blue path).
c) from A straight to D and then straight back to D (green path).
d) Based on the results of your calculation, is kinetic friction a conservative force or not?



4. A block of mass *m* is on a **rough** incline that makes an angle θ with the horizontal. The coefficient of kinetic friction between the block and the incline is μ. A light string connects it to another block of mass *M* that hangs over a frictionless pulley as shown. The block on the incline is **attached to** a spring of spring constant *k* whose other end is secured to a wall at the lower end of the incline. The blocks are released from rest with the spring in equilibrium position. Their masses are such that the block of mass *M* moves downward as it pulls the block of mass *m* up the incline, stretching the spring.



Derive an expression for the speed of the blocks when they have traveled a distance *H*, in terms of system parameters.