Spring-2018 Phys101
Assignment 7
Check MateringPhysics for other problems
Due date: 28 March 2018.

Discussion questions

1- A compressed spring is clamped in its compressed position and then is dissolved in acid. What becomes of its potential energy?

Hint: Read "Can mechanical energy vanish into thin air?"

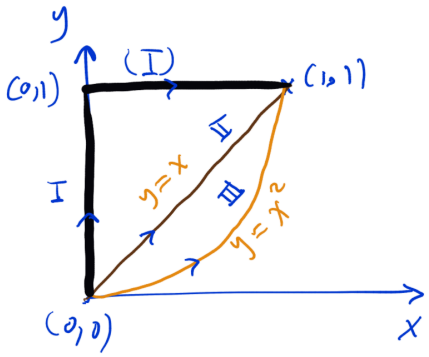
American Journal of Physics 86, 220 (2018); https://doi.org/10.1119/1.5019022

Problems

2- A force has the following spatial dependence

$$\vec{F}(x,y) = xy^2\,\hat{i} + yx^2\,\hat{j}$$

(a) Compute the work done by this force to move an object in a plane from (x,y)=(0,0) to (x,y)=(1,1) along the three different paths, I, II, III, in the figure below using line integrals.



(b) Can you derive a potential function U(x,y) associated with this force?

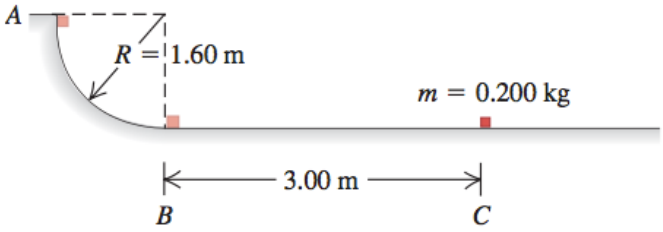
(c) Is this force conservative? Explain.

3- Two blocks with different masses are attached to either end of a light rope that passes over a light, frictionless pulley suspended from the ceiling. The masses are released from rest, and the more massive one starts to descend. After this block has descended 1.20 m, its speed is 3.00 m/s. If the total mass of the two blocks is 15.0 kg, what is the mass of each block?

4- In a truck-loading station at a post office, a small 0.200-kg package is released from rest at point *A* on a track that is one-quarter of a circle with radius 1.60 m. The size of the package is much less than 1.60 m, so the package can be treated as a particle. It slides down the track and reaches point *B* with a speed of 4.80 m/s. From point *B*, it slides on a level surface a distance of 3.00 m to point *C*, where it comes to rest.

(a) What is the coefficient of kinetic friction on the horizontal surface?

(b) How much work is done on the package by friction as it slides down the circular arc from *A* to *B*?



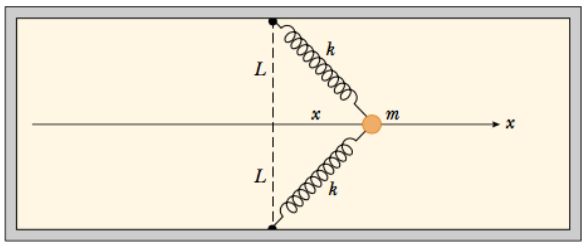
5- A particle of mass **m** is attached between two identical springs on a horizontal frictionless tabletop. The springs have spring constant k, and each is initially unstressed.

a) If the mass is pulled a distance x along a direction perpendicular to the initial configuration of the springs, as shown below, show that the potential energy of the system is

$$U(x) = kx^2 + 2kL(L - \sqrt{x^2 + L^2})$$

b) Use any scientific software to make a plot of $U(x)$ versus x and identify all equilibrium points. Assume that L 1.20 m and k 40.0 N/m.

(c) If the mass is pulled 0.500 m to the right and then released, what is its speed when it reaches the equilibrium point x=0?



Top View

6- A 2.00-kg block situated on a rough incline is connected to a spring of negligible mass having a spring constant of 100 N/m. The pulley is frictionless. The block is released from rest when the spring is unstretched. The block moves 20.0 cm down the incline before coming to rest.

(a) Find the coefficient of kinetic friction between block and incline.

(b) What is its acceleration at its lowest point, just before it stops moving down and just after it starts to move up.