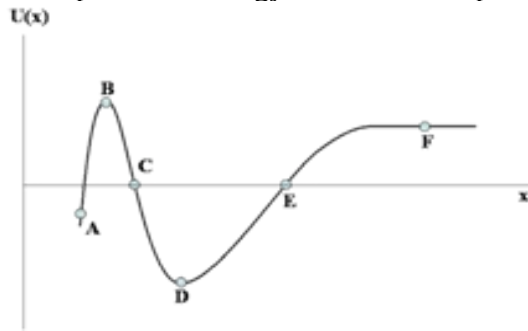


## Energy Problems – Set 4

1

The figure below shows the plot of a potential-energy function for a particle moving along the  $x$ -axis.



a) At each point indicated, state whether the corresponding force  $F_x$  acting on the particle is positive, negative, or zero.

A:	D:
B:	E:
C:	F:

b) At which point does the force have the greatest magnitude? Explain.

c) Identify all points corresponding to stable, unstable, and neutral equilibrium.

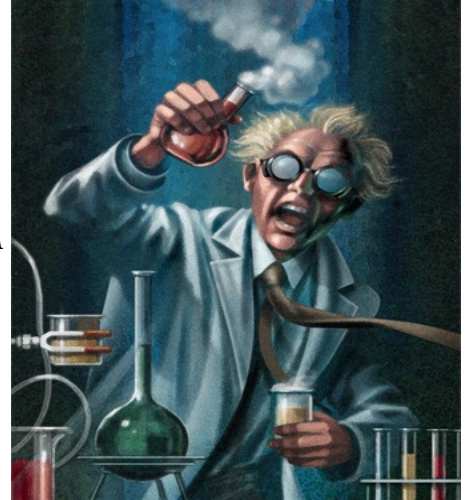
d) Assuming the particle starts at point A with a large positive velocity, identify the points where the particle's speed is a maximum, minimum, and constant. Explain. (Remember, in order for there to be a potential energy, the force must be conservative.)

## Energy Problems – Set 4

2

After getting your BS in Physics, you find yourself working as a lab assistant in the stronghold of a mad scientist in a hollowed out volcano in the middle of a remote tropical island.

He is designing a new Mega-Death Ray, but he needs your help with some calculations. The transmogrifier field of the death ray could either have a potential energy function  $U_1 = Ax^4$  or  $U_2 = Ax^3 - Bx$ .  $A$  and  $B$  are constants and  $x$  is the distance as measured from the reaction chamber.



a) Find the force,  $F_1$ , associated with  $U_1$ .

b) Find the force  $F_2$  associated with  $U_2$ .

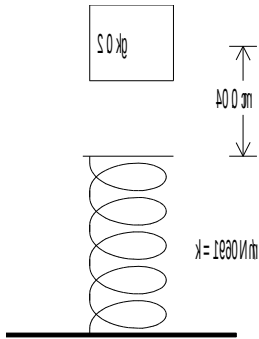
c) If there are any points where the force goes to zero, the entire Island will explode. Are either of the two force fields safe, or are you in mortal danger?

## Energy Problems – Set 4

3

Use Conservation of Energy to solve the following problem.

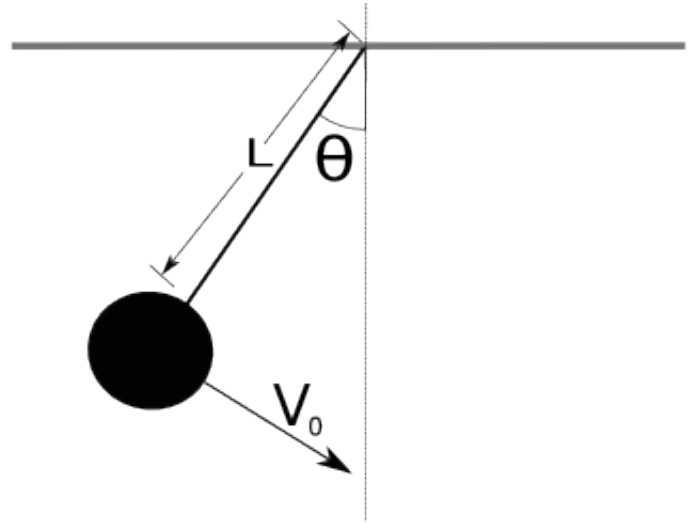
A 2.0 kg block is dropped from a height of 40 cm onto a spring of spring constant  $k = 1960 \text{ N/m}$ . Find the maximum distance the spring is compressed.



Use *Conservation of Energy* to solve the following problem.

The picture shows a pendulum with a weight of mass  $m$  attached to a light (massless) string of length  $L$ .

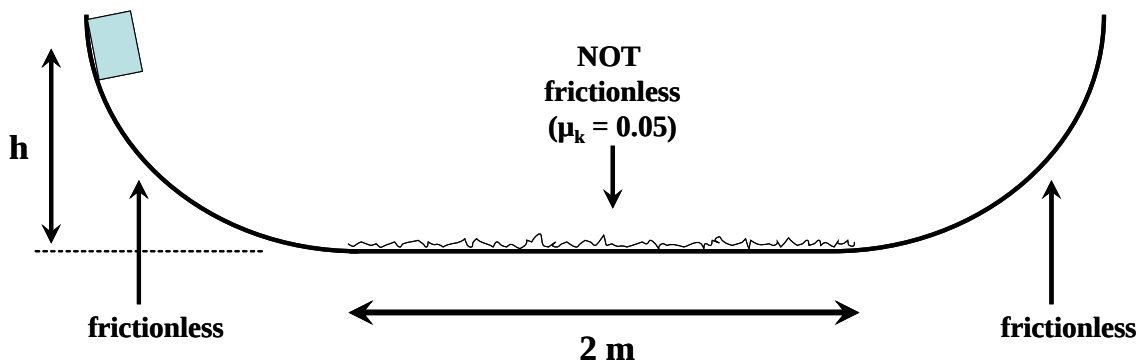
The mass has a speed  $v_0$  when the cord makes an angle  $\theta$  with the vertical.



- Derive an expression for the speed of the mass when it is in its lowest position.
- What is the minimum value of  $v_0$  for the chord to make an angle of  $90^\circ$  on the pendulum's upswing?

Use Conservation of Energy to solve the following problem.

An 8.75-kg block starts at rest, at height  $h = 1.0$  m, and slides down a frictionless ramp onto a horizontal plane where  $\mu_k = 0.05$ . If the block has enough energy after passing the plane, it will rise onto another frictionless ramp, and so forth.



(a) The block is released, makes its first trip to the right hand side, returns to the left hand side, and then returns once more to the right. On this second excursion to the right side, how high up the ramp does the block go?

*Use Conservation of Energy to solve the following problem.*

A stone of mass  $m$  is thrown vertically upward into the air from ground level with an initial speed of  $v_0$ . If a constant drag force equal to 20% of the stone's weight acts on the stone throughout its flight, what is the speed of the stone in terms of  $v_0$  when it returns to the ground?