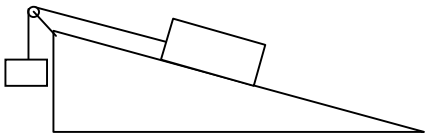
More Energy Problems



1. Two blocks are connected over a pulley by a massless string as shown. The hanging mass is 0.5 kg and the block on the ramp has a mass of 2.0 kg. The ramp is inclined by 30° to the horizontal. Both of the blocks start 0.25 meters above the ground and the ramp is frictionless. How fast are the blocks traveling when the first block reaches the ground? (Assume there is plenty of room and rope for this to happen.)

2. A pendulum consists of a bob of mass *M* and a cord of length *L*. At the bottom of the swing, the cord hits a peg that is a distance *D* below the suspension point.
a. If the bob is to make a complete circle around the peg, what is the minimum speed at the bottom of the swing? (Ignore the thickness of the peg.)
b. From what angle must the pendulum be released in order to reach the bottom of the swing at the speed calculated above?

3. An object of mass 0.5 kg experiences a force that is associated with the potential energy function $U(x) = \frac{4}{2+x}$, where U is in Joules and x is in meters.

a. Sketch the graph of potential energy versus x for x-values 0 to 4 m.

b. The 0.5 kg object is released from rest at the origin. Sketch the kinetic energy of the particle versus x on the same graph.

c. What is the speed of the object when it reaches x= 2m?

4. A 1.5 kg block is launched from a spring (k = 400 N/m) along a horizontal frictionless surface. The spring was compressed 0.5 meters before it was released. After the block leaves the spring, it slides up a ramp that is inclined 20° above the horizontal. The coefficient of friction between the block and the ramp is 0.35. What is the minimum length of the ramp in order for the block to come to rest?

5. Jake (m = 75 kg) swings on a 5 meter rope out over the water. He starts with the rope horizontal, swings through the bottom of the motion and releases the rope when it makes a 30° to the vertical. The bottom of the swing is 2 meters above the water.

a. What is the tension in the rope at the bottom of the motion?

b. What is his speed when he releases the rope?

c. How high will he go above the water after he has released the rope?

d. How fast is he traveling when he hits the water?