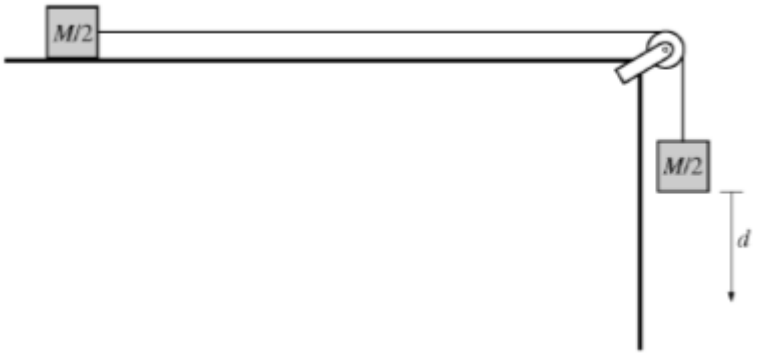
AP Physics C Name _____

2009M3 – Sliding Rope Atwood Problem

Directions: Show all of your work in order to receive full credit. Include all of your givens, units, and original equations used in each solution. All answers should fit in the space provided.



1. A block of mass ***M***/2 rests on a frictionless horizontal table, as shown above. It is connected to one end of a string that passes over a massless pulley and has another block of mass ***M***/2 hanging from its other end. The apparatus is released from rest.

a. Derive an expressing for the speed v_h of the hanging block as a function of the distance ***d*** it descends.

Now the block and pulley system is replaced by a uniform rope of length ***L*** and mass ***M***, with one end of the rope hanging slightly over the edge of the frictionless table. The rope is released from rest, and at some time later there is a length ***y*** of rope hanging over the edge, as shown below. Express your answers to parts (b), (c), and (d) in terms of ***y***, ***L***, ***M***, and fundamental constants.

b. Determine an expression for the force of gravity on the hanging part of the rope as a function of ***y***.

c. Derive an expression for the work done by gravity on the rope as a function of y, assuming y is initially zero.

d. Derive an expression for the speed v_r of the rope as a function of y.

e. The hanging block and the right end of the rope are each allowed to fall a distance L (the length of the rope). The string is long enough that the sliding block does not hit the pulley. Indicate whether v_h from part (a) or v_r from part (d) is greater after the block and the end of the rope have traveled this distance.

_____ v_h is greater _____ v_r is greater _____ The speeds are equal.
Justify your answer.