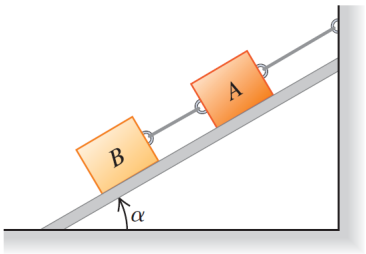
PC1201 Fundamentals of Physics

Tutorial 2

February 3, 2022

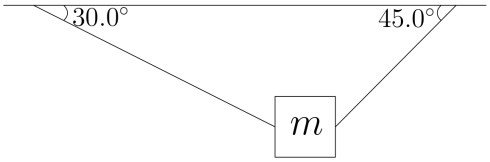
Question 1: Equilibrium Dynamics I (Easy)



Two blocks, each with weight w, are held in place on a frictionless incline. In terms of w and the angle of the incline α, calculate

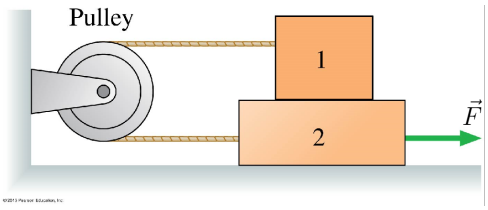
a) The tension in the rope connecting the blocks
b) The tension in the rope that connects block A to the wall
c) The magnitude of the force that the incline exerts on each block.

Question 2 : Equilibrium Dynamics II (Medium)



The two angled ropes are used to support a crate as in the diagram above. The tension in the ropes can have any value up to 1500.0 N. When the tension exceeds this value, the ropes will break. What is the largest mass the ropes can support?

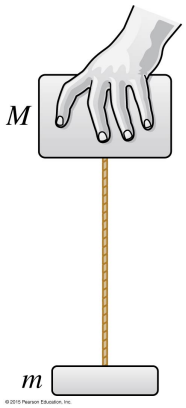
Question 3: Equilibrium Dynamics III (Hard)



A force $\vec{F}$ pulls on block 2 as above such that block 2 moves with constant velocity. If $m_2 = 3m_1$ and the coefficient of kinetic friction on all surfaces is μ_k, determine in terms of m_1 and μ_k,

a) The magnitude and direction of all the kinetic friction acting on the set-up.
b) The magnitude of tension on the rope.
c) The magnitude of the force.

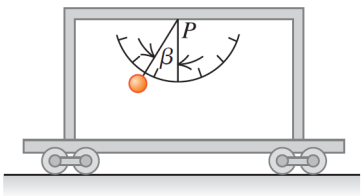
Question 4: Dynamics I (Easy)



A light block of mass m and a heavy block of mass M are attached to the ends of a rope. A student holds the heavier block and lets the lighter block hang below it, as shown above. Then she lets go. Air resistance can be neglected.

a) What is the tension in the rope while the blocks are falling, before either hits the ground?
b) Answer the same question in the scenario where the student was holding the lighter block initially.

Question 5: Dynamics II (Medium)



A ball hanging freely off the ceiling of the cart will make an angle of β under certain conditions of motion of the cart. Which way does the ball move and what is the angle β when

a) The cart is moving toward the left with a constant speed of 4ms^{-1}
b) The cart is moving toward the right with speed increasing at 3ms^{-2}
c) The cart is moving toward the left with speed decreasing at 4.5ms^{-2}

Question 6: Apparent weight (Easy)

The passengers in a roller coaster car feel 50.0% heavier than their true weight as the car goes through a dip with a 50.0 m radius of curvature. What is the car's speed at the bottom of the dip?

Question 7: Dynamics of circular motion (Hard)

In an old-fashioned amusement park ride, passengers stand inside a 3.0-m-tall, 5.0-m-diameter hollow steel cylinder with their backs against the wall. The cylinder begins to rotate about a vertical axis. Then the floor on which the passengers are standing suddenly drops away! If all goes well, the passengers will "stick" to the wall and not slide. Clothing has a static coefficient of friction against steel in the range 0.60 to 1.0 and a kinetic coefficient in the range 0.40 to 0.70. What is the minimum velocity, for which the ride is safe?

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