Name: ID:

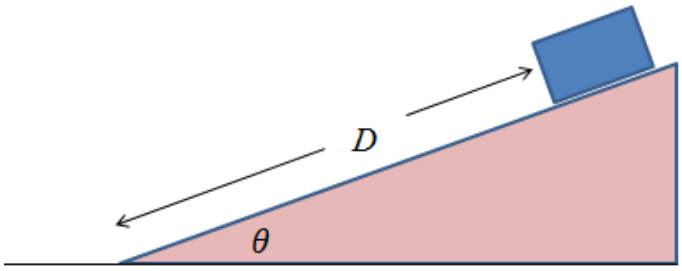
General Physics I (151)

Discussion Questions #3

Introduction to Forces

1. A block of mass m is on a frictionless incline of angle θ and a distance D from the bottom of the incline. You are asked to calculate the time it takes for the block to slide to the bottom, starting from rest.

   a) Draw a free-body diagram (separate from the diagram given) for the block, showing all the forces acting on it (don't forget an axis).



   b) What is the component of the net force along the surface of the incline, expressed in terms of m, θ and g?

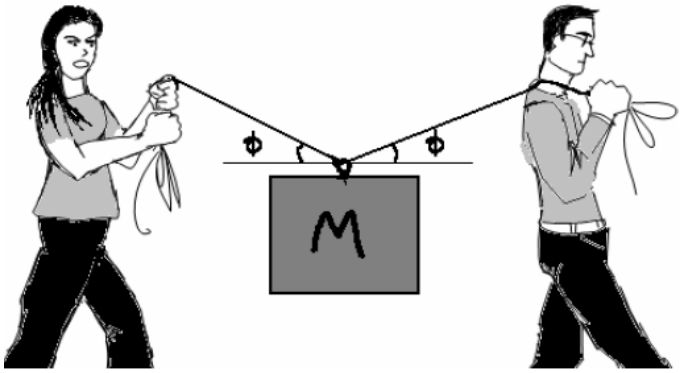
   c) What is the acceleration of the block along the surface?

   d) Write the equation describing the distance the block has slid along the incline as a function of time. Then solve this equation for the time it takes the block to slide all the way to the bottom, expressed in terms of m, θ, D, and g.

2. Two students want to raise a heavy box onto the back of a truck. They do this by putting a rope through a handle on the box, and each lifting one side of the rope, as sketched. The arrangement is symmetrical, so that the rope makes an angle φ with the horizontal on either side. The box is moved at a constant speed.

   In this problem you will compute the magnitude of the tension in the rope. Let the mass of the trunk (including the handle) be *M*, and neglect the mass of the rope.

   a) Draw a free body diagram of the forces on the handle beside the "real world" picture below.



   b) Choose a sensible coordinate system, and write each of the forces as vectors in component form.

   c) Write down the horizontal and vertical components of $\vec{\mathbf{F}} = m\vec{\mathbf{a}}$. Use these equations to solve for the magnitude of the tension in each side of the rope. Give your final answer in terms of *M, g*, and φ.

   d) In this part suppose that while the two people are raising the box, they move it upward with a constant acceleration *a*. What is the magnitude of the tension in each rope now? Give your final answer in terms of *M, g, a*, and φ.