Problem Set 4 – Forces and Newton's Laws

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The unit of force is the Newton (N), which has dimensions of kg$\frac{m}{s^2}$ (Recall that F=ma).

Problem 1

A block rests on a table, and the normal force acting on the block has a magnitude of 25N. What is the mass of the block?

Problem 2

A ball with a mass of 10kg lies at the end of a swinging pendulum. Suppose it is in a position which makes an angle of 30° with the vertical, what is the tension on the cord?

Problem 3

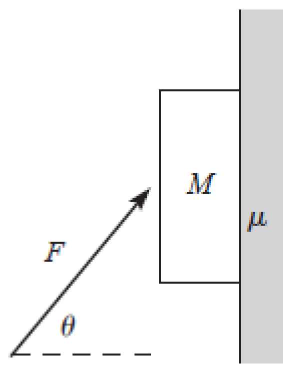
A horizontal force of 10N acts on a block of mass 2kg, which proceeds to slide along a flat surface. If the coefficient of friction between the block and the surface is $\mu_k = .2$, what is its velocity after 10s?

Problem 4

A block lies on a ramp inclined at an angle of $\theta = 45°$. The coefficient of kinetic friction between the block and the ramp us $\mu_k = .2$. The block starts sliding from rest at time $t = 0$. At time $t = 5s$, what is the block's displacement?

Problem 5

A book of mass M is positioned against a vertical wall. The coefficient of friction between the book and the wall is μ. You wish to keep the book from falling by pushing on it with a force **F** applied at an angle θ with respect the horizontal, with θ ranging from $-90°$ to $90°$, as shown.
a) For a given θ, what is the minimum **F** required?
b) For what θ is this minimum **F** is smallest? What is that **F**?
c) What is this limiting value of θ for which there does not exist an **F** that keeps the book up?



Problem 6

With 2 fingers, you hold an ice cream cone motionless upside down, as shown in the figure. The mass of the cone is m, and the coefficient of static friction between your fingers and the cone is μ. When viewed from the side, the angle is the tip is 2θ. What is the minimum normal force you must apply with each finger in order to hold up the cone? In terms of θ, what is the minimum value of μ that allows you to hold up the cone? Assume that you can supply as large a normal force as needed.