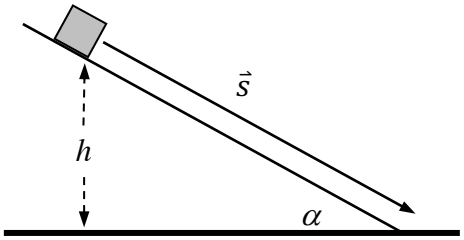
PHYS 1210 Worksheet 5. Work

1. A block of mass m is released from rest on a frictionless ramp at an angle α and height h. The block slides down the ramp, along a displacement vector $\vec{s}$ ending at the bottom of the ramp. The forces acting on the block are its weight $\vec{w}$ and the normal force $\vec{N}$.



A. Next to the diagram of the block on the ramp, draw a free-body diagram for the block.

B. Find a formula for s, the magnitude of $\vec{s}$, in terms of h and α.

C. Find a formula for x, the horizontal component of $\vec{s}$, also in terms of h and α.

D. Analyze the system using both inclined (parallel and perpendicular to the ramp) and plumb (vertical and horizontal) coordinates. For each set of coordinates, find the x- and y-components of the indicated vectors.

Inclined coordinates

$w_x =$

$w_y =$

$N_x =$

$N_y =$

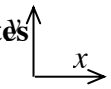
$\Sigma F_x =$

$\Sigma F_y =$

$s_x =$

$s_y =$

Plumb coordinates



$w_x =$

$w_y =$

$N_x =$

$N_y =$

$\Sigma F_x =$

$\Sigma F_y =$

$s_x =$

$s_y =$

E. Find the indicated dot products from the vector components.

Inclined coordinates

$\vec{w} \cdot \vec{s} =$

$\vec{N} \cdot \vec{s} =$

$\Sigma\vec{F} \cdot \vec{s} =$

Plumb coordinates

$\vec{w} \cdot \vec{s} =$

$\vec{N} \cdot \vec{s} =$

$\Sigma\vec{F} \cdot \vec{s} =$

2. Your cousin Throckmorton, m = 20 kg, plays on a R = 1.5-m swing. He swings from an angle $\theta = \pi/6$ from vertical down to $\theta = 0$ (vertical).
   a. What is the net force on Throcky as a function of θ?

   b. How far (total path length) does he travel?

   c. Set up the integral for the total work done on him.

   d. Evaluate the integral.

   e. Is the result the same as $mg\Delta y$? Should it be?