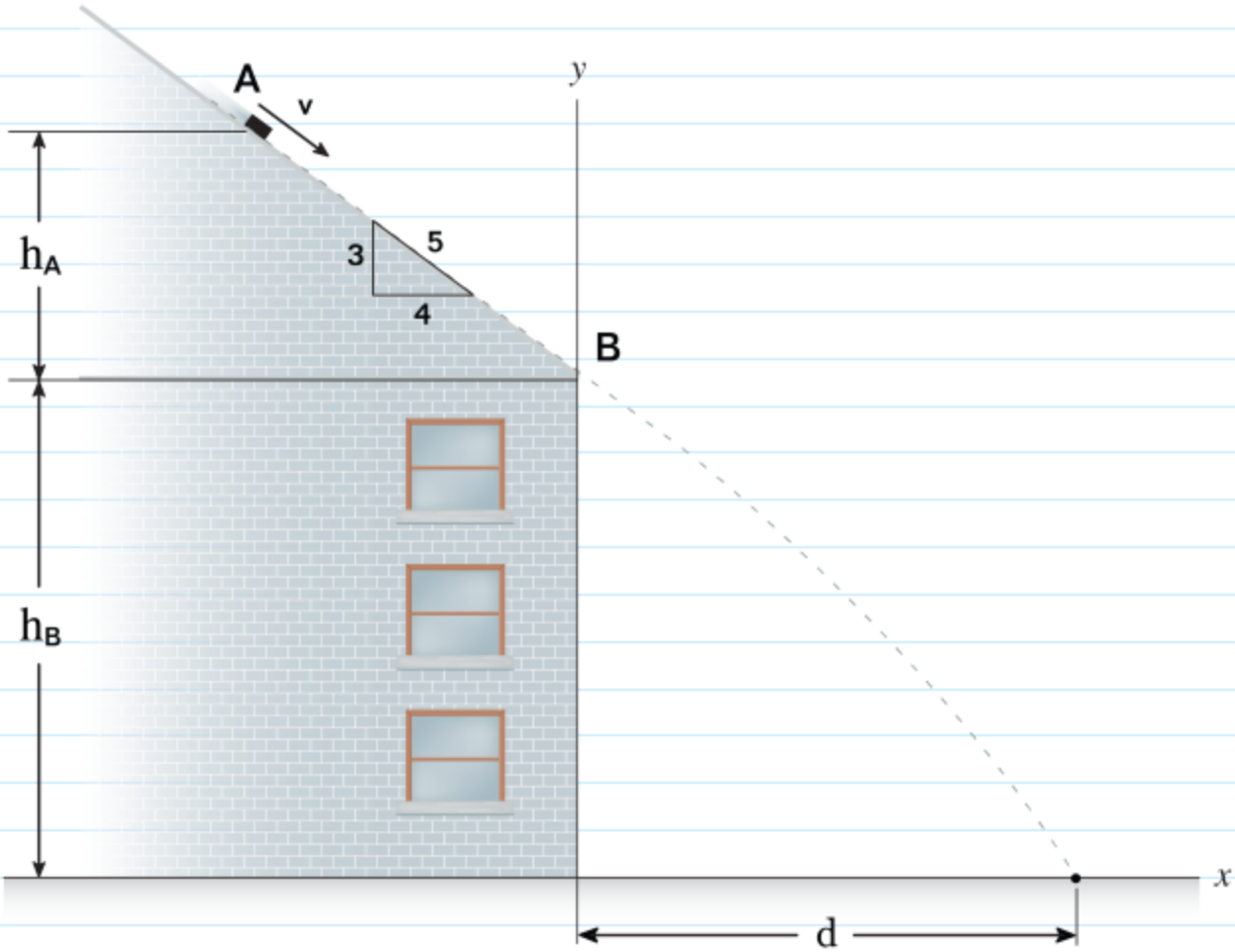
21-P-WE-GD-008



A parcel delivery company has a very unique method of fulfilling orders. While driving by the address, the parcel is launched over the top of the house onto the roof. The package then slides down and lands on the ground near the house.

A $\underset{\sim}{m}$ kg package slides down a frictionless roof as shown. At point A its velocity is $\underset{\sim}{V_A}$ m/s. What is the brick's:

- speed at point B, just before it slides off the roof?
- distance d travelled where it lands?
- speed when it lands?

(assume $g = 9.81\ m/s^2$, $h_A = \underset{\sim}{h_A}$, $h_B = \underset{\sim}{h_B}$)

given

m, g, v_A, h_A, h_B

find

v_B, d, v_f

A to B

N does no work

Work & Energy

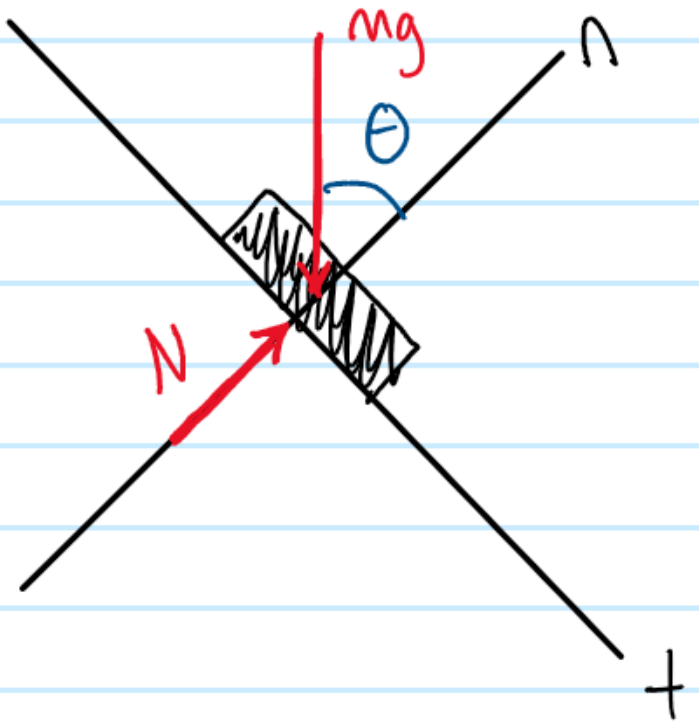
$$T_A + \Sigma U_{A-B} = T_B$$

$$\tfrac{1}{2} m (v_A)^2 + mgh_A = \tfrac{1}{2} m (v_B)^2$$

$$v_B = \sqrt{(v_A)^2 + 2gh_A}$$

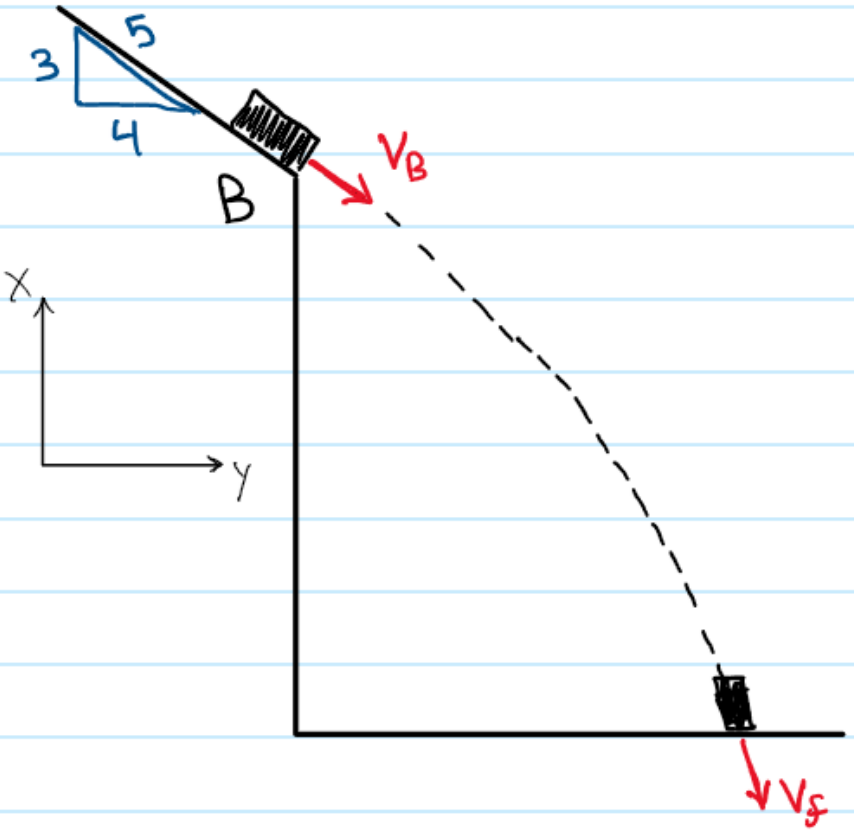
FBD

$$\theta = \tan^{-1}\left(\tfrac{3}{4}\right)$$



B to impact

- using kinematics



$V_{xB} = V_B \, 4/5$

$V_{yB} = V_B \, 3/5$

x

no acceleration in x

$V_{x_B} = V_{x_f}$

y

$V_{y_f}^2 = V_{y_B}^2 + 2gh_B$

$V_{y_f} = \sqrt{V_{y_B}^2 + 2gh_B}$

$V_f = \sqrt{V_{y_f}^2 + V_{x_f}^2}$ speed when box lands

$V_{y_f} = V_{y_B} + gt$

to find t → use to find d

$t = \dfrac{V_{y_f} - V_{y_B}}{g}$

$d = 0 + V_{x_B} t$