Assigment 3

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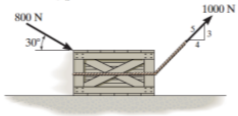
Assignment #3

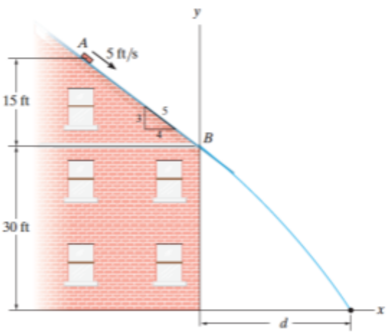
1. The crate, which has a mass of 100 kg, is subjected to the action of the two forces. If it is originally at rest, determine the distance it slides in order to attain a speed of 6 m/s. The coefficient of kinetic friction between the crate and the surface is $\mu_k = 0.2$.



2. When the driver applies the brakes of a light truck traveling 40 km/h, it skids 3 m before stopping. How far will the truck skid if it is traveling 80 km/h when the brakes are applied?

Prob. 14-6

3. The 2-lb brick slides down a smooth roof, such that when it is at A it has a velocity of 5 ft/s. Determine the speed of the brick just before it leaves the surface at B, the distance d from the wall to where it strikes the ground, and the speed at which it hits the ground.



1. Given:

- Right hand force $F_R = 1000N$ has components using the 3-4-5 triangle
  - $F_{Rx} = 1000 \cdot \frac{4}{5} = 800N$ (to the right)
  - $F_{Ry} = 1000 \cdot \frac{3}{5} = 600N$ (upward)
- Left hand force $F_L = 800N$ is at $30°$ below horizontal
  - $F_{Lx} = 800 \cos 30° \approx 692.82N$ (to the left)
  - $F_{Ly} = 800 \sin 30° = 400N$ (downward)

Step 1: Horizontal resultant force

↳ $F_{x,applied} = F_{Rx} - F_{Lx} = 800 - 692.82 \approx 107.18N$

Step 2: Normal force N, Net upward from applied forces = 600 - 400 = 200N

↳ $N = mg - (\text{net upward}) = 100(9.8) - 200 = 780N$

Step 3: Kinetic friction magnitude

↳ $f_K = \mu_K N = 0.20 \cdot 780 = 158N$

Step 4: Net horizontal force available to accelerate the crate

↳ $F_{x,net} = F_{x,applied} - f_K \approx 107.18 - 156 = -48.82N$

This negative result means the frictional resistence is larger than the horizontal driving component, with the given parameters there is no net force available to accelerate the crate to the right

Final Answer

↳ starting from rest the crate will not begin sliding and certainly cannot reach 6 m/s. So the distance the crate slides to reach 6 m/s is zero under the stated data.

2. Given:

- Initial speed $(v_1) = 40$ Km/h
- Stopping distance $(d_1) = 3m$
- New speed $(v_2) = 80$ Km/h
- Find: $d_2 = ?$

Step 1: Work-energy principle

↳ $v^2 = 2ad$, $a = \frac{v^2}{2d}$

↳ Since same force applies for 40 Km/h and 80 Km/h: $\frac{v_1^2}{d_1} = \frac{v_2^2}{d_2}$

Step 2: Solve for d_2

↳ $d_2 = d_1 \left(\frac{v_2}{v_1}\right)^2 \rightarrow d_2 = 3\left(\frac{80}{40}\right)^2 \rightarrow d_2 = 12m$

Final Answer

↳ $d_2 = 12m$

3. Given:

- Weight of brick = 2 lb.
- Velocity at A: $v_A = 5\,ft/s$
- Vertical drop from A to B: $h_{AB} = 15\,ft$
- Vertical height from B to ground: $h_{BG} = 30\,ft$
- Roof is smooth = no friction

We have to find:

- V_B: Speed just before it leaves the roof at B
- d: Horizontal distance from the wall to where it hits the ground
- V_G: Speed when it hits the ground

Step 1: Energy between A and B (no friction)

↳ $V_B^2 = V_A^2 + 2gh_{AB}$, using $g = 32.2\,ft/s^2$

↳ $V_B^2 = 5^2 + 2(32.2)(15) \rightarrow V_B^2 = 25 + 964 = 989 \rightarrow \boxed{V_B = 31.5\,ft/s}$

Step 2: Motion after leaving the roof

↳ $V_{Bx} = V_B \cos 45^\circ = 22.3\,ft/s$

↳ $V_{By} = V_B \sin 45^\circ = 22.3\,ft/s$ (downward)

Step 3: Fall to the ground

↳ $y = V_{By}t + \frac{1}{2}gt^2 \rightarrow 30 = 22.3t + 16.1t^2 \rightarrow 16.1t^2 + 22.3t - 30 = 0$

Solve for t

↳ $t = \frac{-22.3 + \sqrt{22.3^2 + 4(16.1)(30)}}{2(16.1)} \rightarrow t = \frac{-22.3 + \sqrt{497 + 1932}}{32.2} = 0.817\,s$

Step 4: Horizontal distance

$d = V_{Bx}t = 22.3(0.817) = \boxed{18.2\,ft}$

Step 5: Speed when it hits the ground

↳ Vertical component at impact: $V_{By} + gt = 22.3 + 32.2(0.817) = 48.6\,ft/s$

Resultant speed

↳ $V_G = \sqrt{V_{Bx}^2 + V_{Gy}^2} = \sqrt{22.3^2 + 48.6^2} = \sqrt{2858} = \boxed{53.5\,ft/s}$

Final Answer

- Speed at B (V_B) = 31.5 ft/s
- Horizontal distance (d) = 18.2 ft
- Speed at ground (V_G) = 53.5 ft/s

Finish on Oct 31, 2025