October 23, 2025
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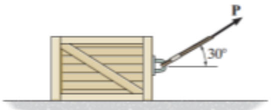
Assignment 2

Assignment #2 – VGP248

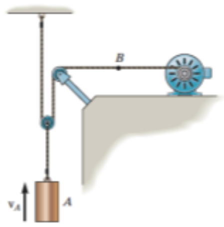
1. If the 50-kg crate starts from rest and achieves a velocity of $v = 4$ m/s when it travels a distance of 5 m to the right, determine the magnitude of force **P** acting on the crate. The coefficient of kinetic friction between the crate and the ground is $\mu_k = 0.3$.



2. The coefficient of static friction between the 200-kg crate and the flat bed of the truck is $\mu_s = 0.3$. Determine the shortest time for the truck to reach a speed of 60 km/h, starting from rest with constant acceleration, so that the crate does not slip.

Prob. 13-35

3. The 400-lb cylinder at A is hoisted using the motor and the pulley system shown. If the speed of point B on the cable is increased at a constant rate from zero to $v_B = 10$ ft/s in $t = 5$ s, determine the tension in the cable at B to cause the motion.



Prob. 13-40

1. Given:

- $m = 50$ Kg
- $v = 4.0$ m/s
- $s = 5.0$ m
- $\mu_k = 0.3$
- angle $\theta = 30°$
- $g = 9.8$ m/s²

Step 1: Divide by s and solve for P

↳ $P(\cos\theta + \mu_k \sin\theta) = \frac{\frac{1}{2}mv^2}{s} + \mu_k mg$

↳ $P = \frac{\frac{1}{2}mv^2/s + \mu_k mg}{\cos\theta + \mu_k \sin\theta}$

Step 2: Plug in given values

↳ $P \approx \frac{(0.5)(50)(4^2)/5 + 0.3(50)(9.8)}{\cos 30° + 0.3\sin 30°} \approx 223.4$ N.

Final Answer:

↳ The pulling force is approximately $P \approx 2.23 \times 10^2$ N (about 223 N.)

2. Given:

- Mass of crate $m = 200$ Kg
- Coefficient of static friction $\mu_s = 0.3$
- Target speed $v = 60$ Km/h $= 60 \times \frac{1000}{3600} = 16.67$ m/s
- Starts from rest $u = 0$
- Aim, crate does not slip

Step 1: Find maximum possible acceleration (before crate slip)

↳ static friction formula: $f_s = ma$, maximum static friction: $f_{s,max} = \mu_s mg$

↳ at the limit: $ma_{max} = \mu_s mg \rightarrow a_{max} = \mu_s g \rightarrow a_{max} = 0.3 \cdot 9.8 = 2.94$ m/s²

Step 2: Use kinematics to find the shortest time to reach $v = 16.67$ m/s

↳ $v = u + at \rightarrow t = \frac{v-u}{a_{max}} = \frac{16.67-0}{2.94} = 5.67$s

Final Answer:

- ↳ Maximum acceleration: $a_{max} = 2.94$ m/s²
- ↳ Shortest time: $t_{min} = 5.67$s
- ↳ The truck must accelerate no faster than 2.94 m/s², and it will take about 5.7 seconds to reach 60 Km/h withot the crate falling

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3. Assuming the rope is massless and the pulleys are frictionless

Step 1: Kinematics (lenght constraint)

↳ $v_A = \frac{1}{2}v_B \rightarrow a_A = \frac{1}{2}a_B$

Given v_B goes from 0 to 10 ft/s in $t = 5$s

↳ $a_B = \frac{10-0}{5} = 2.0$ ft/s², $a_A = \frac{1}{2}(2.0) = 1.0$ ft/s²

Step 2: Dynamics (Newton's 2nd law)

- Let T = tension in the cable (same everywhere)
- The movable pulley (and cylinder) is supported by two upward tensions = 2T
- Downward weight $W = 400$ lb.
- Using $m = W/g$, with $g = 32.2$ ft/s²

↳ $2T - W = ma_A = \frac{W}{g}a_A$

↳ Solve for T $\rightarrow T = \frac{1}{2}\left(W + \frac{W}{g}a_A\right) = \frac{W}{2}\left(1 + \frac{a_A}{g}\right)$

↳ $m = \frac{400}{32.2} = 12.422$ slugs $\rightarrow T = \frac{1}{2}(400 + 12.422(1.0)) = \frac{412.422}{2} \approx 206.21$ lb.

Final Answer: The tension in the cable at B is approximately 206.2 lb.

finished on
Oct 22, 2025