Homework

a G.

Determine the acceleration of the 150-lb cabinet and the normal reaction under the legs A and B if $P = 35$ lb. The coefficients of static and kinetic friction between the cabinet and the plane are $\mu_s = 0.2$ and $\mu_k = 0.15$, respectively. The cabinet's center of gravity is located at G.

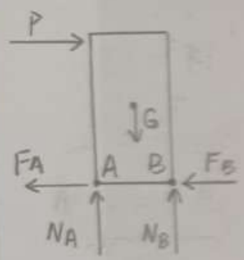
解:

$(F_A+F_B)_{static} = G\cdot\mu_s$
$= 30\,lb < P = 35\,lb$

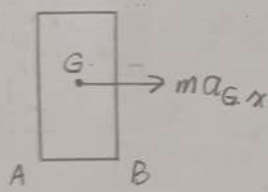
the cabinet will move

$(F_A+F_B)_k = G\cdot\mu_k < P$, it will accelerate.

FBD



KD



$\xrightarrow{+} \Sigma F_x = P - F_A - F_B = m a_{Gx}$

$+\uparrow \Sigma F_y = N_A + N_B - G = 0$

$\circlearrowleft+ \Sigma M_A = -P\cdot d_1 - G d_2 + N_B\cdot d_3 = -m a_{Gx} d_4$

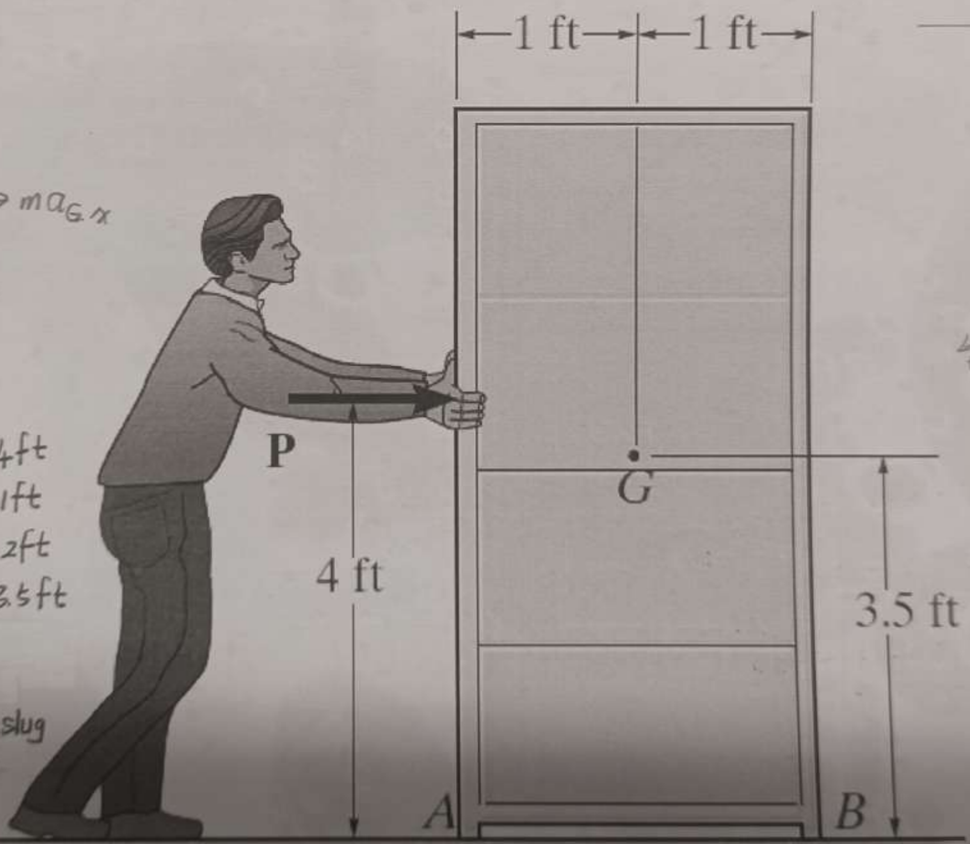
$N_A\cdot\mu_k = F_A,\ N_B\cdot\mu_k = F_B$

$d_1 = 4\,ft$
$d_2 = 1\,ft$
$d_3 = 2\,ft$
$d_4 = 3.5\,ft$

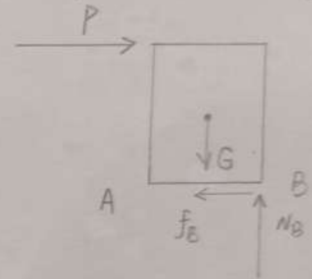
$m = \frac{150}{32.194} = 4.6593$ slug

$\Rightarrow N_A = 26.875\,lb$ $\boxed{ANS}$
$N_B = 123.125\,lb$

$a_{Gx} = 2.6828\,ft/s^2$ $\boxed{ANS}$



A 悬空



$N_B = 150\,lb$

$\circlearrowleft+ \Sigma M_B = +G\cdot d_1 - P\cdot d_2$
$= 150\times 1 - 35\times 4 = 10 \neq 0$

会发生倾翻

∴ A点不可能悬空

FBD如左图所示.

Homework

Motor M exerts a constant force of $P = 750$ N on the rope. If the 100-kg post is at rest when $\theta = 0°$, determine the angular velocity of the post at the instant $\theta = 60°$. Neglect the mass of the pulley and its size and consider the post as a slender rod.

w

解:

At $\theta = 0°$, post rest

$T_1 = 0$

At $\theta = 60°$,

$T_2 = \frac{1}{2} m v_G^2 + \frac{1}{2} I_G w^2 = I_B w^2 \cdot \frac{1}{2}$

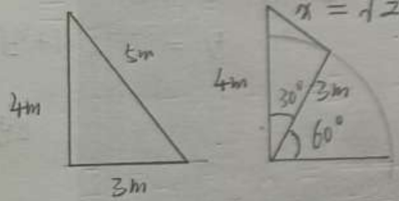
$I_B = I_G + m\left(\frac{L_{AB}}{2}\right)^2 = 300\ kg \cdot m^2$

$I_G = \frac{1}{12} m L_{AB}^2 = 75\ kg \cdot m^2$

From $\theta = 0°$ to $\theta = 60°$:

$U_{1\text{-}2} = + P \cdot S - G \cdot h$

$x = \sqrt{25 - 24\cos 30°}$

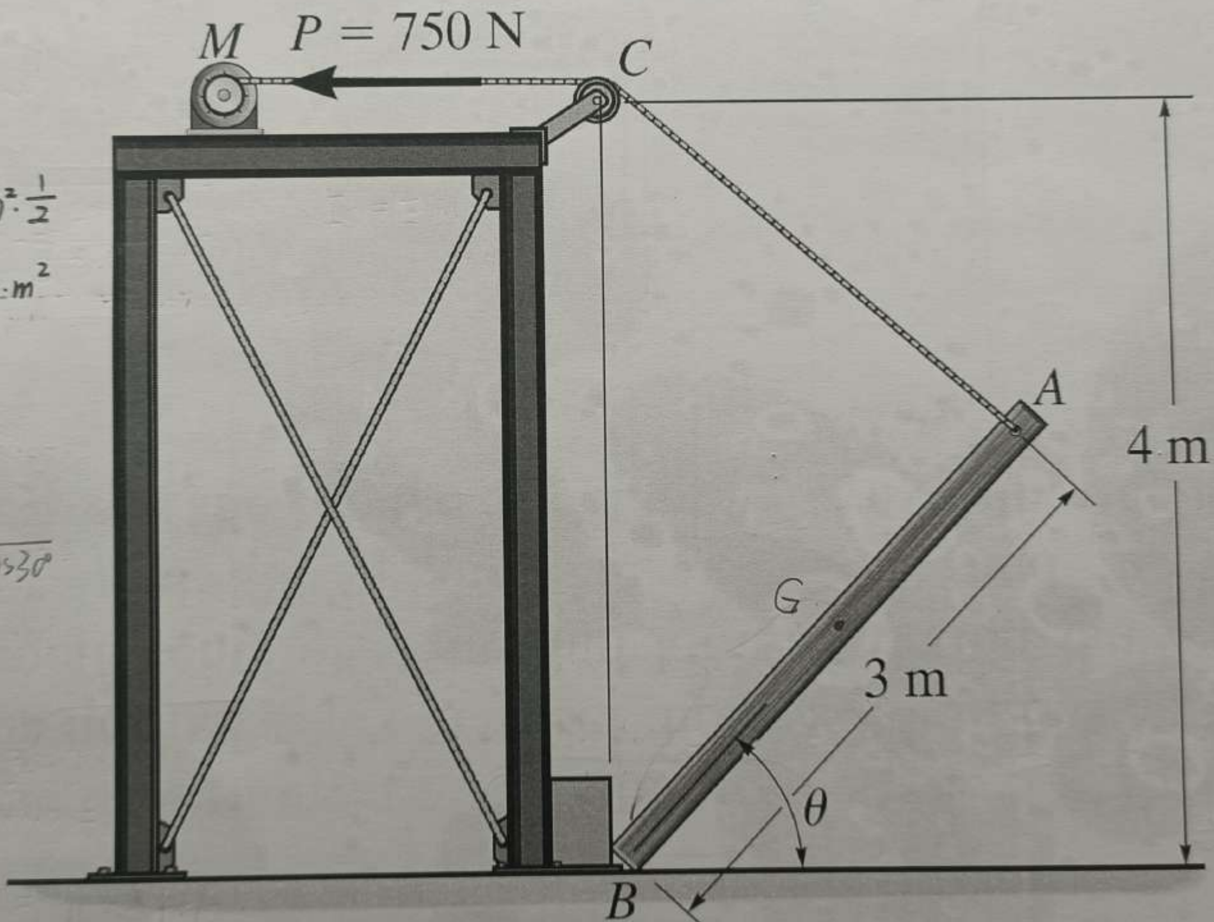


$S = 5 - \sqrt{25 - 24\cos 30°}$ m

$h = 0.75\sqrt{3}$ m

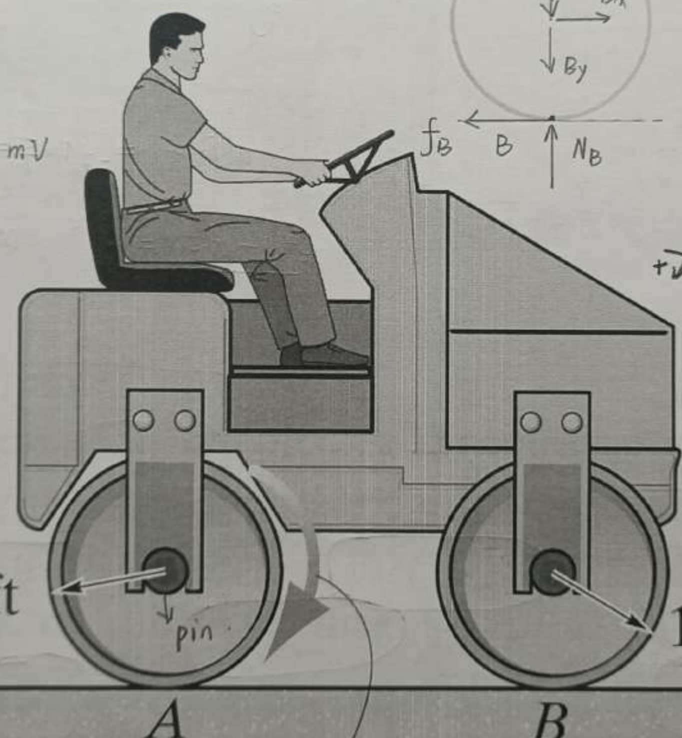
$\therefore\ T_1 + U_{1\text{-}2} = T_2$

$0 + P \cdot S - G \cdot h = \frac{1}{2} I_B w^2 \Rightarrow w = 2.498\ rad/s$ $\boxed{ANS}$



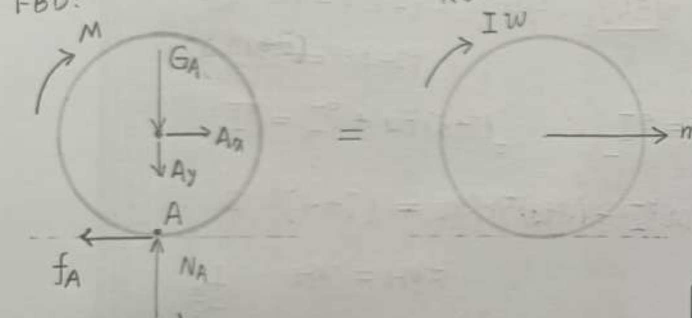
Homework

The frame of a tandem drum roller has a weight of 4000 lb excluding the two rollers. Each roller has a weight of 1500 lb and a radius of gyration about its axle of 1.25 ft. If a torque of $M = 300$ lb·ft is supplied to the rear roller A, determine the speed of the drum roller 10 s later, starting from rest.



解:

For roller A:



$H_{A.1} + \Sigma\int_{t_1}^{t_2} M_A\,dt = H_{A.2}$

starting from rest: $H_{A.1} = 0$

$+\circlearrowright\ M_A = M + A_x \cdot r$

$H_{A.2} = I\omega + mvr$

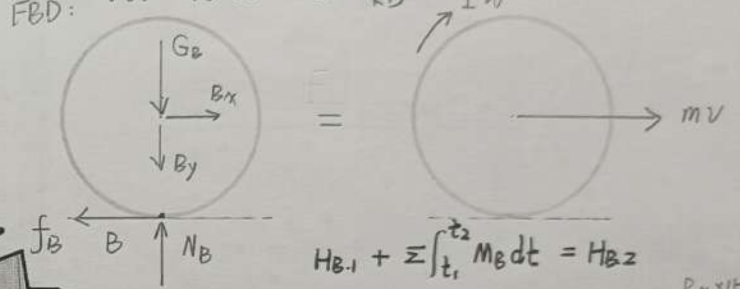
$\Rightarrow 0 + \int_0^{10} (M + A_x \cdot r)\,dt = I\omega + mv\cdot r$ ①

$(300 + A_x \times 1.5)10 = I \cdot \frac{V}{r} + mv\cdot r$

$= 72.8 \times \frac{V}{1.5} + \frac{1500}{32.194} \times V \times 1.5 = 118.42V$

$300 + 1.5A_x = 11.842V$ ①

For roller B:



$H_{B.1} + \Sigma\int_{t_1}^{t_2} M_B\,dt = H_{B.2}$

$B_x \times 15 = 118.42V$ ②

$H_{B1} = 0$

$(-A_x - B_x)10 = \frac{4000}{32.194}V = 12.42V$ ④

$+\circlearrowright\ M_B = B_x \cdot r$

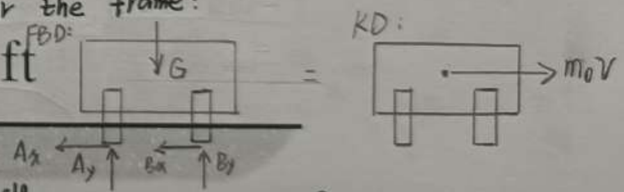
$H_{B.2} = mv\cdot r + I\omega$

$\Rightarrow 0 + \int_0^{10} B_x r\,dt = I\omega + mv\cdot r$ ②

$I = mk^2 = \frac{1500}{32.194} \times 1.25^2 = 72.8\ \text{slug}\cdot\text{ft}^2$

without slipping: $V = \omega \cdot r$ ③

For the frame:



x 方向: $0 + \int_0^{10}(-A_x - B_x)\,dt = m_0 V$ ④

由①②③④: $V = 7.0899$ ft/s $\boxed{\text{ANS}}$

Homework

The 10-g bullet having a velocity of 800 m/s is fired into the edge of the 5-kg disk as shown. Determine the angular velocity of the disk just after the bullet becomes embedded into its edge. Also, calculate the angle θ the disk will swing when it stops. The disk is originally at rest. Neglect the mass of the rod AB.

0.01kg

解:

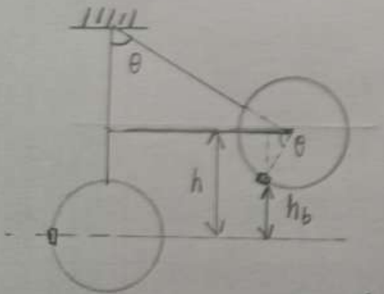
$H_{A.1} = H_{A.2}$

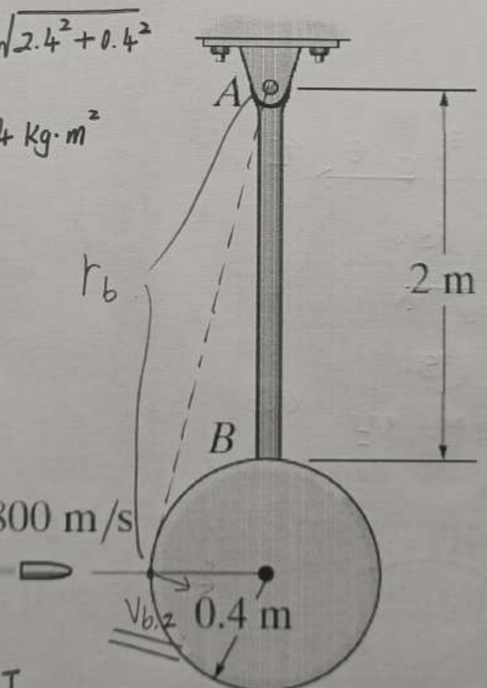
$m_b v_1 (r+L) = m_b \cdot V_{b.2}\, r_b + I_A w \quad , \quad r_b = \sqrt{2.4^2 + 0.4^2}$

$I_A = I_G + m_d (r+L)^2 \quad ; \quad I_G = \frac{1}{2} m_d r^2 = 0.4\ kg \cdot m^2$

$V_{b.2} = w \cdot r_b$

$\Rightarrow w = 0.6562\ rad/s$ $\boxed{ANS}$





$h = (L+r)(1-\cos\theta)$, $h_b = h - r\sin\theta$

$T_2 = 0$, $T_1 = \frac{1}{2} m_b V_{b.2}^2 + \frac{1}{2} I_A w^2 = 6.2995\ J$

$U_{1\text{-}2} = -m_d g h - m_b g h_b$

$T_1 + U_{1\text{-}2} = T_2 \Rightarrow \theta = 18.9°$ $\boxed{ANS}$

$h = 2.4(1-\cos\theta) = 2.4 - 2.4\cos\theta$

$h_b = 2.4 - 2.4\cos\theta - 0.4\sin\theta$