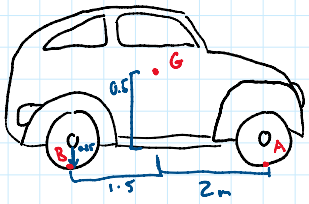
20-R-KIN DK17-19

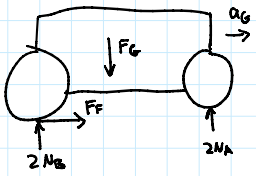
May 29, 2020 9:19 AM

CH17-Dk-17 Intermediate Translation (RBK) Video

Inspiration: 17-27 Hibbeler



A punchbuggy is challenged to race. As it starts from rest, slamming on the accelerometer causes the rear wheels to slip. If the punchbuggy has a mass of 1400 kg with a centre of gravity at G, determine the distance it would travel in 5 seconds and the normal force on each of its four wheels. Assume the mass of the wheels are negligible and the coefficients of static and kinetic friction are $\mu_s = 0.45$ and $\mu_k = 0.3$, respectively.



$\sum F_x = m a_{Gx} = F_F = \mu_k (2N_B) = 0.3(2N_B)$ (sliding)

$\sum F_y = 2N_B + 2N_A - 1400(9.81) = 0$

$\sum M_A = 1400(9.81)(2) - 2N_B(3.5) = 1400\, a_{Gx}(0.5 + 0.25)$

$0.6 N_B = 1400\, a_{Gx}$

$N_B = \frac{7000}{3} a_{Gx}$

$2N_B + 2N_A = 13734$

$N_A = 3140.020134$

$27468 - 7N_B = 1050\, a_{Gx}$

$27468 - \frac{49000}{3} a_{Gx} = 1050\, a_{Gx}$

$N_B = 3666.479866$

$a_{Gx} = \frac{5986}{3726} = 1.580134$

$d = v_0 t + \frac{1}{2} a t^2 = \frac{1}{2}(1.580134)(5^2) = 19.75167785$ m

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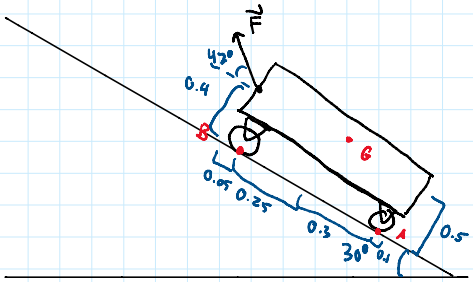
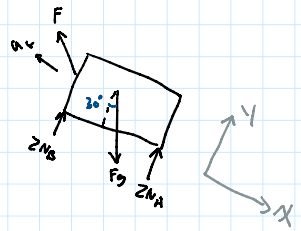
CH17-DK-18 Intermediate Translation (RBK) Homework or PDF Check

Inspiration: 17-32 Hibbeler



You are hauling a heavy cart up a 30° incline. You have been working out so you apply a force of 250 N to the cart. If the cart has a mass of 30 kg, what is the acceleration of the cart and the normal force on each of the cart's wheels? The cart has a center of gravity at G



$\sum F_x = m a_{Gx} = -F\cos 42 + F_g \sin 30$

$\sum F_y = F\sin 42 - F_g \cos 30 + 2N_B + 2N_A = 0$

$\sum M_A = -F_g \sin 30(0.5) + F_g \cos 30(0.3) + 2N_B(0.55) + F\cos 42(0.4) - F\sin 42(0.6) = m a_{Gx}(0.5)$

$30\, a_{Gx} = -250\cos 42 + 30(9.81)\sin 30$

$a_{Gx} = -1.297973546$

$250\sin 42 - 30(9.81)\cos 30 + 2N_B + 2N_A = 0$ $\quad 2N_B + 2N_A = 76.09459104$

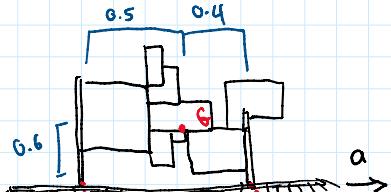
$-30(9.81)\sin 30(0.5) + 30(9.81)\cos 30(0.3) + 1.1N_B + 250\cos 42(0.4) - 250\sin 42(0.6) = 30\, a_{Gx}(0.5)$

$-28.86515172 + 1.1N_B = 30(-1.297973546)(0.5)$

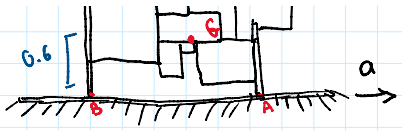
$N_B = 6.679135036$ $\quad N_A = 30.36815548$

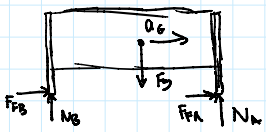
CH17-Dk-19 Intermediate Translation (RBK) Homework or PDF

Inspiration: F17-4 Hibbeler



Your friend is trying to carefully move his mom's modern-art sculpture by dragging a rug underneath it. What is the maximum acceleration of the rug without causing the sculpture to move relative to the rug? Determine the normal





What is the maximum acceleration of the rug without causing the sculpture to move relative to the rug? Determine the normal reaction on the sculpture's legs if the sculpture has a mass of 80 kg with a centre of gravity at G. Assume the coefficient of static and kinetic friction to be $\mu_s = 0.3$ and $\mu_k = 0.15$ respectively.

$\sum F_x = F_{FB} + F_{FA} = ma_{Gx}$ $\quad$ $\sum F_y = N_B + N_A - mg = ma_{Gy} = 0$

① $\sum M_A = mg(0.4) - N_B(0.9) = -ma_{Gx}(0.6)$

Not slipping $\Rightarrow F_F \leq \mu_s N$

$\sum F_x = 0.3N_B + 0.3N_A = 80a_{Gx}$

$\sum F_y = N_B + N_A - (80)(9.81) = 0 \Rightarrow N_B + N_A = 784.8$

$N_A = 784.8 - N_B$

$0.3N_B + 0.3(784.8) - 0.3N_B = 80a_{Gx}$

$235.44 = 80a_{Gx}$ $\quad$ $a_{Gx} = 2.943$

$80(9.81)(0.4) - 0.9N_B = -80(2.943)(0.6)$

$455.184 = 0.9N_B$ $\quad$ $N_B = 505.76$ N

$N_A = 784.8 - 505.76$ $\quad$ $N_A = 279.04$ N

Alternatively: ② $\sum M_G = F_{FB}(0.6) + F_{FA}(0.6) - N_B(0.5) + N_A(0.4) = 0$

$0.3(0.6)N_B + 0.3(0.6)N_A - 0.5N_B + 0.4N_A = 0$

$0.32N_B = 0.56N_A$

$N_B = 1.8125N_A$

$1.8125N_A + N_A = 80(9.81)$ $\quad$ $N_A = 279.04$ N

$N_B = 1.8125(279.04)$ $\quad$ $N_B = 505.76$ N

$\sum F_x = 0.3(505.76) + 0.3(279.04) = 80a_{Gx}$

$a_{Gx} = 2.943 \text{ m/s}^2$