20-R-KIN-DK-18

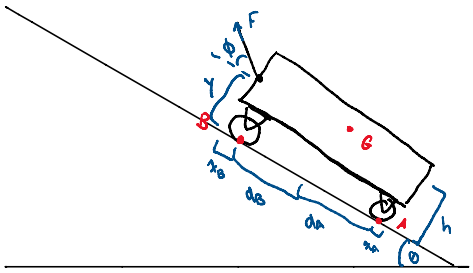
July 22, 2020 9:47 AM

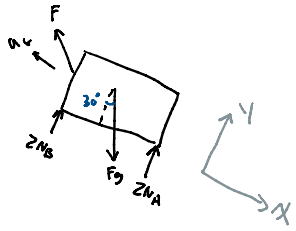
20-R-KIN-DK-18 Intermediate Translation (RBK)

Inspiration: 17-32 Hibbeler

Reworded

You are hauling a heavy cart up a ***theta = 30 degree*** incline. Luckily, you have been working out so you can apply a force of ***F = 250 N*** to the cart. If you apply this force at an angle ***phi = 42 degrees*** and the cart has a mass of ***m = 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.
The force is applied at a height ***y = 0.4 m*** from the ground and G is located at a height ***h = 0.5 m***.
Wheel A is located ***x_A = 0.1 m*** from one side of the cart while wheel B is located ***x_B = 0.05 m*** from the other end.
Wheel A is a distance ***d_A = 0.3 m*** from G while wheel B is a distance ***d_b = 0.25 m***.





$\Sigma F_x = ma_{Gx} = -F\cos 42 + F_g \sin 30$

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

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

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

$a_{Gx} = -1.297873546$

$250\sin 42 - 30(9.81)\cos 30 + 2N_B + 2N_A = 0 \qquad 2N_B + 2N_A = 78.09415984$

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

$-28.86515172 + 1.1N_B = 30(-1.297873546)(0.5)$

$N_B = 9.679135036 \qquad N_A = 30.36915548$