20-R-KIN-DK-42

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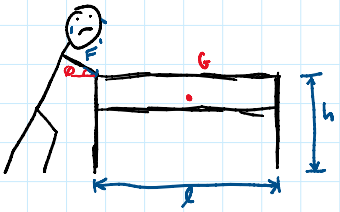
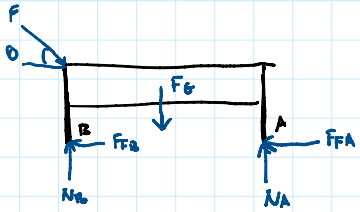
20-R-KIN-DK-42 Intermediate Translation (RBK)

Inspiration: 17-36 Hibbeler

Your friend has just moved into a new apartment and needs help moving some furniture in. You push on a desk at an angle ***theta = 30 degrees*** as shown, and, by chance, apply exactly enough force to overcome static friction. Determine the initial acceleration of the desk at this state and the normal forces at A and B. The desk has a center of gravity at G, with a mass of ***15 kg***. The coefficients of static and kinetic friction are given as ***mu_s = 0.5*** and ***mu_k = 0.3*** respectively.
The desk has a length of ***1.1 m*** and a height of ***1 m***. The center of gravity is located ***0.2 m*** below the top of the desk, and the desk has 4 legs in total.





Static friction force:

$\Sigma F_x = F\cos 30 - F_{FB} - F_{FA} = F\cos 30 - 0.5N_B - 0.5N_A = 0$

$\Sigma F_y = N_B + N_A - F\sin 30 - (15)(9.81) = 0$

$N_B + N_A = F\sin 30 + 147.15$

$F\cos 30 - 0.5F\sin 30 - 73.575 = 0 \qquad F = 119.435\ N$

Sliding desk:

$\Sigma F_x = ma_{Gx}$

$\Sigma F_y = ma_{Gy} = 0$

$119.435\cos 30 - 0.3N_B - 0.3N_A = 15a_{Gx}$

$-119.435\sin 30 + N_B + N_A - 15(9.81) = 0$

$N_B + N_A = 206.867508$

$119.435\cos 30 - 62.06025 = 15a_{Gx}$ $\quad a_{Gx} = 2.75823\ m/s^2$

$\Sigma M_B = -119.435\cos 30(1) - (15)(9.81)(0.55) + N_A(1.1) = -(15)(2.75823)(0.8)$

$N_A = 137.515849\ N$ $\quad N_B = 69.35161$ → Each leg $N_B = 34.6758$

$N_A = 68.7579$