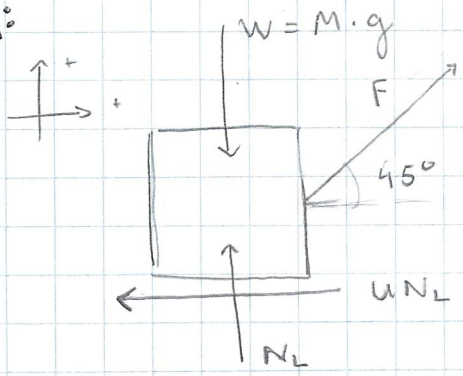
20-P-FA-AF-002

Multidimentional Motion: Beginner

Q: If the lawnmower has a mass of M kg and it's handle is at 45°. The coefficient friction for the entire body is U. Ignore any energy or losses due to mechanical loses. Is it easier to push or pull the lawnmower and what is the minimum force required to overcome friction.

use 9.81 for gravity calculation

A:



$\pm \rightarrow \sum F_x = 0; \quad F\cos(45°) - UN_L = 0$

$+\uparrow \sum F_y = 0; \quad F\sin(45°) + N_L - W = 0$

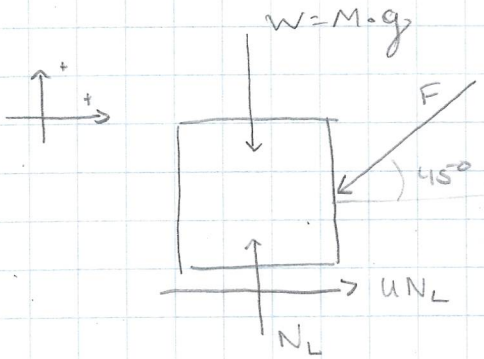
$F = \frac{UN_L}{\cos(45°)}, \quad F = \frac{W - N_L}{\sin(45°)}$

$\sin(45°)UN_L = \cos(45°)W - \cos(45°)N_L$

$N_L[\sin(45°)U + \cos(45°)] = \cos(45°)W$

$N_L = \frac{\cos(45°)W}{[\sin(45°)U + \cos(45°)]}$

$F_P = \frac{UN_L}{\cos(45°)}$



$\pm \rightarrow \sum F_x = 0; \quad -F\cos(45°) + UN_L = 0$

$+\uparrow \sum F_y = 0; \quad -F\sin(45°) + N_L - W = 0$

$F = \frac{UN_L}{\cos(45°)}, \quad F = \frac{N_L - W}{\sin(45°)}$

$UN_L\sin(45°) = \cos(45°)N_L - \cos(45°)W$

$N_L[U\sin(45°) - \cos(45°)] = -\cos(45°)W$

$-\cos(45°)W$

$N_L = [U\sin(45°) - \cos(45)]$

$F_{push} = \frac{UN_L}{\cos(45°)}$

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