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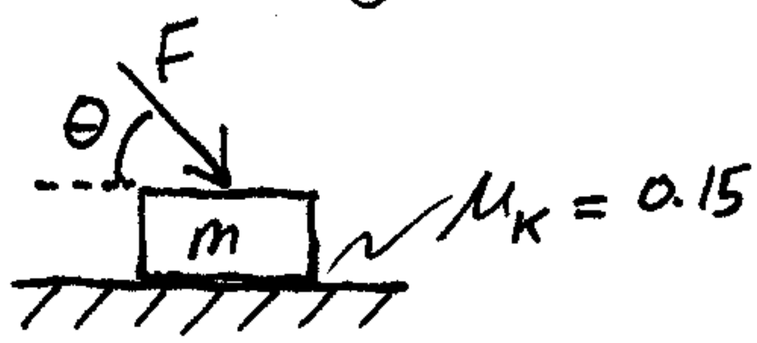
Nov. 5, 2020

This is a problem involving work and energy.

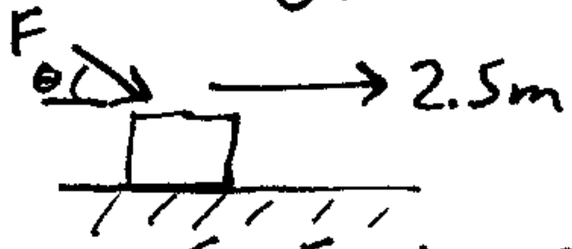


A block on a flat horizontal surface has a force F with magnitude 120N applied to it. The coefficient of kinetic friction between the block and surface is 0.15. What is the velocity of the block when it has moved a distance of 2.5 meters? The mass of the block is m = 3kg, and $\theta = 30°$. The block is initially at rest.

Solution:

Apply the principle of work and energy:

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

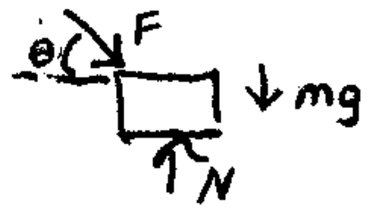


Substitute known quantities:

$$\frac{1}{2}mv_1^2 + \underbrace{F\cos\theta \cdot (2.5)}_{\text{work done by force F}} - \underbrace{N\mu_K \cdot (2.5)}_{\text{work done by friction}} = \frac{1}{2}mv_2^2$$

$v_1 = 0$ (starts from rest)

$N = F\sin\theta + mg$ (normal force)



$N = 120\sin 30° + (3)(9.8)$

$N = 89.4\ N$

substitute known values in above equation:

$$0 + 120\cos 30° \cdot (2.5) - 89.4(0.15)(2.5) = \frac{1}{2}(3)v_2^2$$

solve: $v_2 = 12.3\ m/s$ (answer)