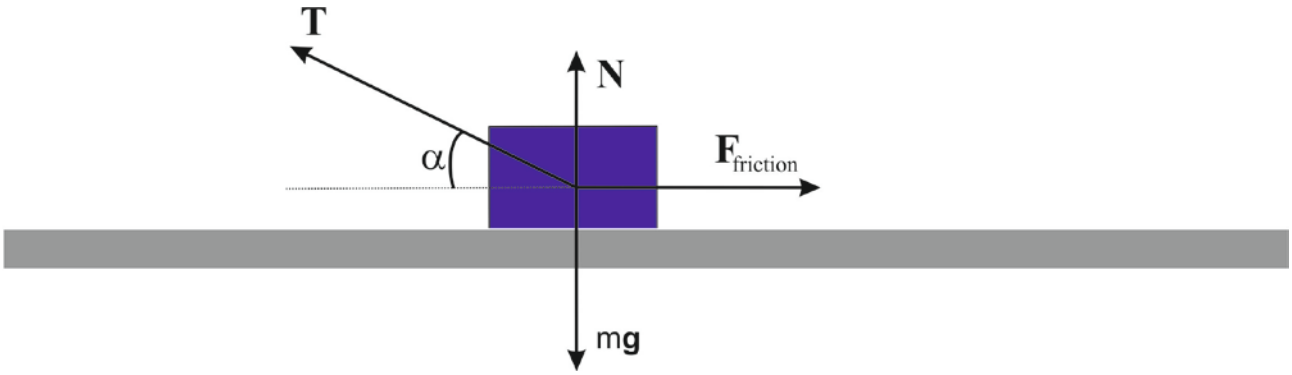
Answer on Question #69195 Physics / Other

A box of mass m is being pulled across a rough floor by means of a massless rope that makes an angle of α with the horizontal. The coefficient of friction between the box and floor is p. What is the tension in the rope when the box moves at a constant velocity? Draw the force diagram.

Solution:



The Newton's second law

$$m\mathbf{a} = \mathbf{T} + m\mathbf{g} + \mathbf{F}_{\text{friction}} + \mathbf{N}.$$

Friction force

$$F_{\text{friction}} = pN,$$

where

$$N = mg\cos\alpha - T\sin\alpha.$$

So

$$F_{\text{friction}} = p(mg\cos\alpha - T\sin\alpha)$$

When the box moves at a constant velocity the acceleration is absent. So

$$0 = T\cos\alpha - F_{\text{friction}} = T\cos\alpha - pmg\cos\alpha + Tp\sin\alpha.$$

$$T = mg\frac{p\cos\alpha}{\cos\alpha + p\sin\alpha}.$$

Answers: $T = mg\frac{p\cos\alpha}{\cos\alpha+p\sin\alpha}$.