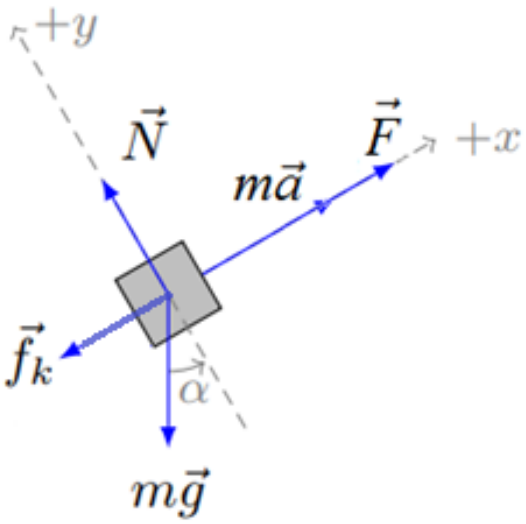
Answer on Question #72536, Physics / Mechanics | Relativity

A crate of mass 30.0 kg is pulled by a force of 180 N up an inclined plane which makes an angle of 30º with the horizon. The coefficient of kinetic friction between the plane and the crate is μk = 0.225. If the crates starts from rest, calculate its speed after it has been pulled 15.0 m. Draw the free body diagram.

Solution:

Free body diagram for body



Newton Second Law:

$$\sum \vec{F_i} = m\vec{g} + \vec{N} + \vec{F} + \vec{f_k} = m\vec{a}$$

The friction force acting on the body:

$$f_k = \mu_k N = \mu_k mg \ \cos\alpha$$

$$ma = F - mg \ \sin\alpha - \mu_k mg \ \cos\alpha$$

$$a = \frac{F - mg \ \sin\alpha - \mu_k mg \ \cos\alpha}{m}$$

$$a = \frac{180\ N - 30\ kg \times 9.81\frac{m}{s^2} \times \ \sin 30° - 0.225 \times 30\ kg \times 9.81\ m/s^2 \ \cos 30°}{30\ kg} = -0.81\ m/s^2$$

This mean that crate will stay at rest. In other words, we can see, that force $F = 180\ N$ compensates weigh projection on x-axis $mg\sin\alpha \approx 150\ N$, but it is not enough to overcome the friction force $f_{k\,max} = \mu_k mg \ \cos\alpha \approx 58.45\ N$.

Answer: ***crate stays at rest***