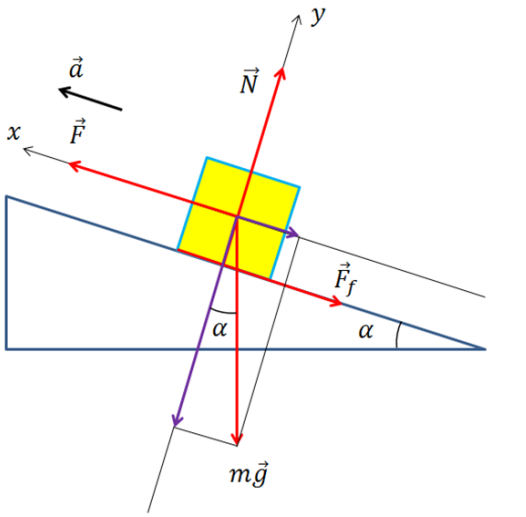
Answer on Question #73196, Physics / Mechanics | Relativity

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

Given. $m = 30.0\ kg$; $F = 180\ N$; $\mu_k = 0.225$; $S = 15.0\ m$; $v_0 = 0$.

Find. v–?

Solution.



According to the second Newton's Low, we have

$$N - mg\cos\alpha = 0 \quad \rightarrow \quad N = mg\cos\alpha$$

$$F - F_f - mg\sin\alpha = ma \quad \rightarrow \quad F - \mu_k N - mg\sin\alpha = ma \quad \rightarrow$$

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

$$= \frac{F}{m} - (\mu_k\cos\alpha + \sin\alpha)g = \frac{180}{30} - (\sin 30° - 0.225\cdot\cos 30°)\cdot 9.8 \approx 3.01\ m/s^2$$

So

$$S = \frac{v^2 - v_0^2}{2a} \quad \rightarrow \quad S = \frac{v^2}{2a} \quad \rightarrow \quad v = \sqrt{2aS} = \sqrt{2\cdot 3.01\cdot 15} \approx 9.5\ m/s$$

Answer. $v = 9.5\ m/s$.