Answer on Question #56323, Physics Mechanics Relativity

a box slides down at constant velocity along an inclined plane which makes angle x with the horizon. if the box is now given an initial velocity v in the upward direction along the plane, what would be the displacement of the box

Solution

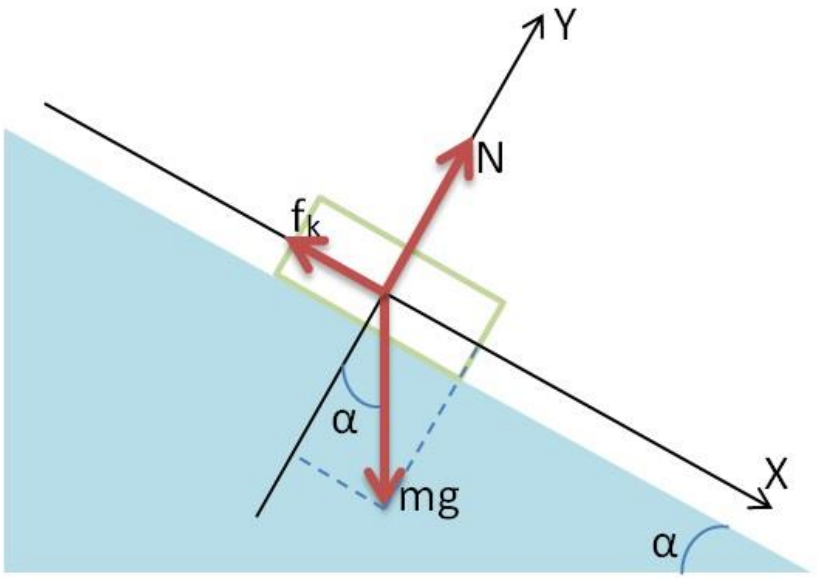

Fig.1

From Newton's second law

$$m\vec{g} + \vec{f}_k + \vec{N} = 0 \qquad (1)$$

m is the mass of box; g is the gravity acceleration; N is reaction force; $f_k = \mu N$ is friction force.

Then

$$\begin{cases} f_k = mg\sin\alpha \\ N = mg\cos\alpha \end{cases} \quad (2)$$

So,

$$mg\sin\alpha = \mu mg\cos\alpha \Rightarrow \mu = tg\alpha \quad (3)$$

The time of motion

$$t = \frac{v}{g\mu\cos\alpha + g\sin\alpha} = \frac{v}{g\cdot tg\alpha\cos\alpha + g\cdot\sin\alpha} = \frac{v}{g\cos\alpha\cdot\frac{\sin\alpha}{\cos\alpha} + g\cdot\sin\alpha} = \frac{v}{2g\cdot\sin\alpha} \quad (4)$$

be the displacement of the box

$$l = \frac{v^2}{2g\left(\mu\cos\alpha + \sin\alpha\right)} = \frac{v^2}{2g\left(tg\alpha\cdot\cos\alpha + \sin\alpha\right)} = \frac{v^2}{4g\sin\alpha}$$

Answer: $l = \frac{v^2}{4g\sin\alpha}$