Answer on Question 61696, Physics, Mechanics | Relativity

Question:

A box of mass m is pushed horizontally on a rough floor with an initial speed of $2\ ms^{-1}$. The coefficient of kinetic friction between the surface and the box is $\mu_k = 0.1$. Calculate the distance the box will move before stopping.

Solution:

Let's first apply the Newton's Second Law of Motion and find the acceleration of the box:

$$\boldsymbol{F} = m\boldsymbol{a},$$

here, $\boldsymbol{F}$ is the net force acting on the box, m is the mass of the box, $\boldsymbol{a}$ is the acceleration of the box.

There is only one force that act on the box in the horizontal direction – the force of friction:

$$F_{fr} = \mu_k N = \mu_k mg,$$

here, N is the normal force acting on the box, μ_k is the coefficient of kinetic friction between the surface and the box and g is the acceleration due to gravity.

Returning to the first equation and taking into account that the force of friction directed in opposite direction to the motion of the box, we get:

$$-\mu_k mg = ma,$$

$$a = -\mu_k g = -0.1 \cdot 9.8\ \frac{m}{s^2} = -0.98\ \frac{m}{s^2}.$$

Then, we can find the distance the box will move before stopping from the kinematic equation:

$$v_f^2 = v_i^2 + 2as,$$

here, $v_f = 0\ ms^{-1}$ is the final velocity of the box, $v_i = 2\ ms^{-1}$ is the initial velocity of the box, a is the acceleration of the box and s is the distance the box will move before it stops.

Then, we get:

$$v_i^2 = -2as,$$

$$s = \frac{v_i^2}{-2a} = \frac{(2\ ms^{-1})^2}{-2 \cdot \left(-0.98\ \frac{m}{s^2}\right)} = 2.04\ m.$$

Answer:

$s = 2.04\ m.$