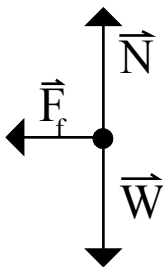


Chapter 5 Problem 52 †



Given

$$\mu_k = 0.71$$

$$\Delta x = 47 \text{ m}$$

$$v_f = 25 \text{ km/h} = 6.94 \text{ m/s}$$

Solution

Find the initial speed of the car.

From the free-body diagram given above and using Newton's 2nd law gives

$$\Sigma \vec{F} = m\vec{a}$$

$$\vec{F}_f + \vec{W} + \vec{N} = m\vec{a}$$

Choose the coordinate system so that the x axis is in the horizontal direction. The acceleration will also be in the x direction. Writing out the equation in unit vector notation gives

$$-\mu_k N \hat{i} - mg \hat{j} + N \hat{j} = ma \hat{i}$$

The x-component of this equation is

$$-\mu_k N = ma \tag{1}$$

and the y-component of this equation is

$$-mg + N = 0 \tag{2}$$

From equation (2) we see that the normal force is mg . Substitute this into equation (1) and solve for the acceleration.

$$-\mu_k(mg) = ma$$

$$a = -\mu_k g = -(0.71)(9.8 \text{ m/s}^2) = -6.96 \text{ m/s}^2$$

Now that we have the acceleration, the following kinematic equation can be used to find the initial velocity.

$$v_f^2 - v_i^2 = 2a\Delta x$$

$$v_i^2 = v_f^2 - 2a\Delta x$$

$$v_i = \sqrt{v_f^2 - 2a\Delta x} = \sqrt{(6.94 \text{ m/s})^2 - 2(-6.96 \text{ m/s}^2)(47 \text{ m})} = 26.5 \text{ m/s}$$

In terms of km/h this is 95.4 km/h . Converting this to miles per hour gives 59.4 mi/h .

†Problem from Essential University Physics, Wolfson