Answer on Question #72587, Physics / Mechanics | Relativity |

box of mass 8.0 kg slides at a speed of 10 ms−1 across a smooth level floor before it encounters a rough patch of length 3.0 m. The frictional force on the box due to this part of the floor is 70 N. What is the speed of the box when it leaves this rough surface? What length of the rough surface would bring the box completely to rest?

Solution:

The kinetic energy of the box is

$$E_{k1} = \frac{mv_1^2}{2} = \frac{8.0kg \cdot (10\,m/s)^2}{2} = 400J.$$

The work done by friction is

$$W = Fl = 70N \cdot 3.0m = 210J.$$

From the energy conservation law we obtain

$$E_{k2} = E_{k1} - W = 400J - 210J = 190J.$$

The speed of the box when it leaves this rough surface is

$$v_2 = \sqrt{\frac{2E_{k2}}{m}} = \sqrt{\frac{2 \cdot 190J}{8.0kg}} = 6.9ms^{-1}.$$

What length L of the rough surface would bring the box completely to rest?

This means that $E'_{k2} = 0$and $E_{k1} = W' = FL$.

$$L = \frac{E_{k1}}{F} = \frac{400J}{70N} = 5.7m$$

Answer: $v_2 = 6.9ms^{-1}$ and $L = 5.7m$.