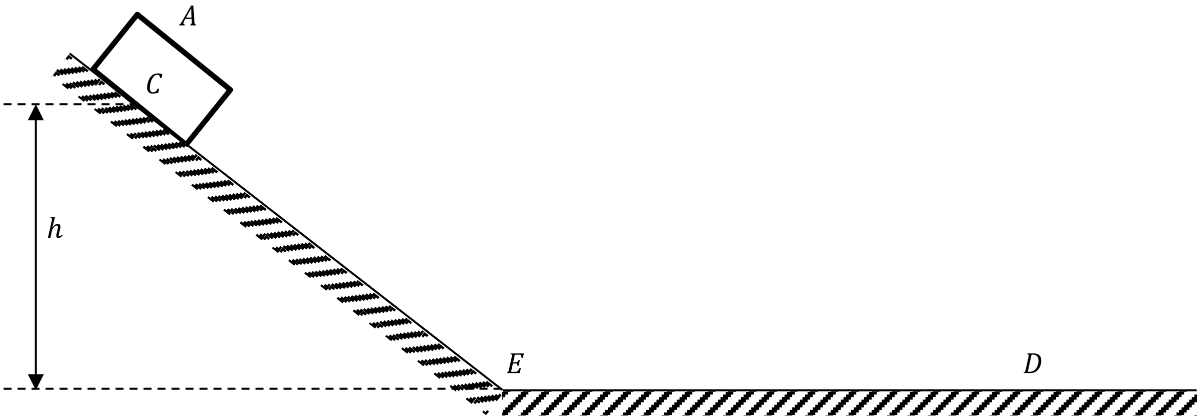
Answer on Question#49528 - Engineering - Other

The $m = 20$ kg suitcase A is released from rest at point C of height $h = 3\text{m}$ from floor ED. The suitcase slides down a friction-less ramp between C and E and continues sliding on the floor until stopping at a certain distance from E. The coefficient of friction between the floor ED and suitcase A is $\mu(ED) = 0.4$. Consider $g = 9.8 \frac{\text{m}}{\text{s}^2}$.

Calculate the distance in m from point E reached by suitcase A as it stops.

Solution:



Since the ramp is friction less, according to the law of conservation of energy the energy of suitcase at points C and E are equal. While sliding on the floor the suitcase loses its kinetic energy to overcome the friction force. The work needed to overcome this force on the interval ED is

$$W = F_f \cdot ED$$

The friction force F_f can be easily found, since we know the coefficient of friction $\mu(ED)$ and the normal force F_N on the interval ED, which is equal to the weight $m \cdot g$ of the suitcase. So the friction force is

$$F_f = F_N \cdot \mu(ED) = m \cdot g \cdot \mu(ED)$$

and the work needed to overcome it is

$$W = m \cdot g \cdot \mu(ED) \cdot ED$$

The kinetic energy of the suitcase at the point E equals the potential energy difference of the suitcase between points C and E, which equals

$$U_{CE} = m \cdot g \cdot h$$

To find the distance ED we need to equate this energy to W:

$$m \cdot g \cdot \mu(ED) \cdot ED = m \cdot g \cdot h$$

And finally

$$ED = \frac{h}{\mu(ED)} = \frac{3\mathrm{m}}{0.4} = 7.5\mathrm{m}$$

Answer: $ED = \frac{h}{\mu(ED)} = 7.5\mathrm{m}$.