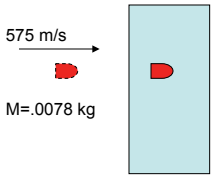
Problem 5.15

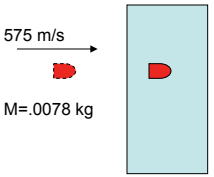
A 7.8 gram bullet moving at 575 m/s penetrates a tree trunk to a depth of 5.5 cm.



a.) Using energy, determine average frictional force to stop:

b.) Determine time of deceleration:

A 7.8 gram bullet moving at 575 m/s penetrates a tree trunk to a depth of 5.5 cm.



b.) Determine time of deceleration:

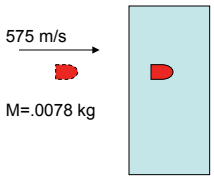
$$v_{avg} = \frac{\Delta x}{\Delta t}$$

$$\Rightarrow \quad \Delta t = \frac{\Delta x}{v_{avg}}$$

$$\Rightarrow \quad \Delta t = \frac{(.055\ \text{m})}{\left(575\ \text{m/s}/2\right)}$$

$$\Rightarrow \quad \Delta t = 1.91\text{x}10^{-4}\ \text{seconds}$$

A 7.8 gram bullet moving at 575 m/s penetrates a tree trunk to a depth of 5.5 cm.



a.) Using energy (either work/energy or conservation of energy), determine average frictional force to stop:

work/energy

$$W_{net} = \Delta KE$$

$$f_k d \cos 180^\circ = \frac{1}{2}mv_2^2 - \frac{1}{2}mv_1^2$$

($\cos 180^\circ = -1$, $v_2 = 0$)

$$\Rightarrow \quad f_k = \frac{-\frac{1}{2}mv_1^2}{-d}$$

$$\Rightarrow \quad f_k = \frac{.5(.0078\ \text{kg})(575\ \text{m/s})^2}{.055\ \text{m}}$$

$$\Rightarrow \quad f_k = 23,444\ \text{nts}$$

conservation of energy

$$\sum KE_1 + \sum U_1 + \sum W_{extraneous} = \sum KE_2 + \sum U_2$$

$$\frac{1}{2}mv_1^2 + (0) + (-fd) = (0) + (0)$$

$$\Rightarrow \quad f = \left[\frac{mv_1^2}{2d}\right]$$

$$\Rightarrow \quad f = \left[\frac{(.0078\ \text{kg})(575\ \text{m/s})^2}{2(.055\ \text{m})}\right]$$

$$\Rightarrow \quad f = 23,444\ \text{nts}$$