

**Exercise 1.26**

(a) A baseball weighs 5.13 oz. What is the kinetic energy, in joules, of this baseball when it is thrown by a major league pitcher at 95.0 mi/h? (b) By what factor will the kinetic energy change if the speed of the baseball is decreased to 55.0 mi/h? (c) What happens to the kinetic energy when the baseball is caught by the catcher? Is it converted mostly to heat or to some form of potential energy?

**Solution****Part (a)**

The kinetic energy is

$$\text{KE} = \frac{1}{2}mv^2,$$

where

$$m = 5.13 \text{ oz} = 5.13 \cancel{\text{oz}} \times \frac{1 \cancel{\text{lb}}}{16 \cancel{\text{oz}}} \times \frac{453.59 \cancel{\text{g}}}{1 \cancel{\text{lb}}} \times \frac{1 \text{ kg}}{1000 \cancel{\text{g}}} \approx 0.145 \text{ kg}$$

$$v = 95.0 \frac{\text{mi}}{\text{h}} = 95.0 \frac{\cancel{\text{mi}}}{\cancel{\text{h}}} \times \frac{5280 \cancel{\text{ft}}}{1 \cancel{\text{mi}}} \times \frac{12 \cancel{\text{in}}}{1 \cancel{\text{ft}}} \times \frac{2.54 \cancel{\text{cm}}}{1 \cancel{\text{in}}} \times \frac{1 \text{ m}}{100 \cancel{\text{cm}}} \times \frac{1 \cancel{\text{h}}}{60 \cancel{\text{min}}} \times \frac{1 \cancel{\text{min}}}{60 \text{ s}} \approx 42.5 \frac{\text{m}}{\text{s}}.$$

Plugging in the numbers gives

$$\text{KE} = \frac{1}{2}(0.145 \text{ kg}) \left(42.5 \frac{\text{m}}{\text{s}}\right)^2 \approx 131 \text{ J}.$$

The conversion factors are all inside the back cover of the textbook.

**Part (b)**

The kinetic energy changes by a factor of

$$\frac{\text{KE}_{\text{final}}}{\text{KE}_{\text{initial}}} = \frac{\frac{1}{2}mv_f^2}{\frac{1}{2}mv_i^2} = \frac{v_f^2}{v_i^2} = \frac{\left(55.0 \frac{\text{mi}}{\text{h}}\right)^2}{\left(95.0 \frac{\text{mi}}{\text{h}}\right)^2} \approx 0.335.$$

**Part (c)**

The kinetic energy of the baseball is converted mostly to thermal energy.