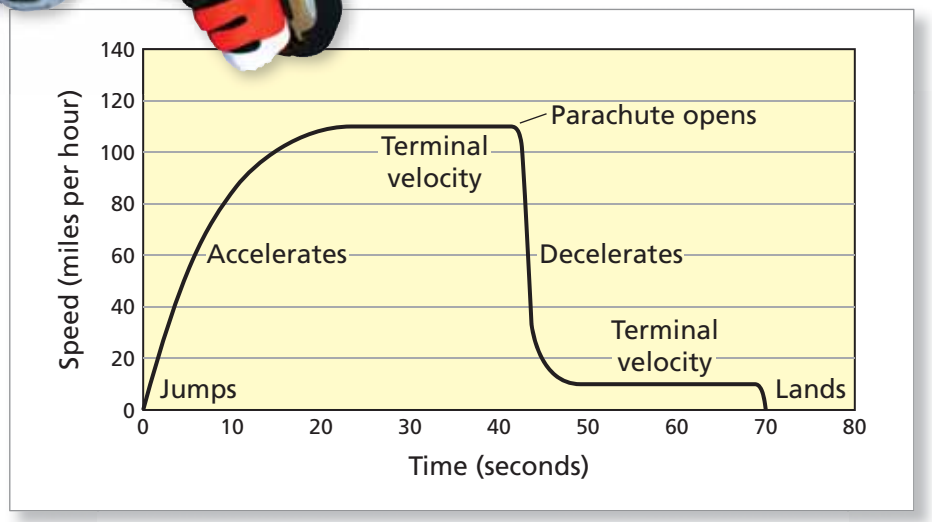
EXAMPLE 4 Converting Units

When an object falls, it accelerates. As its speed increases, the air resistance increases. Eventually, the air resistance will offset the weight of the object, and the object will reach "terminal velocity."

Use the graph to find each velocity in *feet per second*.

a. Terminal velocity *before* the parachute opens—during free fall

b. Terminal velocity *after* the parachute opens



Study Tip

Notice the difference in the "form of one" used in the solutions.

Example 3: $\frac{60 \text{ sec}}{1 \text{ min}}$

Example 4: $\frac{1 \text{ min}}{60 \text{ sec}}$

The form used depends on the units you are trying to obtain in your answer.

SOLUTION

a. From the graph, the free-fall terminal velocity is about 110 miles per hour.

$$110 \frac{\text{mi}}{\text{hr}} = \left(110 \frac{\cancel{\text{mi}}}{\cancel{\text{hr}}}\right)\left(\frac{5280 \text{ ft}}{1 \cancel{\text{mi}}}\right)\left(\frac{1 \cancel{\text{hr}}}{60 \cancel{\text{min}}}\right)\left(\frac{1 \cancel{\text{min}}}{60 \text{ sec}}\right) \approx 161.33 \frac{\text{ft}}{\text{sec}}$$

The free-fall terminal velocity is about 161 feet per second.

b. The parachute terminal velocity is about 10 miles per hour.

$$10 \frac{\text{mi}}{\text{hr}} = \left(10 \frac{\cancel{\text{mi}}}{\cancel{\text{hr}}}\right)\left(\frac{5280 \text{ ft}}{1 \cancel{\text{mi}}}\right)\left(\frac{1 \cancel{\text{hr}}}{60 \cancel{\text{min}}}\right)\left(\frac{1 \cancel{\text{min}}}{60 \text{ sec}}\right) \approx 14.66 \frac{\text{ft}}{\text{sec}}$$

The parachute terminal velocity is about 15 feet per second.

Checkpoint

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c. Estimate the time the parachutist spends in free fall. Explain your reasoning.

d. Estimate the time the parachutist spends with the parachute open. Explain your reasoning.