Description: Explains method to convert units, then has several examples, the hardest being velocity

Learning Goal:

To learn how to change units of physical quantities.

Quantities with physical dimensions like length or time must be measured with respect to a *unit*, a standard for quantities with this dimension. For example, length can be measured in units of meters or feet, time in seconds or years, and velocity in meters per second.

When solving problems in physics, it is necessary to use a consistent system of units such as the International System (abbreviated SI, for the French Système International) or the more cumbersome English system. In the SI system, which is the preferred system in physics, mass is measured in kilograms, time in seconds, and length in meters. The necessity of using consistent units in a problem often forces you to convert some units from the given system into the system that you want to use for the problem.

The key to unit conversion is to multiply (or divide) by a ratio of different units that equals one. This works because multiplying any quantity by one doesn't change it. To illustrate with length, if you know that $1 \text{ inch} = 2.54 \text{ cm}$, you can write

$$1 = \frac{2.54 \text{ cm}}{1 \text{ inch}}.$$

To convert inches to centimeters, you can multiply the number of inches times this fraction (since it equals one), cancel the inch unit in the denominator with the inch unit in the given length, and come up with a value for the length in centimeters. To convert centimeters to inches, you can divide by this ratio and cancel the centimeters.

For all parts, notice that the units are already written after the answer box; don't try to write them in your answer also.

Part A

How many centimeters are there in a length 50.1 inches ?

Express your answer in centimeters to three significant figures.

ANSWER:

= 127   cm

Sometimes you will need to change units twice to get the final unit that you want. Suppose that you know how to convert from centimeters to inches and from inches to feet. By doing both, in order, you can convert from centimeters to feet.

Part B

Suppose that a particular artillery piece has a range R = 6660 yards . Find its range in miles. Use the facts that $1 \text{ mile} = 5280 \text{ ft}$ and $3 \text{ ft} = 1 \text{ yard}$.

Express your answer in miles to three significant figures.

▶ **View Available Hint(s)** (1)

ANSWER:

$$6660 \text{ yards} = \quad \frac{R \cdot 3}{5280} = 3.78 \quad \text{miles}$$

Often speed is given in miles per hour (mph), but in physics you will almost always work in SI units. Therefore, you must convert mph to meters per second (m/s).

Part C

What is the speed of a car going $v = 1.000 \text{ mph}$ in SI units? Notice that you will need to change from miles to meters and from hours to seconds. You can do each conversion separately. Use the facts that $1 \text{ mile} = 1609 \text{ m}$ and $1 \text{ hour} = 3600 \text{ s}$.

Express your answer in meters per second to four significant figures.

▶ **View Available Hint(s)** (2)

ANSWER:

$$v = \quad 0.4469 \quad \text{m/s}$$

Notice that by equating the two values for v, you get $1.000 \text{ mph} = 0.4469 \text{ m/s}$. It might be valuable to remember this, as you may frequently need to convert from miles per hour into more useful SI units. By remembering this relationship in the future, you can reduce this task to a single conversion.