Converting among Units

The Empire State Building is 1,472 feet tall. It is a tourist attraction that brings visitors from all over the world. Most of the world does not think of distances in feet. Distances are measured throughout the world in meters. In order to make sense to our visitors, we need to express the height of the Empire State Building in meters too. The task, though daunting, is possible because there are definitions that relate all these measurements.

Definitions

1 ft = 12 in   1 in = 2.54 cm   1 cm = 0.01 m

The approach to solving these types of problems is called "Unit Analysis" or the "Factor Label Method." Using these definitions, it is possible to convert feet to inches, inches to centimeters, and centimeters to meters. Every definition can be turned into two conversion factors with a numerical value of one:

449 m

If 1 *ft* = 12 *in*, than dividing both sides of the equation by 1 *ft* gives $\frac{1ft}{1ft} = \frac{12in}{1ft} = 1$, and

dividing both sides of the equation by 12 *in* gives $\frac{1ft}{12in} = \frac{12in}{12in} = 1$

Multiplying by a factor equal to one does not change the value, but selecting the correct factor causes units to cancel giving the desired result. Thus:

$$1,472\,ft \times \frac{12in}{1\,ft} \times \frac{2.54cm}{1in} \times \frac{0.01m}{1cm} = 449m$$

Feet cancels, followed by inches, and then centimeters resulting in meters. This procedure can be used to convert any units that are related by definitions.

Answer the questions below with the help of the factor label method.

1. If 3 lumps equals 1 clump and 10 clumps equals 1 pile, how many piles are 96 lumps? _____

2. 1 byte equals 8 bits, 1 kilobyte equals 1,024 bytes, and 1 byte equals 2 nibbles.

    a. How many kilobytes is 36 nibbles? _____

    b. How many bits is 48 nibbles? _____

3. Water has a density of 1 g/mL. This means, for water, 1 g = 1 mL. 1 kg = 1,000 g. Find the following:

    a. the number of milliters (mL) in 1.6 kg of water _____

    b. the number of kilograms (kg) in 75 mL of water _____