

UNIT CONVERSIONS:

Using Dimensional Analysis in the TEAMS Competition

The following resource is provided to help students learn the process of dimensional analysis when conducting unit conversions. Dimensional analysis is used to make unit conversions quickly and correctly. Examples of this method are provided below.



Watch three great videos on unit conversions.

One-Step Dimensional Analysis:

<http://www.youtube.com/watch?v=XKCzn5MLKvk&feature=related>

<http://www.youtube.com/watch?v=aZ3J60GYo6U>

Two-Step Dimensional Analysis:

<http://www.youtube.com/watch?v=J67L1H-Af7Q>

Example 1

1 meter is equivalent to 1,000 millimeters. This relationship can be represented in one of two possible ways:

$$\frac{1m}{1,000mm} \quad \text{or} \quad \frac{1,000mm}{1m}$$

The fraction chosen to conduct data conversion depends on the specific conversion. If the conversion is meters into millimeters, then the second fraction will simplify meters and introduce millimeters. Conversely, if the conversion is millimeters into meters, then the first fraction is best.

Convert 5 millimeters into meters:

$$5mm \left(\frac{1m}{1,000mm} \right) = 5 \times 10^{-3} m$$

Convert 5 meters into millimeters:

$$5m \left(\frac{1,000mm}{1m} \right) = 5 \times 10^3 mm$$

Example 2

Dimensional analysis is also useful in conversions that require multiple steps.

Convert 5 years into seconds:

$$5 \text{ years} \left(\frac{365 \text{ days}}{1 \text{ year}} \right) \left(\frac{24 \text{ hours}}{1 \text{ day}} \right) \left(\frac{60 \text{ min}}{1 \text{ hour}} \right) \left(\frac{60 \text{ sec}}{1 \text{ min}} \right) = 1.5768 \times 10^8 \text{ sec}$$

Convert 5 seconds into years:

$$5 \text{ sec} \left(\frac{1 \text{ min}}{60 \text{ sec}} \right) \left(\frac{1 \text{ hour}}{60 \text{ min}} \right) \left(\frac{1 \text{ day}}{24 \text{ hours}} \right) \left(\frac{1 \text{ year}}{365 \text{ days}} \right) = 1.585 \times 10^{-7} \text{ years}$$

Example 3

It is also useful in unit conversions between the Metric (SI) and the English system and vice versa.

Convert 5 gallons into cubic centimeters:

$$5 \text{ gal} \left(\frac{3.785 \text{ L}}{1 \text{ gal}} \right) \left(\frac{1 \text{ m}^3}{1,000 \text{ L}} \right) \left(\frac{10^6 \text{ cm}^3}{1 \text{ m}^3} \right) = 1.8925 \times 10^4 \text{ cm}^3$$

Convert 250 cubic centimeters into gallons:

$$250 \text{ cm}^3 \left(\frac{1 \text{ m}^3}{10^6 \text{ cm}^3} \right) \left(\frac{1,000 \text{ L}}{1 \text{ m}^3} \right) \left(\frac{1 \text{ gal}}{3.785 \text{ L}} \right) = 0.066 \text{ gal}$$