

Goals: To understand different systems of measurement and to learn how to convert units within those systems.

- Types of Measurement Systems.
 - Metric System.
 - “Standard” Measurements.
- Things we Measure
 - Distance.
 - Unit Rates.
- Dimensional Analysis

Types of Measurement Systems:

Metric System:

The **metric system** is a system of measuring used by the majority of the nations in the world. This system uses **meters** to measure distance, **grams** to measure weight, **litres** to measure volume and **seconds** to measure time. We will study this system in more detail in an upcoming section.

Customary (or Standard) Measurements:

The American system for measurement is a bit more complex than the metric system. In this system, we use units of measurement also called “customary” or “standard”. We will focus below on measurements of distance, weight, volume and time.

Things We Measure:

Below are some of the common unit comparisons that we use within the American system of measurement.

- **Units of Length:**

Customary Units of Length

<i>1 foot (ft.) = 1'</i>	<i>12 inches (in.) = 12''</i>
<i>1 yard (yd.)</i>	<i>3 feet (ft.)</i>
<i>1 mile (mi.)</i>	<i>5,280 feet (ft.)</i>

- **Units of Weight:**

Customary Units of Weight

<i>1 pound (lb.)</i>	<i>16 ounces (oz.)</i>
<i>1 ton</i>	<i>2,000 pounds (lbs.)</i>

- *Units of Volume:*

Customary Units of Volume

<i>1 cup (c.)</i>	<i>8 fluid ounces (fl. oz.)</i>
<i>1 quart (qt.)</i>	<i>2 pints (pt.)</i>
<i>1 pint (pt.)</i>	<i>2 cups (c.)</i>
<i>1 gallon (gal.)</i>	<i>4 quarts (qt.)</i>

- *Units of Time:*

Customary Units of Time

<i>1 minute (min.)</i>	<i>60 seconds (s.)</i>
<i>1 day</i>	<i>24 hours (hrs.)</i>
<i>1 hour (hr.)</i>	<i>60 minutes (min.)</i>
<i>1 year (yr.)</i>	<i>365 days</i>

Dimensional Analysis:

On many occasions, we need to change units of a certain measurement so that the context of our solution makes sense. One method to change units is called **dimensional analysis**. **Dimensional Analysis** is literally the analysis of the relationship between different physical quantities.

The ratio or comparison of the value of one quantity to another is called a **unit conversion**. For example, we know that 1 foot is equivalent to 12 inches. This means that we can use the **unit conversion** $\frac{1 \text{ ft.}}{12 \text{ in.}}$ or $\frac{12 \text{ in.}}{1 \text{ ft.}}$ to convert a measurement from inches into feet (or vice versa). We use unit conversions as “magic 1s” to cancel certain units and then replace them with our desired unit.

For example, say we want to convert 254 miles into feet. Follow the steps below to use dimensional analysis to convert this quantity.

Step 1: Write out our given quantity as a fraction, noting the units.

$$\frac{254 \text{ feet}}{1}$$

Step 2: Select the correct unit conversion and multiply the “magic one” by our given quantity.

Note that we must be careful to multiply by the unit conversion in such a way that the units that we want to cancel will divide out.

$$\frac{254 \text{ feet}}{1} \cdot \frac{1 \text{ mile}}{5,280 \text{ feet}}$$

Step 3: Cancel the units and perform the operation to get the solution!

$$\frac{254 \text{ feet}}{1} \cdot \frac{1 \text{ mile}}{5,280 \text{ feet}} = 0.05 \text{ miles}$$

Distance:

1. Use the length unit conversions to change the units of each given measurement as described below.
 - a. 81 feet to yards.
 - b. 52 yards to feet.
 - c. 48 inches to feet.
 - d. 30,000 ft. to miles.
 - e. 8 yards to inches.
 - f. 5 miles to yards.

Weight:

2. Use the weight unit conversions to change the units of each given measurement as described below.

a. $6\frac{1}{4}$ pounds to ounces.

b. 4.1 tons to ounces.

Units of Time:

3. Use the time unit conversions to change the units of each given measurement as described below.

3.2 gallons to pints

Other Examples:

4. How many seconds are there in one day?

5. A women's softball pitcher can throw her fastball at 60 miles per hour. How fast is this in feet per second? (Round to the nearest fact per second.)

6. How many cubic yards (yd^3) are there in $27 ft^3$? (Careful with this one! Remember that a cubic yard means $yd \cdot yd \cdot yd$.)

