Sect 8.3 - U.S. Units of Measurement

In this section, we will be working with the U.S. system of measurement and converting between various units. To convert from one unit to another unit, we will use unit conversion factors. To form a unit conversion factor, we start with a conversion fact (i.e., 1 ft = 12 in) and divide both sides by the value on one side of the conversion fact. If we use 1 ft = 12 in, we can divide both sides by 12 in to get:

$$\frac{1\text{ ft}}{12\text{ in}} = \frac{12\text{ in}}{12\text{ in}}$$

$$\frac{1\text{ft}}{12\text{in}} = 1$$

Notice that $\frac{1\text{ft}}{12\text{in}}$ is the same as one, so if we needed to convert 48 in into ft, we can multiply 48 in by this unit conversion factor. It does not change the value of 48 in since we are multiply by a form of one:

$$48\text{ in} = 48\text{ in} \bullet 1 = \frac{48\text{in}}{1} \bullet \frac{1\text{ft}}{12\text{in}} = \frac{48\cancel{\text{in}}}{1} \bullet \frac{1\text{ft}}{12\cancel{\text{in}}} = \frac{48}{12}\text{ ft} = 4\text{ ft.}$$

Notice that the inches divide out. We always set-up our unit conversion factors so that the units we are converting from divide out. So, if we had to convert from ft to in, we would use $\frac{12\text{in}}{1\text{ft}}$ so that the ft would divide out, leaving our answer in inches. Here are some common conversions within the U.S. system of measurement:

length	**weight**	**volume**	**other**
12 in = 1 ft	16 oz = 1 lb	8 fl oz = 1 c	1 acre = 43,560 ft^2
3 ft = 1 yd	2,000 lb = 1 ton	2 c = 1 pt	640 acres = 1 mi^2
5280 ft = 1 mi		4 c = 2 pt = 1 qt	144 in^2 = 1 ft^2
		4 qt = 1 gal	9 ft^2 = 1 yd^2
		1 gal = 231 in^3	27 ft^3 = 1 yd^3

Convert each unit as indicated:

Ex. 1 Convert 10.5 yd to ____ ft

Solution:

Since 1 yd = 3 ft, we want to write our unit conversion factor with 1 yd on the bottom:

$$10.5\text{ yd} = \frac{10.5\text{yd}}{1} \bullet \frac{3\text{ ft}}{1\text{yd}} = \frac{10.5\cancel{\text{yd}}}{1} \bullet \frac{3\text{ ft}}{1\cancel{\text{yd}}} = \frac{31.5}{1}\text{ ft} = 31.5\text{ ft}$$

Ex. 2 Convert 177408 in to ____ mi

Solution:

First use 12 in = 1 ft to convert the inches to feet:

$177408\text{ in} = \frac{177408\text{in}}{1} \bullet \frac{1\text{ft}}{12\text{in}} = \frac{177408\text{ft}}{12} = 14{,}784\text{ ft}$

Now, use 5280 ft = 1 mi to convert 14,784 ft into mi:

$14{,}784\text{ ft} = \frac{14784\text{ft}}{1} \bullet \frac{1\text{mi}}{5280\,\text{ft}} = \frac{14784}{5280}\text{ mi} = 2.8\text{ mi}.$

Ex. 3 Convert 4.8 ton to ___ lb

Solution:

Use 1 ton = 2000 lb to convert the tons to lbs:

$4.8\text{ ton} = \frac{4.8\,\text{ton}}{1} \bullet \frac{2000\text{lb}}{1\text{ton}} = 9600\text{ lb}.$

Ex. 4 Convert $\frac{\$9.12}{\text{lb}}$ to $\frac{\$}{\text{oz}}$

Solution:

Use 1 lb = 16 oz to convert the lb to oz. When writing the unit conversion factor, the 1 lb goes on top so that the lbs divide out:

$\frac{\$9.12}{\text{lb}} = \frac{\$9.12}{\text{lb}} \bullet \frac{1\text{lb}}{16\text{oz}} = \frac{\$9.12}{16\text{oz}} = \frac{\$0.57}{\text{oz}}.$

Ex. 5 Convert 85 qt to ____ gal

Solution:

Use 4 qt = 1 gal to convert the qt to gal:

$85\text{ qt} = \frac{85\,\text{qt}}{1} \bullet \frac{1\text{gal}}{4\,\text{qt}} = \frac{85}{4}\text{ gal} = 21.25\text{ gal}$

Ex. 6 Convert $\frac{\$2.45}{\text{pt}}$ to $\frac{\$}{\text{fl oz}}$.

Solution:

First, use 1 pt = 2 c to convert pt to c:

$\frac{\$2.45}{\text{pt}} = \frac{\$2.45}{\text{pt}} \bullet \frac{1\text{pt}}{2\text{c}} = \frac{\$2.45}{2\text{c}} = \frac{\$1.225}{\text{c}}.$

Now, use 1 c = 8 fl oz to convert c to fl oz.

$\frac{\$1.225}{\text{c}} = \frac{\$1.225}{\text{c}} \bullet \frac{1\text{c}}{8\,\text{floz}} = \frac{\$1.225}{8\,\text{floz}} = \frac{\$0.153125}{\text{floz}} \approx \frac{\$0.15}{\text{floz}}.$

Ex. 7 Convert $\frac{\$9.27}{\text{yd}^2}$ to $\frac{\$}{\text{ft}^2}$.

Solution:

Use 9 ft^2 = 1 yd^2 to convert ft^2 to yd^2: $\frac{\$9.27}{\text{yd}^2} \bullet \frac{\text{yd}^2}{9\,\text{ft}^2} = \frac{\$9.27}{9\text{ft}^2} = \frac{\$1.03}{\text{ft}^2}.$