Sect 7.5 - Conversions between the U.S. and Metric System

In this day and age, the metric system is virtually worldwide. Though there was a strong drive in the 1970's for the U.S. to adopt the metric system, the U.S. never made the transition. Thus, the U.S. is the only major country that does not use the metric system. Since the metric system is accepted in the rest of the world and generally used in the Scientific and Health fields, it is important that we have the ability to convert between the two systems.

Here are some useful conversions between the U.S. and Metric Systems:

length	**weight**	**volume**	**other**
1 m ≈ 3.2808 ft	28.35 g ≈ 1 oz	1L ≈ 1.06 qt	1 min = 60 s
1.609 km ≈ 1 mi	454 g ≈ 1 lb	1L ≈ 33.8 fl oz	1 hr = 60 min
2.54 cm = 1 in	1 kg ≈ 2.2 lb	3.785 L ≈ 1 gal	1 hr = 3,600 s
1 m ≈ 1.0936 yd	908 kg ≈ 1 ton		$F = \frac{9}{5}C + 32^\circ$
			$C = \frac{5(F-32^\circ)}{9}$

We will use the same techniques of constructing a unit conversion factor to convert between the two systems.

Convert the following. Round to the nearest hundredth if needed:

Ex. 1 Convert 45 mi to ___ km.

Solution:

Since 1 mi ≈ 1.609 km, then $1 \approx \frac{1.609\text{km}}{1\text{mi}}$.

So, 45 mi ≈ $\frac{45\text{mi}}{1} \bullet \frac{1.609\text{km}}{1\text{mi}} = \frac{72.405}{1}$ km = 72.405 km ≈ 72.41 km.

Ex. 2 Convert 6501 g to ___ lb.

Solution:

Since 1 lb ≈ 454 g, then $1 \approx \frac{1\text{lb}}{454\text{g}}$.

So, 6501 g ≈ $\frac{6501\text{g}}{1} \bullet \frac{1\text{lb}}{454\text{g}} = \frac{6501}{454}$ lb = 14.3193... lb ≈ 14.32 lb.

Ex. 3 Convert 84 qt to ___ L

Solution:

Since 1 L ≈ 1.06 qt, then $1 \approx \frac{1\text{L}}{1.06\text{qt}}$.

So, 84 qt ≈ $\frac{84\text{qt}}{1} \bullet \frac{1\text{L}}{1.06\text{qt}} = \frac{84}{1.06}$ L = 79.2452... L ≈ 79.25 L.

Ex. 4 Convert 12,192 cm to ___ ft

Solution:

There is no direct conversion from centimeters into feet so we will have to work this out in two steps. Here are two different ways of working the problem:

Method #1:

(cm → in) We will first convert to inches and then to feet:

Since 2.54 cm = 1 in, then $1 = \frac{1\text{in}}{2.54\text{cm}}$.

So, 12,192 cm = $\frac{12{,}192\text{cm}}{1} \bullet \frac{1\text{in}}{2.54\text{cm}} = \frac{12{,}192}{2.54}$ in = 4800 in.

(in → ft) Now, convert the inches to feet:

Since 12 in = 1 ft, then $1 = \frac{1\text{ft}}{12\text{in}}$.

So, 4800 in = $\frac{4800\text{in}}{1} \bullet \frac{1\text{ft}}{12\text{in}} = \frac{4800}{12}$ ft = 400 ft.

OR

Method #2:

(cm → m) We will first convert to meters and then to feet:

k h da meters d c m

So, 12192 cm = 12192 = 121.92 m

(m → ft) Now, convert the meters to feet:

Since 1 m ≈ 3.2808 ft, then $1 \approx \frac{3.2808\text{ft}}{1\text{m}}$.

So, 121.92 m = $\frac{121.92\text{ m}}{1} \bullet \frac{3.2808\text{ft}}{1\text{m}} = \frac{399.995...}{1}$ ft ≈ 400 ft.

Notice that the answers derived by the two ways for solving the problem were slightly different. This should make sense when one remembers that the conversions that we are using between U.S. and metric are only approximation and will introduce a small error. To minimize the error, one should not round off until the end of the problem.

Ex. 5 Convert 4730 ml to ___ c.

Solution:

There is no direct conversion between milliliters and cups so we will need to convert this in several steps. If we look at the chart, we see that 1 L ≈ 1.06 qt. In order to use this conversion, we will need to first convert the ml to L:

(ml $\rightarrow$ L) k h da liters d c m

So, 4730 ml = 4730 = 4.730 L or 4.73 L

(L $\rightarrow$ qt) Now, convert from liters to quarts:

Since 1 L ≈ 1.06 qt, then $1 \approx \frac{1.06\,qt}{1L}$.

So, 4.73 L ≈ $\frac{4.73L}{1} \bullet \frac{1.06\,qt}{1L} = \frac{5.0138}{1}$ qt = 5.0138 qt

(qt $\rightarrow$ c) Finally, convert from quarts to cups:

Since 1 qt = 4 c, then $1 = \frac{4c}{1qt}$.

So, 5.0138 qt = $\frac{5.0138\ qt}{1} \bullet \frac{4c}{1qt} = \frac{20.0552}{1}$ c ≈ 20.06 c.

Ex. 6 Convert $\frac{\$8.93}{kg}$ to $\frac{\$\_\_\_}{oz}$.

Solution:

(kg $\rightarrow$ lb) First, convert from kilograms to pounds:

Since 1 kg ≈ 2.2 lb, then $1 \approx \frac{1kg}{2.2lb}$.

So, $\frac{\$8.93}{kg} \approx \frac{\$8.93}{kg} \bullet \frac{1kg}{2.2lb} = \frac{\$8.93}{2.2lb} = \frac{\$4.05909...}{lb}$.

(lb $\rightarrow$ oz) Now, convert the pounds to ounces:

Since 16 oz = 1 lb, then $1 \approx \frac{1lb}{16oz}$

So, $\frac{\$4.05909...}{lb} \bullet \frac{1lb}{16oz} = \frac{\$4.05909...}{16oz} = \frac{\$0.25369...}{oz} \approx \frac{\$0.25}{oz}$.

Ex. 7 Convert 50˚F to ___ C .

Solution:

Plug 50˚ in for F in the formula $C = \frac{5(F-32^\circ)}{9}$ and solve:

$C = \frac{5((50^\circ)-32^\circ)}{9} = \frac{5(18^\circ)}{9} = \frac{90^\circ}{9}$
= 10˚ C.

Ex. 8 Convert 81˚C to ___ F.

Solution:

Plug 81˚ in for C in the formula $F = \frac{9}{5}C + 32^\circ$ and solve: $F = \frac{9}{5}\left(\frac{81^\circ}{1}\right) + 32^\circ$
= 145.8˚ + 32˚ = 177.8˚ F.

Ex. 9 When certain type of metal is heated, it expands at a rate of $\frac{0.0003\,\text{m}}{1°\text{C}}$. How fast does in it expand in inches per degrees Fahrenheit?

<u>Solution:</u>

We need to convert $\frac{0.0003\,\text{m}}{1°\text{C}}$ to $\frac{\text{in}}{1°\text{F}}$

Let's first convert 0.0003 m to cm and then from cm to in.

(m $\Rightarrow$ cm)

$$0.0003\text{ m} = 0.\underset{\cup\cup}{00}03 = 0.03\text{ cm}$$

(cm $\Rightarrow$ in)

$$0.03\text{ cm} = \frac{0.03\,\text{cm}}{1} \bullet \frac{1\text{in}}{2.54\,\text{cm}} = \frac{0.03}{2.54}\text{ in} = 0.011811\ldots\text{ in}$$

Thus, $\frac{0.0003\,\text{m}}{1°\text{C}} = \frac{0.011811\ldots\text{ in}}{1°\text{C}}$

Now, we need to convert one degree change in Celsius to degrees changed in Fahrenheit. We do not plug in 1 into the formula since we are not converting 1˚ C to Fahrenheit, but we are finding the change from say 0˚ C to 1˚ C

0˚ C: $F = \frac{9}{5}(0) + 32 = 32˚\text{ F}$

1˚ C: $F = \frac{9}{5}(1) + 32 = 1.8 + 32˚\text{ F} = 33.8˚\text{ F}$

Thus, 1˚ C – 0˚ C = 33.8˚ F – 32˚ F = 1.8˚ F

Hence, $\frac{0.011811\ldots\text{ in}}{1°\text{C}} = \frac{0.011811\ldots\text{ in}}{1.8°\text{F}} = \frac{0.00656167\ldots\text{ in}}{1°\text{F}} \approx \frac{0.00656\text{ in}}{1°\text{F}}$.

It expands at a rate of ≈ 0.00656 inches per degree Fahrenheit.