

Step by Step: Conversions

SI Units (International System of Units)

Length = meters

Mass = grams (really kilograms)

Time = seconds

Volume = liters

Temperature: $^{\circ}\text{C} = 5/9 (^{\circ}\text{F} - 32)$

$\text{K} = ^{\circ}\text{C} + 273$

Multipliers

exa (E)

peta (P)

tera (T)

giga (G)

mega (M)

****kilo (k)**

****deci (d)**

****centi (c)**

****milli (m)**

micro (μ)

nano (n)

pico (p)

femto (f)

atto (a)

Example with meters:

1 Em = 1×10^{18} m

1 Pm = 1×10^{15} m

1 Tm = 1×10^{12} m

1 Gm = 1×10^9 m

1 Mm = 1×10^6 m

1 km = 1×10^3 m

1 dm = 1×10^{-1} m

1 cm = 1×10^{-2} m

1 mm = 1×10^{-3} m

1 μ m = 1×10^{-6} m

1 nm = 1×10^{-9} m

1 pm = 1×10^{-12} m

1 fm = 1×10^{-15} m

1 am = 1×10^{-18} m

(Same for grams, seconds & liters and any other units!)**

1 Mg = 1×10^6 g

1 kg = 1×10^3 g

1 dg = 1×10^{-1} g

1 cg = 1×10^{-2} g

1 mg = 1×10^{-3} g

1 μ g = 1×10^{-6} g

1 ng = 1×10^{-9} g

1 pg = 1×10^{-12} g

1 Ms = 1×10^6 s

1 ks = 1×10^3 s

1 ds = 1×10^{-1} s

1 cs = 1×10^{-2} s

1 ms = 1×10^{-3} s

1 μ s = 1×10^{-6} s

1 ns = 1×10^{-9} s

1 ps = 1×10^{-12} s

1 Ml = 1×10^6 l

1 kl = 1×10^3 l

1 dl = 1×10^{-1} l

1 cl = 1×10^{-2} l

1 ml = 1×10^{-3} l

1 μ l = 1×10^{-6} l

1 nl = 1×10^{-9} l

1 pl = 1×10^{-12} l

Length: 1 m = 39.37 in 2.54 cm = 1 in
1 km = 0.621 mile 1 mile = 5280 ft

Volume: **** 1 L = 1 dm³ and 1 ml = 1 cm³**
1 L = 1.06 qt 1 gal = 3.773 L 1 gal = 4 qt

Mass: 1 kg = 2.205 lb 1 lb = 16 oz

Ex. 1) Convert 49.6 in to miles

Since we are trying to change inches to miles, look above and write down every conversion you can find, that has **inches** in it. Also think in your head for any inch conversions you know, such as inches to feet.

$$12 \text{ in} = 1 \text{ ft} \quad 1 \text{ m} = 39.37 \text{ in} \quad 2.54 \text{ cm} = 1 \text{ in}$$

Also look above and write down any conversions you can find that include **miles**, since we are trying to go to **miles**.

$$1 \text{ km} = 0.621 \text{ mile} \quad 1 \text{ mile} = 5280 \text{ ft}$$

Now figure out the units going between each conversion. Remember that you are **starting at inches** in the conversion, so **write it going from inches to whatever**. Also remember that you are **trying to get to miles at the end**, so **write it going from whatever to miles**.

$$\begin{array}{lll} 12 \text{ in} = 1 \text{ ft} & 1 \text{ m} = 39.37 \text{ in} & 2.54 \text{ cm} = 1 \text{ in} \\ \text{in} \rightarrow \text{ft} & \text{in} \rightarrow \text{m} & \text{in} \rightarrow \text{cm} \end{array} \qquad \begin{array}{ll} 1 \text{ km} = 0.621 \text{ mile} & 1 \text{ mile} = 5280 \text{ ft} \\ \text{km} \rightarrow \text{mi} & \text{ft} \rightarrow \text{mi} \end{array}$$

Notice the 1st conversion ends in feet and the 5th conversion starts at feet. These two could be used together to get to the answer.

$$\begin{array}{ll} 12 \text{ in} = 1 \text{ ft} & 1 \text{ mile} = 5280 \text{ ft} \\ \text{in} \rightarrow \text{ft} & \text{ft} \rightarrow \text{mi} \end{array}$$

Notice the 2nd conversion ends in meters. Is there a way to get from meters to either km (4th conversion) or ft (5th conversion). Looking above and writing down every conversion with either kilometers or feet will hopefully allow you to find a conversion, linking the two conversions. The conversion for kilometers and meters will do this.

$$\begin{array}{lll} 1 \text{ m} = 39.37 \text{ in} & 1 \text{ km} = 1 \times 10^3 \text{ m} & 1 \text{ km} = 0.621 \text{ mile} \\ \text{in} \rightarrow \text{m} & \text{m} \rightarrow \text{km} & \text{km} \rightarrow \text{mi} \end{array}$$

Notice the 3rd conversion ends in cm. Is there a way to get from centimeters to either km (4th conversion) or ft (5th conversion). Looking above and writing down every conversion with either kilometers or feet will hopefully allow you to find some conversions, linking the two conversions. For this one you will also need to write down conversions having centimeters. Going from cm to km, you could change cm to meters and then meters to kilometers (see below).

$$\begin{array}{cccc}
 2.54 \text{ cm} = 1 \text{ in} & 1 \text{ cm} = 1 \times 10^{-2} \text{ m} & 1 \text{ km} = 1 \times 10^3 \text{ m} & 1 \text{ km} = 0.621 \text{ mile} \\
 \text{in} \rightarrow \text{cm} & \text{cm} \rightarrow \text{m} & \text{m} \rightarrow \text{km} & \text{km} \rightarrow \text{mi}
 \end{array}$$

Any of these 3 routes would get you to the correct answer. The first route is the shortest, so we will use it.

$$\begin{array}{l}
 \text{in} \rightarrow \text{ft} \rightarrow \text{mi}^{**} \\
 \text{or} \quad \text{in} \rightarrow \text{m} \rightarrow \text{km} \rightarrow \text{mi} \\
 \text{or} \quad \text{in} \rightarrow \text{cm} \rightarrow \text{m} \rightarrow \text{km} \rightarrow \text{mi}
 \end{array}$$

First we need to change inches to feet. Write the conversion down below the fraction (the cross). Then we put one part of the conversion on top and one part of the conversion on the bottom of the fraction (the cross), so that the inches will cancel. With the original inches in the numerator, we need to put the conversion inches in the denominator, so that they cancel.

$$\begin{array}{r}
 49.6 \text{ in} \quad | \quad \text{—————} \\
 | \\
 \text{in} \rightarrow \text{ft} \\
 1 \text{ ft} = 12 \text{ in}
 \end{array}$$

$$\begin{array}{r}
 49.6 \text{ in} \quad | \quad 1 \text{ ft} \\
 | \quad 12 \text{ in}
 \end{array}$$

Second we need to change the feet to miles. Write the conversion down below. Then in the fraction (the cross), we put one part on top and one part on the bottom, so that the feet will cancel. With the original feet in the numerator, we need to put the conversion feet in the denominator, so that they cancel.

$$\frac{49.6 \text{ in}}{12 \text{ in}} \times \frac{1 \text{ ft}}{12 \text{ in}}$$

$$\begin{aligned} &\text{ft} \rightarrow \text{mi} \\ &1 \text{ mi} = 5280 \text{ ft} \end{aligned}$$

$$\frac{49.6 \text{ in}}{12 \text{ in}} \times \frac{1 \text{ ft}}{12 \text{ in}} \times \frac{1 \text{ mi}}{5280 \text{ ft}} = 7.83 \times 10^{-4} \text{ mi}$$

On the calculator, either:

- Multiply 12 by 5280 and write that answer in the denominator. Then 49.6 divided by the denominator.
- Since everything in the denominator must be divided, 49.6 divide 12 **divide** 5280 equals your answer.

Ex. 2) Convert 49.6 in to km

Again look for conversions with inches and with kilometers:

$$\begin{array}{llllll} 1 \text{ ft} = 12 \text{ inches} & 1 \text{ m} = 39.37 \text{ in} & 1 \text{ inch} = 2.54 \text{ cm} & 1 \text{ km} = 1 \times 10^3 \text{ m} & 1 \text{ km} = 0.621 \text{ mi} \\ \text{in} \rightarrow \text{ft} & \text{in} \rightarrow \text{m} & \text{in} \rightarrow \text{cm} & \text{m} \rightarrow \text{km} & \text{mi} \rightarrow \text{km} \end{array}$$

1st Conversion: Try to get from feet to meters or miles. You can get to miles by 1 mi = 5280 ft. Then use conversion #5.

2nd Conversion: Use 2nd conversion and the 4th conversion. (A perfect match, since conversion #4 starts with meters.)

3rd Conversion: Try to get from centimeters to meters or miles. You can get from centimeters to meters by: 1 cm = 1 X10⁻² m. Then use conversion #4.

The second conversion way is the shortest, so we will use it.

$$\begin{array}{l} \text{in} \rightarrow \text{ft} \rightarrow \text{mi} \rightarrow \text{km} \\ \text{or} \quad \text{in} \rightarrow \text{m} \rightarrow \text{km} \text{ **} \\ \text{or} \quad \text{in} \rightarrow \text{cm} \rightarrow \text{m} \rightarrow \text{km} \end{array} \quad 1 \text{ m} = 39.37 \text{ in}, \quad 1 \text{ km} = 1 \times 10^3 \text{ m}$$

Use the first conversion to cancel out the inches.

$$\frac{49.6 \text{ in}}{1} \left| \frac{\quad}{\quad} \right|$$

$$1 \text{ m} = 39.37 \text{ in}$$

$$\frac{49.6 \text{ in}}{1} \left| \frac{1 \text{ m}}{39.37 \text{ in}} \right| \frac{\quad}{\quad}$$

$$1 \text{ km} = 1 \times 10^3 \text{ m}$$

Put in the 2nd conversion to cancel out the meters.

$$\frac{49.6 \text{ in}}{1} \left| \frac{1 \text{ m}}{39.37 \text{ in}} \right| \left| \frac{1 \text{ km}}{1 \times 10^3 \text{ m}} \right| = \mathbf{1.26 \times 10^{-3} \text{ km}}$$

On calculator: 49.6 divide 39.37 **divide** 1 X10³.
 (on calculator: 1 then either **EE** or **EXP** or **X10^x** button 3)
 Do **not** type in X10 separately, use one of the above buttons!

Ex. 3) Convert 15.6 kg/m³ to g/cm³

The method is the same, when there are units in the numerator and denominator. We will first fix the numerator units, changing kilograms to grams. Look on the conversion table for any conversions with grams or kilograms. Write them all down, if necessary. You will see that we can go from kg to g by using : 1 kg = 1 X10³ g
 **Put this conversion in, so kg will cancel.

$$\frac{15.6 \text{ kg}}{\text{m}^3} \left| \frac{\quad}{\quad} \right|$$

$$1 \text{ kg} = 1 \times 10^3 \text{ g}$$

$$\frac{15.6 \text{ kg}}{\text{m}^3} \left| \frac{1 \times 10^3 \text{ g}}{1 \text{ kg}} \right|$$

At this point the numerator is fixed; it is in grams. Now we must change the m^3 to cm^3 . Look above for conversions! There are conversions for cm^3 and dm^3 ($1 \text{ ml} = 1 \text{ cm}^3$ and $1 \text{ L} = 1 \text{ dm}^3$), but there are no conversions for m^3 . Therefore we must make a cubed conversion for ourselves.

Step 1: Find a conversion to use that is not cubed. Look for a conversion between meters and centimeters. There is a conversion for centimeters: $1 \text{ cm} = 1 \times 10^{-2} \text{ m}$

Step 2: Since we want cubed units, cube both sides of the equation to get the new conversion equation.

(If we had needed squared units, you would have squared both sides.)

$$\begin{aligned} (1\text{cm})^3 &= (1 \times 10^{-2} \text{ m})^3 \\ 1\text{cm}^3 &= 1 \times 10^{-6} \text{ m}^3 \end{aligned}$$

$$\frac{15.6 \text{ kg}}{\text{m}^3} \left| \frac{1 \times 10^3 \text{ g}}{1 \text{ kg}} \right|$$

$$1\text{cm}^3 = 1 \times 10^{-6} \text{ m}^3$$

Now put the conversion in so that the m^3 in the denominator will cancel. Notice when this is done the cm^3 ends up being in the denominator, where we want it.

$$\frac{15.6 \text{ kg}}{\text{m}^3} \left| \frac{1 \times 10^3 \text{ g}}{1 \text{ kg}} \right| \left| \frac{1 \times 10^{-6} \text{ m}^3}{1 \text{ cm}^3} \right| = \mathbf{1.56 \times 10^{-2} \text{ g/cm}^3}$$

On calculator: 15.6 multiplied by 1 **EE** or **EXP** or **X10^x** 3 multiplied by 1 **EE** or **EXP** or **X10^x** then (+/-) or (-) **button** 6

****Do not do X then EE.** If you hit multiply and then one of the exponent buttons, you will get the wrong power!

End of Notes