

Dimensional Analysis:

Dimensional analysis, or the “train tracks” method, is a way of converting units.

Let’s say you were given this problem:

Express 224.83 km in m.

The first step is to write down the unit you want to end up with, in this case m.

?m =

Then set it equal to the units you were given, multiplied by your conversion. Write the conversion with the units you were given on the bottom, so they cancel out.

NOTE: HOW TO FIND A CONVERSION-- A conversion factor is the number of one unit that equals another unit. For example, 100 cm = 1 m. The conversion factor here is either 100cm/1m or 1m/100cm. Note that both fractions equal one.

$$?m = 224.83 \text{ km} \times \frac{1000m}{1km}$$

Now multiply and simplify your units. Notice that the km cancel out.

$$224.83 \text{ km} = 224830 \text{ m}$$

Now let’s do a slightly more complicated problem. Say you were asked to:

Convert 30 cm into km.

First:

$$?km = 30 \text{ cm} \times \dots$$

Next we multiply by the conversion factor. We could figure out how many cm in a km, but it’s much simpler to just use two conversion factors. Instead of $\text{cm} \rightarrow \text{km}$, we’ll use $\text{cm} \rightarrow \text{m}$ and then $\text{m} \rightarrow \text{km}$. So our conversion factors are $\frac{100\text{cm}}{1m}$ and $\frac{1000m}{1km}$.

Remember to keep identical units on opposite sides of the fractions so they can cancel out.

$$? \text{ km} = 30 \text{ cm} \times \frac{1 \text{ m}}{100 \text{ cm}} \times \frac{1 \text{ km}}{1000 \text{ m}}$$

Multiply and simplify your units.

$$30 \text{ cm} = 0.0003 \text{ km}$$

Now for the hardest one. You're asked to:

Convert 30 $\frac{\text{miles}}{\text{hour}}$ into $\frac{\text{meters}}{\text{seconds}}$.

First:

$$? \frac{\text{meters}}{\text{second}} = \frac{30 \text{ miles}}{\text{hour}} \times \dots$$

Your conversion factors need to deal with the miles to meters and the hours to seconds. A mile is 1609.34 meters, so one conversion factor would be $\frac{1 \text{ mile}}{1609.34 \text{ m}}$. The time conversion factors would be in two steps, $\frac{1 \text{ hour}}{60 \text{ minutes}}$ and $\frac{1 \text{ minute}}{60 \text{ seconds}}$. Remember to align your units so they can cancel.

$$? \frac{\text{meters}}{\text{second}} = \frac{30 \text{ miles}}{\text{hour}} \times \frac{1609.34 \text{ meters}}{1 \text{ mile}} \times \frac{1 \text{ hour}}{60 \text{ min}} \times \frac{1 \text{ minute}}{60 \text{ seconds}}$$

Multiply and simplify your units.

$$\frac{30 \text{ miles}}{\text{hour}} \approx \frac{13.41 \text{ meters}}{\text{second}}$$