Shell Tutorial Center

Dimensional Analysis

Think of units algebraically! (i.e. you can cancel similar terms!)

For example: $\frac{m}{s} \times s \longrightarrow \frac{m}{\cancel{s}} \times \frac{\cancel{s}}{1} = m!$

Using this, we can change units for anything. Watch!

$$30\,ft \times \frac{12\,in}{1\,ft} \longrightarrow 30\,\cancel{ft} \times \frac{12\,in}{1\,\cancel{ft}} = 30 \times 12\,in = 360\,in$$

What about units like m^2 or cm^3? No problem!

Suppose we need to convert 10 m^2 into mm^2.

Just remember you need to square $\frac{1000\,mm}{1\,mm}$ to make the m^2 cancel.

$$10\,m^2 \left(\frac{1000\,mm}{1\,mm}\right)^2 \longrightarrow 10\,m^2 \left(\frac{1000\,mm}{1\,mm}\right)^2 = 10{,}000{,}000\ mm^2$$

Notice if you do it wrongly like this: $10\,m^2 \left(\frac{1000\,mm}{1\,mm}\right)^2 = 10{,}000{,}000\ mm^2$, which is off by 9,990,000! Oh no!

All the numbers in the parentheses have to get squared for this to work!

Now let's do a more complicated one. We need to convert 360 km/h to m/s.

$$360\,\frac{km}{h}\left(\frac{1000\,m}{1\,km}\right)\left(\frac{1h}{60\,min}\right)\left(\frac{1\,min}{60\,sec}\right)$$

We cancel the km, h, min terms, leaving only m and s.

$$360\,\frac{\cancel{km}}{\cancel{h}}\left(\frac{1000\,m}{1\,\cancel{km}}\right)\left(\frac{1h}{60\,\cancel{min}}\right)\left(\frac{1\,\cancel{min}}{60\,s}\right) = \frac{360 \times 1000}{60 \times 60} = 100\,\frac{m}{s}$$

You can use dimensional analysis to check calculations. For example, consider the easy formula distance = rate x time. [m] = [m/s][s]. Notice the seconds cancel and the two sides are equivalent!

Using terms with units can help catch mistakes before they happen. For example you need a distance in m and are given a time in seconds and a velocity in mi/h. [m] ≠ [mi/h][s]. No units cancel. We have to convert using the above methods.

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