Dimensional Analysis

Dimensional Analysis

- DA is a method for converting units (unit conversions)
- Units are a critical part of describing every measurement.
- Before you can work with units mathematically, you frequently must convert from one unit to another.
- DA <u>does not</u> do your math for you, but it makes sure you get your multiplications and divisions straight.

What's the method?

- Write the term to be converted, (both number and unit) as a fraction
- Make a fraction of the conversion formula, such that
  - if the unit in step 1 is in the numerator, that same unit in step 2 must be in the denominator.
  - if the unit in step 1 is in the denominator, that same unit in step 2 must be in the numerator.
- Us as many conversion formulas as needed until you get the desired units.

What's the method?

- Cancel units (to make sure you end up with the desired units)
- Multiply everything on top
- Multiply everything on bottom
- Divide the top by the bottom
- Round to the correct number of significant digits.

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15 mi = __?__ km

$$= \frac{15\ mi}{1} \left| \frac{5280\ ft}{1\ mi} \right| \frac{12\ in}{1\ ft} \left| \frac{2.54\ cm}{1\ in} \right| \frac{1\ m}{100\ cm} \left| \frac{1\ km}{1000\ m} \right.$$

$$= \frac{15*5280*12*2.54*1*1\ km}{1*1*1*1*100*1000}$$

$$= \frac{2,414,016\ km}{100,000}$$

$$= \boxed{24.1\ km}$$

Or if you knew the conversion factor 1 mi = 1.6 km

15 mi = __?__ km

$$= \frac{15\ mi}{1} \left| \frac{1.6\ km}{1\ mi} \right.$$

$$= \frac{15*1.6\ km}{1*1}$$

$$= \boxed{24\ km}$$

Dimensional Analysis

- **Two factor conversions**
  - ➤**15 mi/hr = __?__ m/s**
- **Use the same method as one factor.**

$15 \text{ mi/hr} = \underline{\ ?\ } \text{ m/s}$

$$= \frac{15 \text{ mi}}{1 \text{ hr}} \cdot \frac{1.6 \text{ km}}{1 \text{ mi}} \cdot \frac{1000 \text{ m}}{1 \text{ km}} \cdot \frac{1 \text{ hr}}{3600 \text{ sec}}$$

$$= \frac{15*1.6*1000 \text{ m}*1*1}{1*1*1*3600 \text{ s}}$$

$$= \frac{24{,}000 \text{ m}}{3{,}600 \text{ s}}$$

$$= \boxed{6.67 \text{ m/s}}$$

!DANGER!

$$\frac{15 \text{ mi/hr}}{1}$$

$15 \text{ mi/hr} = \underline{\ ?\ } \text{ m/s}$

ALSO ACCEPTABLE

$$\frac{1 \text{ hr}}{3600 \text{ sec}} \cdot \frac{15 \text{ mi}}{1 \text{ hr}} \cdot \frac{1.6 \text{ km}}{1 \text{ mi}} \cdot \frac{1000 \text{ m}}{1 \text{ km}}$$

$$\frac{1 \text{ hr}}{3600 \text{ sec}} \cdot \frac{15 \text{ mi}}{1 \text{ hr}} \cdot \frac{1.6 \text{ km}}{1 \text{ mi}} \cdot \frac{1000 \text{ m}}{1 \text{ km}}$$

$$\left(\frac{15 \text{ mi}}{1 \text{ hr}}\right) \cdot \left(\frac{1.6 \text{ km}}{1 \text{ mi}}\right) \cdot \left(\frac{1000 \text{ m}}{1 \text{ km}}\right) \cdot \left(\frac{1 \text{ hr}}{3600 \text{ sec}}\right)$$

Conversion Factors that are nice to know

- Length:
  - ➤2.54 cm = 1 in
  - ➤5280 ft = 1 mi
  - ➤1.6 km = 1 mi
  - ➤1600 m = 1 mi
  - ➤1000 m = 1 km
  - ➤100 cm = 1 m
  - ➤1000 mm = 1 m
- Time:
  - ➤1 hr = 3600 sec
- Mass
  - ➤2.2 lb = 1 kg

Practice

16 wosets = 1 nureau   3.8 zowers = 13 bofa   0.12 zables = 1 bofa

5 zlock = 17 wosets   8.4 zowers = 1 vug   7 nureau = 23 zables

19.6 jertains = 1 zlock

1967 bofa = ? zables
  236 zables

0.56 nureau = ? wosets
  9 wosets

8.5 bofa = ? vug
  0.30 vug

Go Forth and DA