Chem Project

by Adam Clark

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Abstract: We will focus on Dimensional Analysis and Molarity.

DIMENSIONAL ANALYSIS

Dimensional analysis is a way to convert units.

Part 1: Simple Unit Conversions

Let's say we want to convert meters to centimeters. First we need to ask how many meters are in a centimeter.

$$1\text{Meter} = 100\text{Centimeter}$$
$$\text{or}$$
$$\tfrac{1}{100}\text{Meter} = 1\text{Centimeter}$$

Lets say we have 5 meters. We intuitively know that's 500 centimeters. How'd we do that?

Because 1 Meter is the same as 100 Centimeters we can say:

$$\frac{100\text{Centimeters}}{1\text{Meter}} = 1$$

Using the definition intuitively we get:

$$\frac{5\text{Meters}}{1} \times \frac{100\text{Centimeters}}{1\text{Meter}} = \frac{500\text{Centimeters}}{1}$$

The two 'Meters' cancel out. Leaving our units with Centimeters.

$$\frac{5\cancel{\text{Meters}}}{1} \times \frac{100\text{Centimeters}}{1\cancel{\text{Meter}}} = \frac{500\text{Centimeters}}{1}$$

Let's try it out:
Given:

$$1\text{Meter} = 100\text{Centimeter}$$
or
$$\tfrac{1}{100}\text{Meter} = 1\text{Centimeter}$$

How many Meters is 10,000 Centimeters?

0. Re-State as a fraction $\frac{10{,}000\text{Centimeters}}{1}$

1. Find Conversion Factor $\frac{1\text{Meter}}{100\text{Centimeter}}$

2. Multiply to cancel units

$$\frac{10{,}000\cancel{\text{Centimeters}}}{1} \times \frac{1\text{Meter}}{100\cancel{\text{Centimeters}}} = 100\text{Meters}$$

or

$$\frac{10{,}000\cancel{\text{Centimeters}}}{1} \div \left(\frac{1\text{Meter}}{100\cancel{\text{Centimeters}}}\right)^{-1} =$$
$$\frac{10{,}000\cancel{\text{Centimeters}}}{1} \div \frac{100\cancel{\text{Centimeter}}}{1\text{Meters}} = 100\text{Meters}$$

Multi-layer DIMENSIONAL ANALYSIS
Let's say we have the conversion factors

$$1 \text{ Meter} = 100 \text{ Centimeter}$$

$$1 \text{ Inch} = 2.54 \text{ Centimeter}$$

How do we convert from Meters to Inches? We can use dimensional analysis.

$$\frac{x \text{ Meters}}{1} \times \frac{100 \text{ Centimeters}}{1 \text{ Meters}} = z \text{ Centimeters}$$

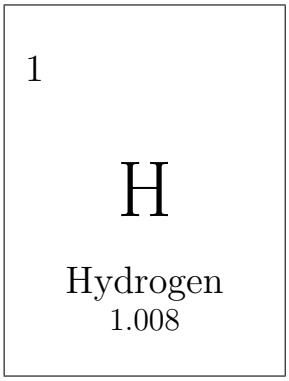
$$\frac{z \text{ Centimeters}}{1} \times \frac{1 \text{ Inches}}{2.54 \text{ Centimeters}} = y \text{ Inches}$$

$$\frac{x \text{ Meters}}{1} \times \frac{100 \text{ Centimeters}}{1 \text{ Meters}} \times \frac{1 \text{ Inches}}{2.54 \text{ Centimeters}} = y \text{ Inches}$$

Notice how the units cancel out.

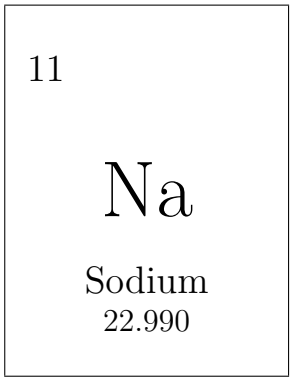
$$\frac{x \cancel{\text{ Meters}}}{1} \times \frac{100 \cancel{\text{ Centimeters}}}{1 \cancel{\text{ Meters}}} \times \frac{1 \text{ Inches}}{2.54 \cancel{\text{ Centimeters}}} = y \text{ Inches}$$

DIMENSIONAL ANALYSIS and Chemistry



Let's say we have 10g of Hydrogen, how many moles is that?
To get our conversion factor we look at the periodic table and take the molar mass.

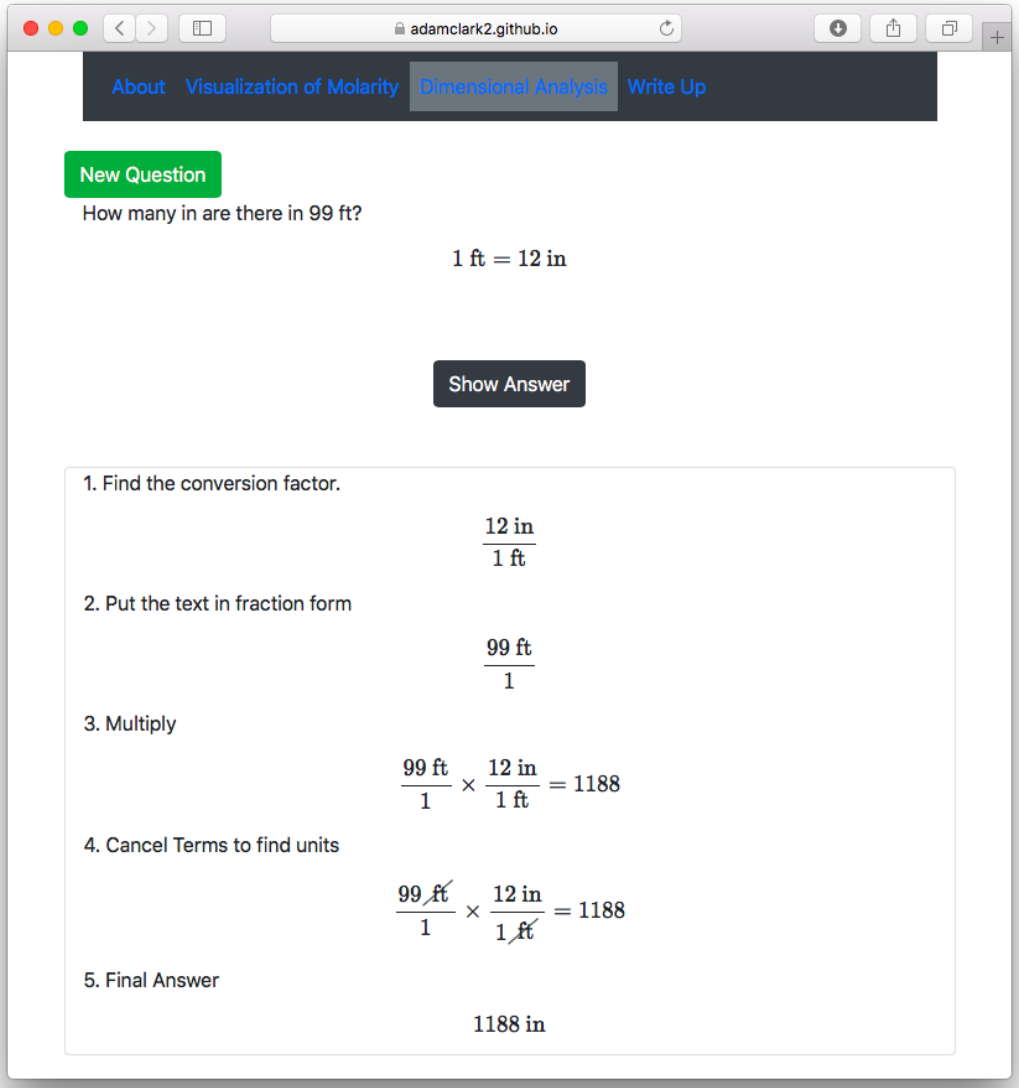
$$\frac{10 \text{ g of Hydrogen}}{1} \times \frac{1 \text{ mole of Hydrogen}}{1.008 \text{ g of Hydrogen}} = 9.92 \text{ g of Hydrogen}$$



Let's say we have 1 mole of sodium. How many grams is that?

$$\frac{1 \text{ mole of Na}}{1} \times \frac{22.990 \text{ g of Na}}{1 \text{ mole of Na}} = 22.99 \text{ g of Na}$$

Use the website for practice problems.



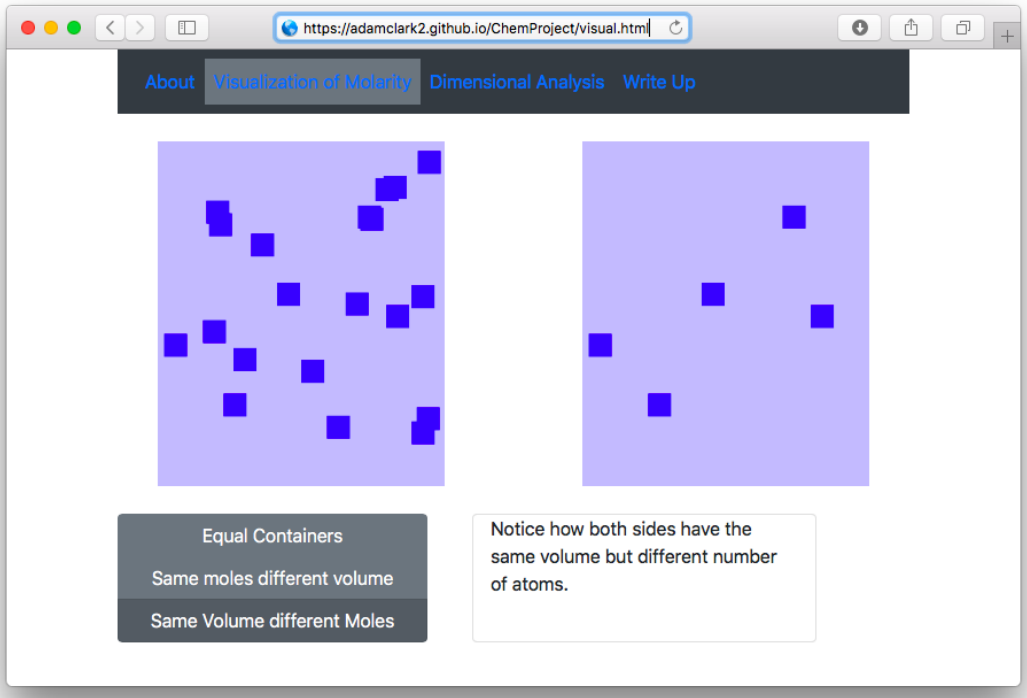
https://adamclark2.github.io/ChemProject/dimensional_analysis.html

MOLARITY

Molarity is defined as:

$$\text{Molarity} = \frac{\text{Number of Moles}}{\text{Liters}}$$

Molarity is concentration. Let's visualize that:



https://adamclark2.github.io/ChemProject/visual.html

As we can see above the left side has more 'atoms' than the right, but they have the same liter's.

We can also use this definition to do math. Let's say we have a 5 Molar solution and we have 2 liters of it, how many Moles do we have?

$$\frac{5 \text{ Moles}}{1 \text{ Liters}} \times \frac{2 \text{ liters}}{1} = 10 \text{ Moles}$$