

Dimensional Analysis

(a.k.a. the Factor-Label Method a.k.a. the Unit Cancellation Method)
(For now, I am pulling rank and telling you that you must do it this way! for now ...)

Temporarily, we are going to take an aside from a specific “topic” and work on some problem solving skills using what is to become everybody’s new favorite method! We need to do a little math. Actually, we need to do a lot of math. Some questions on the AP are notorious for making you do mathematical conversions in the context of environmental science, but I will admit that I have used dimensional analysis many times in non-academic scenarios. Maybe you may have to figure out the gas efficiency of your car, the gas usage in your weekly commute, or even your possible savings for trading in your gas-guzzler for a more fuel-efficient model. You could possibly have to compare the cost difference of heating a home using oil or natural gas. Maybe you might have to calculate number of BTU’s of heat needed to generate the electricity produced by a coal-fired power plant. The possibilities are almost endless... So how are you going to accomplish such tasks? Some of you are going to remind me that you have your own way of doing things, but for now you **must** show you work dimensional analysis style. Remember: you have to bring some prior skills and knowledge to the table. You should already have the acquired knowledge of basic math functions, **and** have the ability to convert to and from scientific notation if necessary, **and** know the conversions of simple metric prefixes (milli, centi, kilo.) Now you just have to use those skills in conjunction with the dimensional analysis style of problem solving.

Example 1:

Convert 1 day into minutes. Be sure to show all labels and numbers in your work.

Example 2:

Convert 10 gallons of water into pounds of water.

Given: 1 gallon of water = 8 pounds of water

Example 3:

Convert one year into minutes. Be sure to show all labels and numbers in your work. (no quick use of song lyrics allowed!)

Example 4:

Convert 2 days into seconds. Be sure to show all labels and numbers in your work.

Example 5:

Convert 0.500 kWh into BTUs (British Thermal Units).

Given: 3,400 BTU’s = 1 kWh

Example 6:

Convert 4 Kilocalories to Joules

Given: 1 Kilocalorie = 4184 joules

Example 7:

How many inches are there in 1 meter?

Given: there are approximately 2.5cm in 1 inch

Example 8:

Convert 2,000 ft³ of natural gas into dollars (\$)

Given: Natural gas is available at a cost of \$5.00 per 1000 ft³

Example 9:

Convert 160km/hr into miles/hr

Given: there are 1.6 km in 1 mile

Example 10:

How many square feet are there in a 200 square meter house?

1 square meter = 10.76 square feet

Example 11:

A clerk can sort 400 sheets per hour. If there are 200 sheets in an inch, how many hours will it take her to file 100 inches of loose sheets?

Example 12:

Determine the average fuel consumption in gallons (per year) of the average American car given the following:

Given: The average car is driven 10,000 miles per year. The mileage rate for the average car is 25 miles per gallon of gasoline.