

Study Tip—What does it mean to show your work?

“Show your work” is code for “Explain to me how you came up with an answer.”

Generally, the answer itself is very few points, so getting good at explanation is a key tool.

In chemistry, “show your work” generally refers to a relatively complex mathematical problem and these generally come in two types. (Sometimes you mix the two.)

Remember all “Final Answers” should have

1. Appropriate significant figures and units
2. A zero before the decimal if the value is less than 1 and not in scientific notation
3. Scientific notation should be reported in the format “N x 10^x”

Where N is a number between 1 and 10

And you use an “x” not an “E” or “e” or “*” or “.” or something else between the N and the 10.

Circling or boxing the answer is a good way to tell the instructor what to grade. While not required, if you don't circle it (or circle more than one thing) do not complain if you lose points because the instructor graded the wrong thing.

Type 1. Algebraic Equations.

These are problems solved by using some type of algebraic equation. Two examples from early in the class are density and the conversion between Celsius and Kelvin. For algebraic problems, do this:

An object with density of 13.6 g/cm³ has a mass of 123 g, what volume would it displace?

STEP

1—write the equation using standard variables

Note: when in doubt about variables, use words. Sometimes context helps to know what the variable means

EXAMPLE

density = mass/volume

(PV=nRT makes the V clear)

2—rewrite equation in same format

Put appropriate numbers into the equation and include units and significant figures

Make sure that the units of the numbers you input all match

(for example, if you were given mass in kg, change it to grams

to match the mass unit in density before putting the number into the equation.)

$$13.6 \text{ g/cm}^3 = 123 \text{ g/volume}$$

3—do whatever rearranging you need to solve equation

$$\begin{aligned} (13.6 \text{ g/cm}^3) * \text{volume} &= 123 \text{ g} \\ \text{volume} &= 123 \text{ g}/(13.6 \text{ g/cm}^3) \\ \text{volume} &= 9.04411 \end{aligned}$$

4—check your answer for appropriate significant figures and units

$$\text{Volume} = 9.04 \text{ cm}^3$$

5—circle the answer you want graded

$9.04 \text{ cm}^3 = \text{Volume}$

Type 2. Dimensional Analysis

These are even more common and are often variations on unit conversions. Density can also be used as a conversion factor

How many minutes does it take a car traveling at 65 miles per hour to move 23.5 meters?

STEP

1—Identify starting point, where you want to wind up
And any conversions given in the problem
You may want to note these, but it is not necessary.

EXAMPLE

given = 23.5 m
want = time in minutes
Useful conversions: 1 hr \equiv 60 min
100 cm = 1 m

1b—Remember that numbers with divided units are:
normally not your starting point, but a conversion factor
exceptions like when converting a speed into different units, miles per hour to m/s
rewriting as an equality is a mental trick to prevent bias for top or bottom

65 miles per hour = 65 mi/hr
65 miles = 1 hr

2—Start on the left with what you are given
INCLUDE UNITS!
Units are on top unless it is something like: “/m” or m⁻¹

23.5 m

3—write the conversion factor, with units so units cancel
Remember to keep units and number of the equality together

$23.5 \text{ m} \times \frac{100 \text{ cm}}{1 \text{ m}}$

4—continue conversions until you get to the unit you want

$$23.5 \text{ m} \times \frac{100 \text{ cm}}{1 \text{ m}} \times \frac{1 \text{ in}}{2.54 \text{ cm}} \times \frac{1 \text{ ft}}{12 \text{ in}} \times \frac{1 \text{ mi}}{5280 \text{ ft}} \times \frac{1 \text{ hr}}{65 \text{ mi}} \times \frac{60 \text{ min}}{1 \text{ hr}} =$$

5—do the calculation

The easiest way (no need for parenthesis)

Ignore all values of “1”, it doesn’t change anything and more buttons are more potential error

Before each number on top press “X”

Before each number on the bottom press “÷”

Order does not matter

$$23.5 \text{ m} \times \frac{100 \text{ cm}}{1 \text{ m}} \times \frac{1 \text{ in}}{2.54 \text{ cm}} \times \frac{1 \text{ ft}}{12 \text{ in}} \times \frac{1 \text{ mi}}{5280 \text{ ft}} \times \frac{1 \text{ hr}}{65 \text{ mi}} \times \frac{60 \text{ min}}{1 \text{ hr}} = \boxed{0.13 \text{ min}}$$

6—Check that your number has the correct significant figures and units

Remember that conversions between units in the same unit system are exact (as is 1 inch = 2.54 cm)

If a conversion is measured (as speed is in the given example),

we normally consider the “1” as exact and the other number as measured.

Do NOT assume that your “given” determines the final answer, it might not;

so check each conversion for significant figures.

IF you strike through units to check that they cancel correctly, make sure the original units are still visible to the instructor. If not you may not receive full credit for showing work.

7—Circle your final answer (see above)