

CHEM 101 Handout: How to use the unit-conversion method for calculations

You will need to complete many calculations in CHEM 101. The method presented here is an almost fool-proof approach. It cannot guarantee that you will be able to get the correct result. However, if you use it correctly, it is almost impossible to get a wrong answer and not know it.

The two most important things to remember are:

- **ALWAYS** include all units in your calculation.
- **RESIST** the temptation to quickly start entering numbers into your calculator - this should be almost the last step in solving the problem.

Here is a step-by-step approach to problem-solving using this method.

1. Carefully consider the problem and write down
 - the starting or given quantity
 - the desired units for the answer
2. Write a unit plan (how to get from the starting unit to the desired unit)
3. Write the equivalences you need and the two possible conversion factors for each.
4. Set up the calculation using the correct conversion factors to follow your unit plan.
5. Carefully check that the calculation will give the desired unit for the answer.
6. Complete the calculation (make sure that you know how to use your calculator).
7. Round the answer to the correct number of significant figures.
8. Final check: Does the answer seem reasonable?

Try these sample problems (solutions are on the back).

Sample Problem #1: The daily value for sodium is 2,400 mg. How many grams of sodium is this?

Sample Problem #2: You notice that a 1.0 cup serving of dried soup mix contains almost 25% of the daily value for sodium. How many milliliters of soup is this? Note that 1 cup = 0.264 liters.

1. Starting quantity = 2,400 mg Desired unit = g

2. Unit plan: mg \rightarrow g

3. 1 g = 1,000 mg (you are responsible to know the milli prefix)

$$\frac{1 \text{ g}}{1000 \text{ mg}} \quad \text{and} \quad \frac{1000 \text{ mg}}{1 \text{ g}}$$

4. $2,400 \text{ mg} \times \frac{1 \text{ g}}{1000 \text{ mg}} = \underline{\hspace{2cm}} \text{ g}$

5. $2,400 \cancel{\text{ mg}} \times \frac{1 \text{ g}}{1000 \cancel{\text{ mg}}} = \underline{\hspace{2cm}} \text{ g}$ mg cancels out to give g,
the desired unit

6. $2,400/1000 = 2.400$ (result from calculator)

7. 2,400 is ambiguous for sig figs. It is probably safest to assume only 2 sig figs and report your result as 2.4 g.

8. If you keep in mind that milligrams are smaller units than grams, then it makes sense that the quantity expressed in grams has a smaller number (2.4 compared to 2,400).

1. Starting quantity = 1.0 cup Desired unit = mL

2. Unit plan: cup \rightarrow L \rightarrow mL

3. 1 cup = 0.264 L (given in problem) and 1 L = 1,000 mL (you should know)

$$\frac{1 \text{ cup}}{0.264 \text{ L}} \quad \text{and} \quad \frac{0.264 \text{ L}}{1 \text{ cup}} \quad \frac{1 \text{ L}}{1000 \text{ mL}} \quad \text{and} \quad \frac{1000 \text{ mL}}{1 \text{ L}}$$

4. $1.0 \text{ cup} \times \frac{0.264 \text{ L}}{1 \text{ cup}} \times \frac{1000 \text{ mL}}{1 \text{ L}} = \underline{\hspace{2cm}} \text{ mL}$

5. $1.0 \cancel{\text{ cup}} \times \frac{0.264 \cancel{\text{ L}}}{1 \cancel{\text{ cup}}} \times \frac{1000 \text{ mL}}{1 \cancel{\text{ L}}} = \underline{\hspace{2cm}} \text{ mL}$ cup and L cancel out to
give mL, the desired unit

6. $1.0 \times 0.264 \times 1000 = 264.0$ (result from calculator)

7. 1.0 cup has only 2 sig. figs, so answer = 260 ml or $2.6 \times 10^2 \text{ mL}$

8. Since 1 cup $\sim \frac{1}{4}$ L and there are 1000mL/L, we can expect $\sim \frac{1}{4} \times 1000$ or $\sim 250 \text{ mL}$