Practice Problems on Unit Conversion
Using Dimensional Analysis (Factor Label Method)

These are practice problems. It is assumed that you have already been introduced to the method of "dimensional analysis." Answers are provided at the end of this document. You should look at the question, work it out *on paper* (not in your head), before checking the answers at the end. The purpose of these problems is not merely to get the right answer, but to practice writing out the dimensional analysis setup. We will be using this method all semester and I will be asking for your setups, so don't just work out an answer on your calculator without writing out a setup.

In these practice problems, I am going to ask you to stick to ONLY the following conversions between the English and metric system (these are the only conversions that I will give you on exams). In some cases you can look up conversions elsewhere, but I would rather you didn't. I want you to learn how to make conversions that take more than one single step.

1 inch = 2.54 cm exactly **1 lb = 454 g** **1 qt = 0.946 L**
1 mi = 5280 ft **1 qt = 2 pt** **4qt = 1 gal**

You should also remember that 1 cc = 1 cm^3 = 1 mL exactly. (This is a conversion you need to know.)

For all problems, please ***show your dimensional analysis setup and give your answer to the correct significant figures.*** Remember you can use any of the conversions shown above.

1. Convert 3598 grams into pounds.
2. Convert 231 grams into ~~ounces~~. nanograms
3. A beaker contains 578 mL of water. What is the volume in quarts?
4. How many ng are there in 5.27×10^{-13} kg?
5. What is 7.86×10^{-2} kL in dL?
6. What is 0.0032 gallons in cL?
7. A box measures 3.12 ft in length, 0.0455 yd in width and 7.87 inches in height. What is its volume in cubic centimeters?
8. A block occupies 0.2587 ft^3. What is its volume in mm^3?
9. If you are going 55 mph, what is your speed in nm per second?
10. If the density of an object is 2.87×10^{-4} ~~lbs/cubic~~ inch, what is its density in g/mL?

decigrams/meters cubed

Answers are on the next page.

Answers:

1. $x \text{ lb} = 3598 \text{ g} \left(\frac{1 \text{ lb}}{454 \text{ g}} \right) = 7.93 \text{ lb}$

2. $x \text{ oz} = 231 \text{ g} \left(\frac{1 \text{ lb}}{454 \text{ g}} \right) \left(\frac{16 \text{ oz}}{1 \text{ lb}} \right) = 8.14 \text{ g}$

3. $x \text{ qt} = 578 \text{ mL} \left(\frac{1 \text{ L}}{10^3 \text{ mL}} \right) \left(\frac{1 \text{ qt}}{0.946 \text{ L}} \right) = 0.611 \text{ qt}$

4. $x \text{ ng} = 5.27 \text{x} 10^{-13} \text{ kg} \left(\frac{10^{12} \text{ ng}}{1 \text{ kg}} \right) = 0.527 \text{ ng}$

5. $x \text{ dL} = 7.86 \text{x} 10^{-2} \text{ kL} \left(\frac{10^4 \text{ dL}}{1 \text{ kL}} \right) = 786 \text{ dL}$

6. $x \text{ cL} = 0.0032 \text{ gal} \left(\frac{4 \text{ qt}}{1 \text{ gal}} \right) \left(\frac{0.946 \text{ L}}{1 \text{ qt}} \right) \left(\frac{10^2 \text{ cL}}{1 \text{ L}} \right) = 1.2 \text{ cL}$

7. You should the volume of a box is calculated thus; V = L x W x H.
   First you have to convert all the dimensions to the same unit such as inches.

   $x \text{ in} = 3.12 \text{ ft} \left(\frac{12 \text{ in}}{1 \text{ ft}} \right) = 37.4 \text{ in}$

   $x \text{ in} = 0.0455 \text{ yd} \left(\frac{3 \text{ ft}}{1 \text{ yd}} \right) \left(\frac{12 \text{ in}}{1 \text{ ft}} \right) = 1.64 \text{ in}$

   $V = 37.4 \text{ in} \times 1.64 \text{ in} \times 7.87 \text{ in} = 483 \text{ in}^3$

   Note the question is asking for cm^3. We know the conversion from in to cm. We can easily convert in^3 to cm^3 thus:

   $$\left(\frac{2.54 \text{ cm}}{1 \text{ in}} \right)^3 = \left(\frac{2.54^3 \text{ cm}^3}{1 \text{ in}^3} \right)$$

   Thus, we can convert 483 in^3 into cm^3 as follows:

   $$x \text{ cm}^3 = 483 \text{ in}^3 \left(\frac{2.54^3 \text{cm}^3}{1 \text{ in}^3} \right) = 7.91 \text{ x } 10^3 \text{ cm}^3$$

8. $$x \text{ mm}^3 = 0.2587 \text{ ft}^3 \left(\frac{12^3 \text{ in}^3}{1 \text{ ft}^3} \right) \left(\frac{2.54^3 \text{ cm}^3}{1 \text{ in}^3} \right) \left(\frac{10^3 \text{ mm}^3}{1 \text{ cm}^3} \right) = 7.326 \text{ x } 10^6 \text{ mm}^3$$

9. $$x \frac{\text{nm}}{\text{s}} = \frac{55 \text{ mi}}{1 \text{ h}} \left(\frac{5280 \text{ ft}}{1 \text{ mi}} \right) \left(\frac{12 \text{ in}}{1 \text{ ft}} \right) \left(\frac{2.54 \text{ cm}}{1 \text{ in}} \right) \left(\frac{10^7 \text{ nm}}{1 \text{ cm}} \right) \left(\frac{1 \text{ h}}{60 \text{ min}} \right) \left(\frac{1 \text{ min}}{60 \text{ s}} \right) = 2.5 \text{ x } 10^{10} \text{ nm/s}$$

10. $$x \frac{\text{g}}{\text{mL}} = \left(\frac{2.87 \text{x} 10^{-4} \text{ lb}}{1 \text{ in}^3} \right) \left(\frac{454 \text{ g}}{1 \text{ lb}} \right) \left(\frac{1 \text{ in}^3}{2.54^3 \text{ cm}^3} \right) \left(\frac{1 \text{ cm}^3}{1 \text{ mL}} \right) = 7.95 \text{x} 10^{-3} \text{ g/mL}$$