

Dimensional Analysis

Model 1

All measurements consist of a numerical value **AND** a unit.



Q1. In the drawing of the buyer's thoughts, what does "2 pounds" represent?

Q2. a) In the buyer's thoughts, which number is a conversion factor?

b) Using one grammatically correct sentence, describe a unique characteristic of a conversion factor. (In other words, how can you recognize a conversion factor when you see one?)

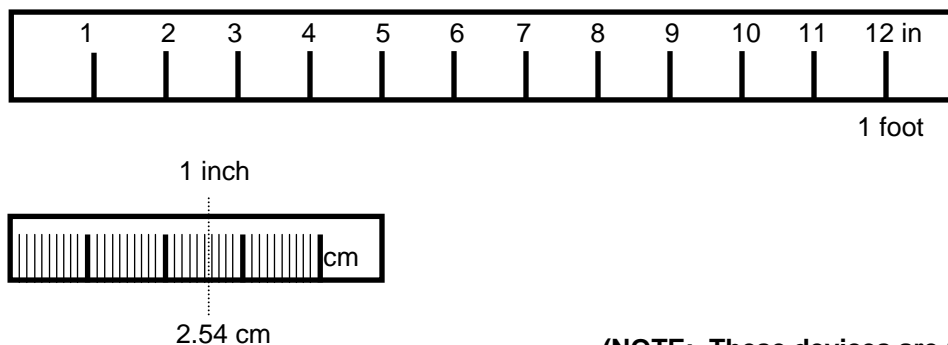
Q3. If the unit "pounds" is used in the problem, why does "pounds" disappear in the final answer of \$3.98? Give a mathematical reason, using grammatically correct sentences in your explanation.

Q4. What is the unit in the final answer? Why does this occur?

Q5. a) Suppose another market offered five pounds of apples for \$6. **SHOW** using a mathematical equation (much like the one in Model 1) how the buyer would do this problem. Provide the answer with the correct units.

b) How much will the buyer save by switching to the other market?

Model 2



(NOTE: These devices are not drawn to scale!)

Q6. a) Based on Model 2 above, complete the following equality statements:

$$1 \text{ in} = \underline{\hspace{2cm}} \text{ cm}$$

$$\underline{\hspace{2cm}} \text{ in} = 1 \text{ foot}$$

b) Write each of the equalities above in the form of a fraction.

Q7. Houston Rockets basketball player Yao Ming is about 7.5 feet tall. **SHOW using a mathematical equation** (as in Model 1) how you can use the information above (in Q6b) to calculate his height ***in inches***. This setup should ALWAYS INCLUDE UNITS!

Q8. Using the same kind of setup, convert your answer in Q7 to centimeters. This setup should ALWAYS INCLUDE UNITS!

Q9. Each of the calculations in Q7 and Q8 were single-step conversions. We can combine the two problems to make one multi-step problem. By filling in the blanks, use the following multi-step setup to convert Yao Ming's height from feet to centimeters. Remember, this setup should **ALWAYS include units**. (HINT: What unit will be at the beginning? What unit will be at the end?)

$$\text{_____} \times \left(\text{_____} \right) \times \left(\text{_____} \right) = \text{_____}$$

Q10. Based on Q9, what kind of information did you use first to start the setup of your problem (measurement or conversion factor)? What comes after that information in the setup?

Q11. Based on Q10, which piece of information in the problem is more likely to change from one problem to another, the measurement or the conversion factor?

Q12. Do you think the order of information in the setup matters or do you think setting up the problem in a certain order helps you solve the problem easier? Explain.

Exercises

KEEP IN MIND WHEN PRACTICING:

- Do these exercises on a separate piece of paper, showing all of your work. ***This will NOT be graded*** but showing your work is good practice.
- You ***need to know*** metric prefixes by memory for exams/quizzes.
- You ***do not*** need to know English to metric conversions by memory. You can refer to the back cover of your textbook for conversions that you may need. They will also be provided on exams.

I. Jabberwocky

This exercise is to reinforce the concept that problems are set up based on UNITS. Nonsense words taken from the poem *Jabberwocky* (from Lewis Carroll's *Through the Looking Glass*)

There are 20 tumtum trees in the tulgey wood.

In each tulgey wood is one frumious Bandersnatch.

There are 5 slithy toves in 2 borogoves.

There are 2 mome raths per Jabberwock.

There are 2 Jubjub birds in 200 tumtum trees.

There are 200 mome raths in each borogove.

There are 5 Jubjub birds per slithy tove.

The question is: If there are 5 frumious Bandersnatches, how many Jabberwocks are there?

You should use a dimensional analysis setup to show your work!

HINT: What information above is a conversion factor and what information is not?

II. If you have done the previous problem correctly, you have just done a “multi-step conversion” problem (a problem that involves more than one conversion factor). Here is some practice with multi-step conversions.

1. Calculate the cost of gasoline for a 420 mile trip if your car averages 20 miles/gal of gas, and the gas costs \$0.95/gallon.

Gasoline for the 420 mile trip costs approximately \$_____ (your gas mileage is dependent on a lot of factors, so think about how impossible it is to know to the penny how much you will end up spending!)

2. Harold's car has a fuel efficiency of 35 miles per gallon. Kumar's car has a fuel efficiency of 12 kilometers per liter. Who gets better gas milage, Harold or Kumar?

3. A unit of length called the “furlong” is used in horse racing. The units of length called the “chain” and the “link” are used in surveying. There are 8 furlongs in 1 mile (mi), 10 chains in 1 furlong, and 100 links in 1 chain. To three significant figures, what is the length of 1 link in inches?