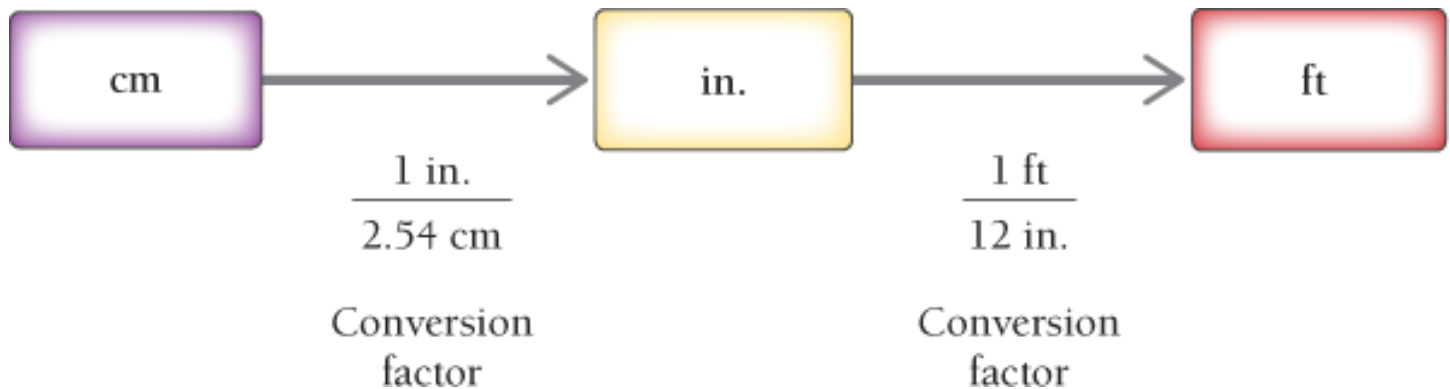


2.7 Solving Multistep Unit Conversion Problems

Convert between units.

When solving multistep unit conversion problems, follow the preceding procedure, but add more steps to the solution map. Each step in the solution map should have a conversion factor, with the units of the previous step in the denominator and the units of the following step in the numerator. For example, suppose you want to convert 194 cm to ft. The solution map begins with cm, and you use the relationship $2.54 \text{ cm} = 1 \text{ in.}$ to convert to in. Then use the relationship $12 \text{ in.} = 1 \text{ ft}$ to convert to ft.

SOLUTION MAP



Once the solution map is complete, follow it to solve the problem.

SOLUTION

$$194 \cancel{\text{ cm}} \times \frac{1 \cancel{\text{ in.}}}{2.54 \cancel{\text{ cm}}} \times \frac{1 \text{ ft}}{12 \cancel{\text{ in.}}} = 6.3648 \text{ ft}$$

$$194 \text{ cm} \times 1 \text{ in.} / 2.54 \text{ cm} \times 1 \text{ ft} / 12 \text{ in.} = 6.3648 \text{ ft}$$

You then round to the correct number of significant figures—in this case, three (from 194 cm, which has three significant figures).

$$6.3648 \text{ ft} = 6.36 \text{ ft}$$

$$6.3648 \text{ ft} = 6.36 \text{ ft}$$

Because 1 foot is defined as 12 in., it does not limit significant figures.

Finally, check the answer. The units of the answer, feet, are the correct ones, and the magnitude seems about right. A foot is larger than a centimeter, so it is reasonable that the value in feet is smaller than the value in centimeters.



Example 2.10 Solving Multistep Unit Conversion Problems

A recipe for making creamy pasta sauce calls for 0.75 L of cream. Your measuring cup measures only in cups. How many cups of cream should you use? (4 cups = 1 quart)(4 cups=1 quart)

SORT

Begin by sorting the information in the problem into given and find.

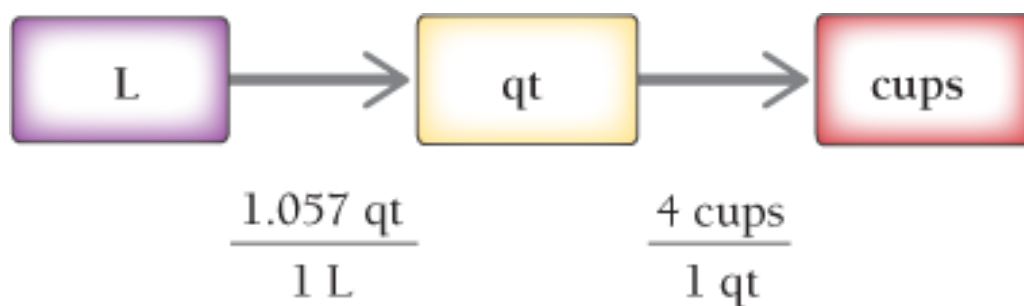
GIVEN: 0.75 L

FIND: cups

STRATEGIZE

Draw a solution map for the problem. Begin with the *given* quantity and symbolize each step with an arrow. Below the arrow, write the conversion factor for that step. The solution map ends at the *find* quantity.

SOLUTION MAP



RELATIONSHIPS USED

1.057 qt = 1 L 1.057 qt=1 L (from **Table 2.3**)

4 cups = 1 qt 4 cups=1 qt (given in problem statement)

SOLVE

Follow the solution map to solve the problem. Begin with 0.75 L and multiply by the appropriate conversion factor, canceling units to arrive at qt. Then, use the second conversion factor to arrive at cups.

Round the answer to the correct number of significant figures. In this case, you round the answer to two significant figures because the quantity given has two significant figures.

SOLUTION

$$0.75 \cancel{\text{L}} \times \frac{1.057 \cancel{\text{qt}}}{1 \cancel{\text{L}}} \times \frac{4 \text{ cups}}{1 \cancel{\text{qt}}} = 3.171 \text{ cups}$$

$$3.171 \text{ cups} = 3.2 \text{ cups}$$

$$0.75 \text{ L} \times 1.057 \frac{\text{qt}}{1 \text{ L}} \times 4 \frac{\text{cups}}{1 \text{ qt}} = 3.171 \text{ cups} \quad 3.171 \text{ cups} = 3.2 \text{ cups}$$

CHECK

Check your answer. Are the units correct? Does the answer make physical sense?

The answer has the right units (cups) and seems reasonable. A cup is smaller than a liter, so the value in cups should be larger than the value in liters.

SKILLBUILDER 2.10 | Solving Multistep Unit Conversion Problems

A recipe calls for 1.2 cups of oil. How many liters of oil is this?

FOR MORE PRACTICE

Problems 85, 86.

Interactive Worked Example 2.10

Solving Multistep Unit Conversion Problems



Example 2.11 Solving Multistep Unit Conversion Problems

One lap of a running track measures 255 m. To run 10.0 km, how many laps should you run?

SORT

Begin by sorting the information in the problem into given and find. You are given a distance in km and asked to find the distance in laps. You are also given the quantity 255 m per lap, which is a conversion factor between m and laps.

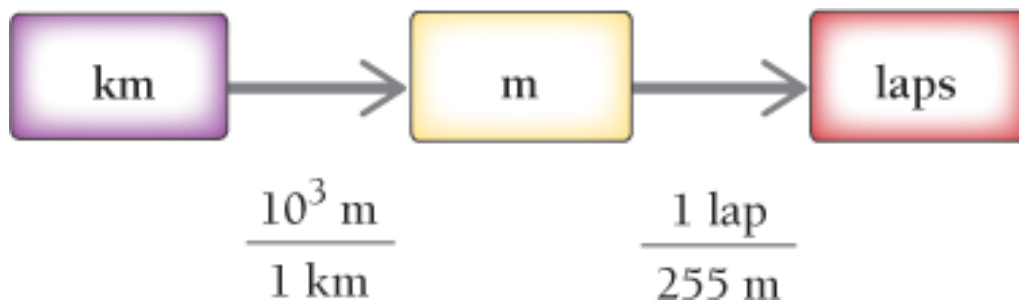
GIVEN: 10.0 km
255 m = 1 lap

FIND: number of laps

STRATEGIZE

Build the solution map beginning with km and ending at laps. Focus on the units.

SOLUTION MAP



RELATIONSHIPS USED

$$1 \text{ km} = 10^3 \text{ m} \quad 1 \text{ km} = 103 \text{ m} \text{ (from Table 2.2)}$$

$$1 \text{ lap} = 255 \text{ m} \quad 1 \text{ lap} = 255 \text{ m} \text{ (given in problem)}$$

SOLVE

Follow the solution map to solve the problem. Begin with 10.0 km and multiply by the appropriate conversion factor, canceling units to arrive at m. Then, use the second conversion factor to arrive at laps. Round the intermediate answer (in blue) to three significant figures because it is limited by the three significant figures in the given quantity, 10.0 km.

SOLUTION

$$10.0 \cancel{\text{ km}} \times \frac{10^3 \cancel{\text{ m}}}{1 \cancel{\text{ km}}} \times \frac{1 \text{ lap}}{255 \cancel{\text{ m}}} = 39.216 \text{ laps} = 39.2 \text{ laps}$$

$$10.0 \text{ km} \times 103 \text{ m} / 1 \text{ km} \times 1 \text{ lap} / 255 \text{ m} = 39.216 \text{ laps} = 39.2 \text{ laps}$$

CHECK

Check your answer. Are the units correct? Does the answer make physical sense?

The units of the answer are correct, and the value of the answer makes sense. If a lap is 255 m, there are about 4 laps to each km (1000 m), so it seems reasonable that you would have to run about 40 laps to cover 10 km.

SKILLBUILDER 2.11 | Solving Multistep Unit Conversion Problems

A running track measures 1056 ft per lap. To run 15.0 km, how many laps should you run? (1 mi = 5280 ft)(1 mi=5280 ft)

SKILLBUILDER PLUS

An island is 5.72 nautical mi from the coast. How far away is the island in meters? (1 nautical mi = 1.151 mi)(1 nautical mi=1.151 mi)

FOR MORE PRACTICE

Problems 83, 84.
