Converting units using the Factor Label Method

Introduction: Many of you have been taught how to do conversions. You’ve converted units of length, time, and maybe even speed. There are many different conversions to do, and it is easy to get mixed up in those calculations. My goal is to teach you a very methodical way to solve these types of problems. Also called dimensional analysis, the factor-label method is very reliable once you have mastered its basic concepts.

Part 1: Conversions using the factor label method.

Directions: In this exercise you will be asked to set up conversion problems using our factor label method. The rules are very simple:

1. Conversion Factors are fractions showing known relationships between different units.
2. Units from conversion factors must line up diagonally so that they cancel out and only the desired unit remains.
3. Once all the conversion factors are in place, you multiply by any numbers on the top and divide by any numbers on the bottom.

The Setting: On an isolated island of Avogadro, located somewhere in the pacific, the natives have never heard of the metric system or SI units for measurement. However, since the beginning of the invention of the words BIG and SMALL, measurement has been a part of the lives of all people. They have developed their own system of measurement. With the recent discovery of their island, scientists have scrambled to connect the two systems so that scientific information can be shared. Carefully read through the following relationships.

- 15 snails laid end to end are equal to the diameter of one coconut
- 4 coconuts laid side by side equal the distance a frog jumps in one hop
- 12 hops by a frog equals the length of one cut palm tree
- 20 palm trunks are equal to the length of one riki-ball field

Here are the relationships with abbreviations:

<table>
<thead>
<tr>
<th>Conversion</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 sn = 1 cn</td>
<td>15 sn = 1 cn</td>
</tr>
<tr>
<td>4 cn = 1 fh</td>
<td>4 cn = 1 fh</td>
</tr>
<tr>
<td>12 fh = 1 pt</td>
<td>12 fh = 1 pt</td>
</tr>
<tr>
<td>20 pt = 1 rbf</td>
<td>20 pt = 1 rbf</td>
</tr>
</tbody>
</table>
Fill in the table below by writing all the possible conversion factors we can use below. There are two for each relationship, they are simply reciprocals of each other.

<table>
<thead>
<tr>
<th>Relationship</th>
<th>Conversion Factor 1</th>
<th>Conversion Factor 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 sn = 1 cn</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 cn = 1 fh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 fh = 1 pt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 pt = 1 rbf</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sample Problem:** The fastest avogadrian man can run the length of 2 riki-ball fields in 1 minute and 39 seconds. How many snails has he run?

\[
\frac{2 \text{ rbf}}{1} \cdot \frac{20 \text{ pt}}{1 \text{ rbf}} \cdot \frac{12 \text{ fh}}{1 \text{ pt}} \cdot \frac{4 \text{ cn}}{1 \text{ fh}} \cdot \frac{15 \text{ sn}}{1 \text{ cn}} = 28,800 \text{ sn}
\]

**Problems:** Solve the following problems using the factor label method.

1. How many frog hops are there in 1.5 riki-ball fields?

2. How many snails long is a boat if it is the length of 2.5 palm trunks?

3. An Avogadrian woman harvests 1300 snails in one day. If she lays them out, how many palm trunks long will the line of snails be?

4. How many snails tall is a tree that measures 2.0 palm trunks in height?
5. A table measures 78 snails in length. How many palm trunks long is it?

6. The distance across the island is 50.5 riki-ball fields.
   a. How many frog hops is it across the island?
   b. How many snails wide is the island?

7. A frog can complete 46 hops in one minute, how many riki-ball fields has he covered?

8. If the same frog continues hopping for 16.7 minutes, how many riki-ball fields will he cover? (Hint: You will need to use a new conversion factor relating hops and minutes)

9. An American scientist measure’s the frog hop to be 60 centimeters each. How long is a riki-ball field in meters? (Hint: two new conversion factors!)

10. How many meters long is a palm trunk?

11. How many snails long is a 100 m dash?

12. How many millimeters long is an Avogadrian snail? (Hint: One more new cf!)
ON YOUR OWN: Complete the following conversions showing the factor-label method.

A. 124 coconuts = ___________ sn
B. 355 coconuts = ___________ fh
C. 75 frog hops = ___________ rbf
D. 0.25 rikiball fields = ___________ cn
E. 7,000 snails = ___________ pt
F. 10 palm trunks = ___________ cn
G. 0.455 frog hops = ___________ sn
H. 2.38 rikiball fields = ___________ pt
I. 370 centimeters = ___________ fh
J. 35.5 meters = ___________ cm
K. 11,000 snails = ___________ mm
L. 250 meters = ___________ mm
M. 3.52 frog hops = ___________ mm
N. 7.05 palm trunks = ___________ m
O. $3.5 \times 10^3$ rikiball fields = ___________ cm
P. $2.56 \times 10^6$ mm = ___________ rbf