

Dimensional Analysis

Factor Label Method

<u>English Unit</u>	<u>SI Unit</u>	<u>Relationship</u>
Mile	Kilometer	1 mile = 1.609 Km
Foot	Meter	1 ft = .305 M
Inch	Centimeter	1 inch = 2.54 Cm
Pound	Grams	1 lb = 453.59 G
Ounce	Grams	1 oz = 28.35 G
Gallon	Liter	1 gallon = 3.79 L

Math practice for DA:

$$7 \times \frac{3}{4} = ?$$

set up as fractions:

$$\frac{7}{1} \times \frac{3}{4} = \frac{21}{4} = 5.25$$

try one more:

$$12 \times \frac{7}{24} = ?$$

$$\frac{12}{1} \times \frac{7}{24} = \frac{84}{24} = 3.5$$

or factor out (simplify) first

$$\frac{\overset{1}{\cancel{12}}}{1} \times \frac{7}{\underset{2}{\cancel{24}}} = \frac{7}{2} = 3.5$$

We can also factor out labels or units

63 in. X 1 ft./12 in.

$$\frac{\overset{21}{\cancel{63 \text{ in.}}}}{1} \times \frac{1 \text{ ft.}}{\underset{4}{\cancel{12 \text{ in.}}}} = \frac{63}{12} \text{ ft} = 5.25 \text{ ft}$$

Steps to Dimensional Analysis

1. Define the "given" and "goal"

Ex. Problem:

How many centimeters are in 27 inches?

2. Identify relationship between these.

$$2.54 \text{ cm} = 1 \text{ inch}$$

3. Arrange relationship into two possible conversion factors

$$\frac{2.54 \text{ cm}}{1 \text{ inch}} \text{ or } \frac{1 \text{ inch}}{2.54 \text{ cm}}$$

4. Pick a conversion factor so units will cancel

ex: How many centimeters are in 27 inches?

*Units always cancel on the diagonal

"given" \rightarrow $\frac{27 \cancel{\text{in}}}{1} \times \frac{2.54 \cancel{\text{cm}}}{1 \cancel{\text{inch}}} = 68.6 \text{ cm}$ "goal" (units)

or

chemists
use "picket fence"

$$\begin{array}{c|c} 27 \text{ in.} & 2.54 \text{ cm} \\ \hline 1 & 1 \text{ inch} \end{array} = 68.6 \text{ cm}$$

Why does this work?

$$12 \times \frac{754}{754} = 12$$

$$12 \times 1 = 12$$

How many eggs in 4.75 dozen?

relationship?

How many feet in 4 meters?

relationship: 1 foot = 0.305 meters

Solve with dimensional analysis

$$55 \text{ mm} = \underline{\hspace{2cm}} \text{ m}$$

relationship:
1000 mm = 1 m



2 step DA - try it!

How many feet in a 850 centimeters?

relationship: 1 foot = 0.305 meters

relationship: 1 meter = 100 cm

patterns...

what 2 patterns are present?

Convert 35 meters to miles.

$$\frac{35 \text{ m} \mid 100 \text{ cm} \mid 1 \text{ in} \mid 1 \text{ ft} \mid 1 \text{ mile}}{1 \text{ m} \mid 2.54 \text{ cm} \mid 12 \text{ in} \mid 5280 \text{ ft}} =$$

1. Cross out units that cancel above.

2. Describe the relationship of top and bottom number:
(top must = bottom in each section)



1 hr = 60 min	1 min = 60 sec	1 ton = 2000 lbs	7 days = 1 week
24 hrs = 1 day	1 kg = 2.2 lbs	1 gal = 3.79 L	264.2 gal = 1 cubic meter
1 mi = 5,280 ft	1 kg = 1000 g	1 lb = 16 oz	20 drops = 1 mL
365 days = 1 yr	52 wks = 1 yr	2.54 cm = 1 in	1 L = 1000 mL
0.621 mi = 1.0 km	1 yd = 36 in.	1 cc = 1 cm ³	1 mL = 1 cm ³

1.) How many miles will a person run during a 10 kilometer race?

2.) The moon is 250,000 miles away. How many feet is it from earth?

3.) A family pool holds 10,000 gallons of water. How many cubic meters is this?

Conversions: English to English

$$1 \text{ mile} = 5280 \text{ ft}$$

$$1 \text{ mile} = 1760 \text{ yards}$$

$$1 \text{ yard} = 3 \text{ ft}$$

$$1 \text{ ft} = 12 \text{ in}$$

distance

Bridges: English -- Metric

$$1 \text{ inch} = 2.54 \text{ cm}$$

$$1 \text{ gallon} = 4 \text{ quarts}$$

$$1 \text{ quart} = 2 \text{ pints}$$

$$2 \text{ cups} = 1 \text{ pint}$$

$$1 \text{ cup} = 16 \text{ tablespoons (Tbl)}$$

$$1 \text{ Tbl} = 3 \text{ teaspoons (tsp)}$$

volume

$$1 \text{ qt} = 0.946 \text{ L}$$

$$1 \text{ Ton} = 2000 \text{ lbs}$$

$$1 \text{ lb.} = 16 \text{ oz.}$$

mass

$$2.2 \text{ pound (lb)} = 1 \text{ kg}$$

How many centimeter are in 5 miles?

How many teaspoons in 2 liters?

How many inches in a 8.2 miles?

How many ounces in a 45 kg?