Unit Analysis

Mr. Merrick · October 7, 2025

Introduction

Unit analysis converts one unit to another by multiplying by *conversion factors* that equal 1. At each step, the "old" unit *crosses out* with the same unit in the denominator. In this packet, you may assume no outside formulas are needed: every numerical equivalence you need appears either in a local Data Box or in the **Giant Master Table** at the end of this packet. Keep that table open while you work.

How to show your work (always include the units):

- 1. Write the given quantity with its unit.
- 2. Multiply by conversion factors written as fractions so that unwanted units cancel.
- 3. Continue until only the desired unit remains, then compute the number.

Example (with crosses): Converting 1 day to seconds

$$1\,\mathrm{day} \,\times\, \frac{24\,\mathrm{h}}{1\,\mathrm{day}} \,\times\, \frac{60\,\mathrm{min}}{1\,\mathrm{h}} \,\times\, \frac{60\,\mathrm{s}}{1\,\mathrm{min}} \,=\, 86,400\,\mathrm{s}.$$

Practice

1) A person's height is 5 ft 8 in. Convert to cm and m.

- 2) Convert 2.50 km to mi and to ft.
- 3) A jug holds 1.75 L. How many cups and US gallons is this?

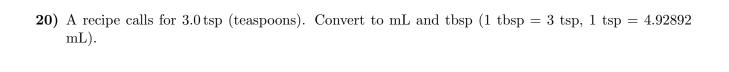
4) Convert $12.0\,\mathrm{lb}$ to kg and g.

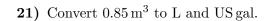
5)	A room is 12 ft \times 15 ft. Find its area in m ² .
6)	Convert $750\mathrm{mL}$ to $\mathrm{in^3}$ and to qt.
7)	Convert $3.25\mathrm{ft^3/min}$ to L/s.
8)	A warm room is 72°F. Convert to °C and K.

9) Convert 35.0 psi to kPa and bar.

10)	A shower flows at $12.0\mathrm{L/min}$. Convert to gal/min and to $\mathrm{ft^3/h}$.
11)	A car's fuel economy is $7.50\mathrm{L}/100\mathrm{km}$. Convert to mpg (US).
12)	On a trip you average $90.0\mathrm{km/h}$ for $2.25\mathrm{h}$. How far is this in miles?
13)	A runner covers $3.20\mathrm{km}$ in $18.0\mathrm{min}$. Find average speed in m/s and km/h.
14)	A cyclist rides at $24 \mathrm{km/h}$. How many minutes to travel $7.5 \mathrm{km}$?

15)	A car goes $65\mathrm{mph}$ for $45\mathrm{min}$. How far in km?
16)	A metal sample has mass $540\mathrm{g}$ and volume $400\mathrm{cm}^3$. Find density in $\mathrm{g/cm}^3$ and $\mathrm{kg/m}^3$
17)	Cooking oil has density $0.92\mathrm{g/mL}$. What is the mass of $2.50\mathrm{L}$ of oil in kg?
18)	A wood block has density $0.60\mathrm{g/cm^3}$ and mass $900\mathrm{g}.$ Find its volume in $\mathrm{cm^3}$ and mL.
19)	Convert $4.5\mathrm{mi}$ to km and m.





22) Convert
$$3.6 \,\mathrm{m/s}$$
 to km/h and mph.

23) A bottle is
$$355 \,\mathrm{mL}$$
. Express this in floz (US) and in cups (1 floz = $29.5735 \,\mathrm{mL}$).

24) Convert
$$1.25 \, \mathrm{yd^2}$$
 to $\mathrm{m^2}$ and $\mathrm{ft^2}$.

Unit Analysis — Master Table

SI Prefixes (Name, Symbol, Factor) milli m 10^{-3} centi c 10^{-2} kilo k 10^3

60 s = 1 min; 60 min = 1 h; 24 h = 1 day

Length

1 in = 2.54 cm exact $12\,\mathrm{in} = 1\,\mathrm{ft};\, 3\,\mathrm{ft} = 1\,\mathrm{yd};\, 5280\,\mathrm{ft} = 1\,\mathrm{mi}$ $1\,\mathrm{km} = 1000\,\mathrm{m};\,1\,\mathrm{mi} = 1609\,\mathrm{m} \approx 1.609\,\mathrm{km}$ $1 \,\mathrm{m} = 3.28084 \,\mathrm{ft}$

Area

 $1\,\mathrm{m}^2\approx 10.764\,\mathrm{ft}^2;\, 1\,\mathrm{cm}^2\approx 0.1550\,\mathrm{in}^2;\, 1\,\mathrm{yd}^2=9\,\mathrm{ft}^2$

${\bf Volume}$

 $1 L = 1000 \,\mathrm{mL} = 1000 \,\mathrm{cm}^3$ $1 \,\mathrm{m}^3 = 1000 \,\mathrm{L}$ $1\,\mathrm{in^3} = 16.387\,\mathrm{cm^3};\, 1\,\mathrm{ft^3} = 28.3168\,\mathrm{L}$ $1 \text{ gal (US)} = 3.78541 \,\text{L}; \, 1 \,\text{qt} = 0.94635 \,\text{L}$ $1\,\rm{cup} = 236.588\,\rm{mL};\,1\,\rm{fl}\,\rm{oz} = 29.5735\,\rm{mL}$ $1 \, \text{tbsp} = 3 \, \text{tsp}; \, 1 \, \text{tsp} = 4.92892 \, \text{mL}$

Mass & Density

 $\begin{array}{l} 1~{\rm kg} = 1000~{\rm g;}~1~{\rm lb} = 453.59237~{\rm g}~exact \\ \rho = \frac{m}{V};~~{\rm Water} \approx 1.00~{\rm g/cm^3} = 1000~{\rm kg/m^3} \end{array}$

${\bf Pressure}$

 $1 \,\mathrm{psi} = 6894.757 \,\mathrm{Pa}; \, 1 \,\mathrm{kPa} = 1000 \,\mathrm{Pa}; \, 1 \,\mathrm{bar} = 100,000 \,\mathrm{Pa}$

Speed (Grade 8/9)
$$v = \frac{d}{t}; \quad d = vt; \quad t = \frac{d}{v}$$

$$1 \text{ km/h} = \frac{1000}{3600} \text{ m/s} \approx 0.2778 \text{ m/s}; 1 \text{ mph} \approx 1.609 \text{ km/h}$$

$$\label{eq:continuity} \begin{split} \textbf{Temperature} \\ ^{\circ}C &= \frac{5}{9} \, (^{\circ}F - 32); \quad K = ^{\circ}C + 273.15 \end{split}$$