

DIMENSIONAL ANALYSIS



UNIT CONVERSIONS

Dimensional Analysis is a problem-solving method which uses the fact that any number multiplied by **1** keeps the same value

* Multiply by fractions that are equivalent to 1

$$A * \frac{1}{1} * \frac{1}{1} * \frac{1}{1}$$

$$\text{If } B=A, C=B, D=C, \text{ then } = A * \frac{B}{A} * \frac{C}{B} * \frac{D}{C}$$

* Match units diagonally across from each other

$$\frac{\text{UNIT 1}}{\text{UNIT 2}} \times \frac{\text{UNIT 3}}{\text{UNIT 1}} \times \frac{\text{UNIT 4}}{\text{UNIT 3}} \times \frac{\text{UNIT 2}}{\text{UNIT 5}}$$

* Cancel the same unit when they are diagonally across and keep what is left over

$$\frac{\text{UNIT 1}}{\text{UNIT 2}} \times \frac{\text{UNIT 3}}{\text{UNIT 1}} \times \frac{\text{UNIT 4}}{\text{UNIT 3}} \times \frac{\text{UNIT 2}}{\text{UNIT 5}} = \frac{\text{UNIT 4}}{\text{UNIT 5}}$$

* Multiply all the numbers in the numerator, multiply all the numbers in the denominator, then divide

Example:

Convert 0.5 miles to inches

$$0.5 \text{ miles} \times \frac{5280 \text{ feet}}{1 \text{ mile}} \times \frac{12 \text{ inches}}{1 \text{ foot}} =$$

$$= 0.5 \text{ miles} \times \frac{5280 \text{ feet}}{1 \text{ mile}} \times \frac{12 \text{ inches}}{1 \text{ foot}}$$

$$= \frac{(0.5 \times 5280 \times 12)}{(1 \times 1)} \text{ inches}$$

$$= \boxed{31,680 \text{ inches}}$$

Example:

Convert 3 miles per hour to meters per second

$$\begin{aligned}
 & \frac{3 \text{ miles}}{\text{hour}} \times \frac{1609 \text{ meters}}{1 \text{ mile}} \times \frac{1 \text{ hour}}{60 \text{ minutes}} \times \frac{1 \text{ minute}}{60 \text{ seconds}} \\
 &= \frac{3 \text{ miles}}{\text{hour}} \times \frac{1609 \text{ meters}}{1 \text{ mile}} \times \frac{1 \text{ hour}}{60 \text{ minutes}} \times \frac{1 \text{ minute}}{60 \text{ seconds}} \\
 &= \frac{3 \cdot 1609 \text{ meters}}{1 \cdot 60 \cdot 60 \text{ seconds}} = \frac{4827 \text{ meters}}{3600 \text{ seconds}} = \boxed{1.34 \text{ meters/second}}
 \end{aligned}$$

Example:

Convert 2 kilowatt hours (kWh) to watt seconds (Ws)

$$\begin{aligned}
 & 2 \text{ kilowatt hours} \times \frac{60 \text{ minutes}}{1 \text{ hour}} \times \frac{60 \text{ seconds}}{1 \text{ minute}} \times \frac{1000 \text{ watts}}{1 \text{ kilowatt}} = \\
 &= 2 \text{ kilowatt hours} \times \frac{60 \text{ minutes}}{1 \text{ hour}} \times \frac{60 \text{ seconds}}{1 \text{ minute}} \times \frac{1000 \text{ watts}}{1 \text{ kilowatt}} \\
 &= \frac{2 \cdot 60 \cdot 60 \cdot 1000}{1 \cdot 1 \cdot 1} \text{ watt seconds} \\
 &= \boxed{7,200,000 \text{ watt seconds}}
 \end{aligned}$$

COMMON UNIT CONVERSIONS

CUSTOMARY

LENGTH

12 inches = 1 foot
3 feet = 1 yard
5280 feet = 1 mile

WEIGHT

16 ounces = 1 pound
2000 pounds = 1 ton

VOLUME

1 cup = 8 fluid ounces
1 pint = 2 cups
1 quart = 2 pints
4 quarts = 1 gallon

METRIC

10 millimeters = 1 centimeter
1000 millimeters = 1 meter
100 centimeters = 1 meter
1000 meters = 1 kilometer

1000 grams = 1 kilogram

1000 milliliters = 1 liter

CUSTOMARY ↔ METRIC

1 inch = 2.54 centimeters
1 mile = 1.609 kilometers

1 ounce = 28.350 grams
1 pound = 454 grams

1 fluid ounce = 29.57 milliliters
1 gallon = 3.785 liters

METRIC CONVERSIONS

To convert to larger unit
move decimal LEFT

To convert to smaller unit
move decimal right

