

General Chemistry Dimensional Analysis

Concepts, Notations, Calculation Setups



Managing units ("dimensional analysis") is key to confidence in solving problems

Use unit conversions and calculation setups that eliminate (~~cancel~~) unwanted units...
Change the known information into the desired answer with the desired units.



COMMON MATHEMATICAL EXPRESSIONS

Algebra notation: $A \times B$ is also written as $A \cdot B$ → Use "Order of Operations" PEMDAS

Density is expressed as $D = \text{Mass}/V$ or mass per volume (mass/vol) in units of $\frac{\text{kg}}{\text{L}}$ or $\frac{\text{g}}{\text{mL}}$

ALGEBRA NOTATION FOR CHEMISTRY CALCULATION TASKS

$$\frac{a}{b} \times \frac{c}{d} = \frac{ac}{bd}$$

→ except for typing, avoid using this form: $a/b \times c/d = ac/bd$

$$\frac{a}{b} \times \frac{c}{a} = \frac{c}{b}$$

→ Note: Here, **A** simply "cancels out" **A**

$$\frac{\cancel{a}}{b} \times \frac{c}{\cancel{a}} = \frac{c}{b}$$

$$\frac{a}{b} \div \frac{c}{d} = \frac{ad}{bc}$$

rearranged as $\frac{a}{b} \times \frac{d}{c} = \frac{ad}{bc}$

Rarely written as $\frac{a}{b} / \frac{c}{d} = \frac{ad}{bc}$

EXAMPLES OF LOGICAL CALCULATION SETUPS

A truck will travel 315 miles. How many gallons of gas is needed if it gets 7.0 miles per gallon?

Set up the math to cancel unwanted units and automatically get the desired units and the right answer.

Notice that 7.0 miles / gal is not useful, but you can use 1 gal / 7.0 miles which is also a true statement.

$$\frac{315 \text{ miles}}{1} \times \frac{1 \text{ gallon}}{7.0 \text{ miles}} = 45 \text{ gallons} \quad \text{*note that the truck uses 1 gal per 7 miles}$$

A country diner bakes 40 cakes in a month. How many chickens do they need to have?

The recipe calls for 3 eggs per cake. One chicken hen lays 6 eggs on average each week.

$$\frac{40 \text{ cakes}}{1 \text{ month}} \times \frac{3 \text{ eggs}}{1 \text{ cake}} \times \frac{1 \text{ hen}}{\text{assumed}} \times \frac{1 \text{ week}}{6 \text{ eggs}} \times \frac{1 \text{ month}}{4 \text{ weeks}} = \underline{\quad ? \quad} \text{ hens} = \frac{40 \times 3}{6 \times 4} = 5 \text{ hens}$$

A 14.57 g piece of glass has a density of 2.63 g/mL (2.63 g per mL*). What is its volume in mL?

$$\frac{14.57 \text{ g}}{1} \times \frac{1 \text{ mL}}{2.63 \text{ g}} = 5.54 \text{ mL} \quad \text{*note that there is 1 mL of volume per 2.63 g of glass}$$

What is its volume in liters? $\frac{5.54 \text{ mL}}{1} \times \frac{1 \text{ Liter}}{1000 \text{ mL}} = \underline{\quad ? \quad} \text{ L} = 0.00554 \text{ L}$ or $5.54 \times 10^{-3} \text{ L}$