

Measurements

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Unit Conversions: Length and Mass

Length

- 1 km = 1000 m
- 1 m = 100 cm
- 1 cm = 10 mm
- 1 mile = $\approx$ 1.6 km

Mass

- 1 tonne = 1000 kg
- 1 kg = 1000 g
- 1 g = 1000 mg

Unit Conversions: Capacity and Time

Capacity & Volume

- 1 litre = 1000 ml
- 1 litre = 1000 cm³
- 1 m³ = 1,000,000 cm³

Time

- 1 hour = 60 min = 3600 s
- 1 day = 24 hours
- 1 year = 365 days

Converting Area and Volume Units: Square and Cube the Conversion Factor!

Length

- 1 m = 100 cm
- 1 cm = 10 mm
- 1 km = 1000 m

Area ($\times$ factor²)

- 1 m² = 10,000 cm²
- 1 cm² = 100 mm²
- 1 km² = 1,000,000 m²

Volume ($\times$ factor³)

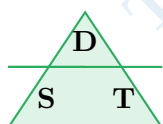
- 1 m³ = 1,000,000 cm³
- 1 cm³ = 1000 mm³
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Converting Between Units

Smaller unit? **Multiply** $\times$
Larger unit? **Divide** $\div$

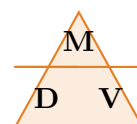
Key: 5 m² $\neq$ 500 cm²
5 m² = 5 $\times$ 10,000 = 50,000 cm²

Speed, Distance and Time

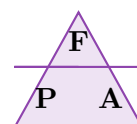


- $S = D \div T$ $D = S \times T$ $T = D \div S$
- **Units:** km/h, m/s, mph. Match units throughout!
- **Average speed:** $\frac{\text{total distance}}{\text{total time}}$
- **m/s $\leftrightarrow$ km/h:** divide by 3.6 OR multiply by 3.6

Density and Pressure



Density



Pressure

- **Density:** $D = M \div V$ $M = D \times V$
 $V = M \div D$
- **Units:** g/cm³, kg/m³
- **Pressure:** $P = F \div A$ $F = P \times A$
 $A = F \div P$
- **Units:** N/m² (Pa), N/cm²

Bounds and Error Intervals

If x is rounded to unit u :

$$x - \frac{u}{2} \leq \text{true value} < x + \frac{u}{2}$$

- **LB** = $x - \frac{u}{2}$ (included, $\leq$)
- **UB** = $x + \frac{u}{2}$ (excluded, $<$)

Example: $w = 23 \text{ cm}$ (nearest cm) $\Rightarrow 22.5 \leq w < 23.5$

Bounds in Calculations:

Op.	Maximum	Minimum
$A + B$	$\text{UB}(A) + \text{UB}(B)$	$\text{LB}(A) + \text{LB}(B)$
$A - B$	$\text{UB}(A) - \text{LB}(B)$	$\text{LB}(A) - \text{UB}(B)$
$A \times B$	$\text{UB} \times \text{UB}$	$\text{LB} \times \text{LB}$
$A \div B$	$\text{UB}(A) \div \text{LB}(B)$	$\text{LB}(A) \div \text{UB}(B)$

Common Traps and Pitfalls

1. **The Time Trap:** 1 hour 30 min = 1.5 h, **not** 1.3 h. Always convert minutes: hours + $\frac{\text{minutes}}{60}$.
2. **The Area/Volume Conversion Trap:** $1 \text{ m}^2 \neq 100 \text{ cm}^2$. It equals **10,000** cm^2 (square the factor). Same logic for volume: cube it.
3. **The Average Speed Trap:** Average speed $\neq$ average of the two speeds. Always use $\frac{\text{total } D}{\text{total } T}$.
4. **The Bounds Trap:** The upper bound uses $<$ (strict). A value of exactly UB would round **up**, so it belongs to the next interval.
5. **The Units Trap:** Always check that density units match (g with cm^3 , or kg with m^3) before substituting into $D = M \div V$.

Quick Exam Strategy

Identify the measure: “How fast/far/long?” $\rightarrow$ SDT “Heavy per cm^3 ?” $\rightarrow$ Density “Force per area?” $\rightarrow$ Pressure “Range of values?” $\rightarrow$ Bounds

Multi-stage speed: Find each time separately ($T = D \div S$), then $\bar{S} = \frac{\sum D}{\sum T}$.

Reverse problems: Rearrange the formula first (e.g. $V = M \div D$), then substitute.

Bounds calculations: For **max**: use UB on top / LB on bottom of any division. For **min**: swap them.

Always: State the formula $\rightarrow$ substitute $\rightarrow$ calculate $\rightarrow$ include units in your final answer.