

# University Physics 1A

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## Factor Label Method

For converting units of measure, you can multiply by one, using equal unit measures as equivalent fractions:

$$1 = \frac{2.54in}{1cm} = \frac{5280ft}{1mi} = \frac{1mi}{5280ft}$$

### Example

A wheel rotates at 1.234 rad/s. Convert this to rev/min.

$$\frac{1.234rad}{1s} \times \frac{1rev}{2\pi rad} \times \frac{60s}{1min} = \frac{74.04rev}{2\pi min} = 116.3 \frac{rev}{min}$$

## Uncertainty

Uncertainties should have the same level of precision as the measurement.

$$1.23 \pm 0.06$$

$$4.56 \pm 0.09$$

When adding numbers with uncertainty, the uncertainties are added:

$$1.23 + 4.56 \pm (0.06 + 0.09)$$

When subtracting numbers with uncertainty, the uncertainties are still added because it is still compounded by the operation:

$$4.56 - 1.23 \pm (0.06 + 0.09)$$

When multiplying numbers with uncertainty, we sum together the relative uncertainty:

$$(1.23 \pm 0.06)(4.56 \pm 0.09) = (1.23)(4.56)\left(1 \pm \left(\frac{0.06}{1.23} + \frac{0.09}{4.56}\right)\right)$$

When dividing numbers with uncertainty, it follows the same rule as multiplication:

$$\begin{aligned}\frac{1.23 \pm 0.06}{4.56} \cdot 0.09 &= \frac{1.23}{4.56} \left(1 \pm \left(\frac{0.06}{1.23} + \frac{0.09}{4.56}\right)\right) \\ &= 0.27(1 \pm (0.05 + 0.02)) \\ &= 0.27 \pm (0.27)(0.07) \\ &= 0.27 \pm 0.02\end{aligned}$$

Uncertainty arises from the tools of measurement and the precision associated with the instrument.

You can find all my notes at <http://omgimanerd.tech/notes>. If you have any questions, comments, or concerns, please contact me at [alvin@omgimanerd.tech](mailto:alvin@omgimanerd.tech)