Introduction to Mechanics
Unit Conversion

Lana Sheridan

De Anza College

Jan 8, 2020

Last time

- physics vocabulary
- definitions of base units
- dimensional analysis

Dimensional Analysis Question

Which of the following equations are dimensionally correct?
(1) $v_f = v_i + ax$
(2) $y = (2\ \text{m})\cos(kx)$, where $k = 2\ \text{m}^{-1}$.

A (1) only

B (2) only

C both

D neither

[1] Serway & Jewett, Page 16, # 9.

Dimensional Analysis Question

Which of the following equations are dimensionally correct?
(1) $v_f = v_i + ax$
(2) $y = (2\ \text{m})\cos(kx)$, where $k = 2\ \text{m}^{-1}$.

A (1) only
B (2) only ←
C both
D neither

[1] Serway & Jewett, Page 16, # 9.

Warm Up Question: Dimensional Analysis Question

(1) Units of $v_f = v_i + ax$:

$$\begin{aligned} [\mathrm{ms}^{-1}] &= [\mathrm{ms}^{-1}] + [\mathrm{ms}^{-2}] \times [\mathrm{m}] \\ [\mathrm{ms}^{-1}] &= [\mathrm{ms}^{-1}] + [\mathrm{m}^2\ \mathrm{s}^{-2}] \end{aligned}$$

No. (1) is not dimensionally correct.

Warm Up Question: Dimensional Analysis Question

(2) Units of $y = (2\ \text{m})\cos(kx)$

$$\begin{aligned} [\text{m}] &= [\text{m}] \times \cos([\text{m}^{-1}] \times [\text{m}]) \\ [\text{m}] &= [\text{m}] \end{aligned}$$

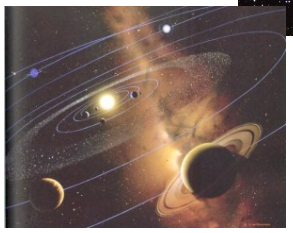
Yes. (2) is dimensionally correct.

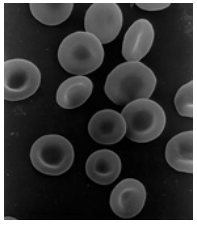
Overview

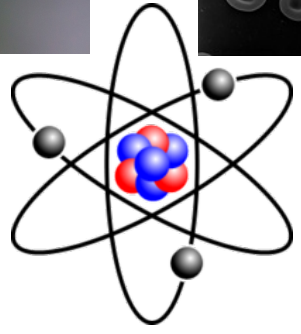
- symbols for scaling units
- measurement uncertainty and significant figures
- precision and trueness
- scientific notation
- unit conversions (non-SI units)

Scale of Units

Scale	Prefix	Symbol
10^{21}	zetta	Z
10^{15}	peta	P
10^{12}	tera-	T
10^{9}	giga-	G
10^{6}	mega-	M
10^{3}	kilo-	k
10^{2}	hecto-	h
10^{1}	deka-	da
10^{0}	—	—
10^{-1}	deci-	d
10^{-2}	centi-	c
10^{-3}	milli-	m
10^{-6}	micro-	μ
10^{-9}	nano-	n
10^{-12}	pico-	p
10^{-15}	femto-	f







Scale of Units

You need to know for this course:

Scale	Prefix	Symbol
10^3	kilo-	k
10^0	—	—
10^{-1}	deci-	d
10^{-2}	centi-	c
10^{-3}	milli-	m

Unit Scaling Examples

What is 8 cm in meters?

Unit Scaling Examples

What is 8 cm in meters?

$$(8\ \text{cm}) \times \left(\frac{1\ \text{m}}{100\ \text{cm}}\right) = 0.08\ \text{m}.$$

Unit Scaling Examples

What is 8 cm in meters?

$$(8\ \text{cm}) \times \left(\frac{1\ \text{m}}{100\ \text{cm}}\right) = 0.08\ \text{m}.$$

What is 508 μs in seconds?

Unit Scaling Examples

What is 8 cm in meters?

$$(8\text{ cm}) \times \left(\frac{1\text{ m}}{100\text{ cm}}\right) = 0.08\text{ m}.$$

What is 508 μs in seconds?

$$(508\ \mu\text{s}) \times \left(\frac{1\text{ s}}{1{,}000{,}000\ \mu\text{s}}\right) = 0.000508\text{ s}.$$

Unit Scaling Examples

What is 8 cm in meters?

$$(8\text{ cm}) \times \left(\frac{1\text{ m}}{100\text{ cm}}\right) = 0.08\text{ m}.$$

What is 508 μs in seconds?

$$(508\ \mu\text{s}) \times \left(\frac{1\text{ s}}{1{,}000{,}000\ \mu\text{s}}\right) = 0.000508\text{ s}.$$

What is 3 g/cm^3 in kg/m^3?

Unit Scaling Examples

What is 8 cm in meters?

$$(8\ \text{cm}) \times \left(\frac{1\ \text{m}}{100\ \text{cm}}\right) = 0.08\ \text{m}.$$

What is 508 μs in seconds?

$$(508\ \mu\text{s}) \times \left(\frac{1\ \text{s}}{1{,}000{,}000\ \mu\text{s}}\right) = 0.000508\ \text{s}.$$

What is 3 g/cm^3 in kg/m^3?

$$(3\ \text{g/cm}^3) \times \left(\frac{1\ \text{kg}}{1000\ \text{g}}\right) \times \left(\frac{100\ \text{cm}}{1\ \text{m}}\right)^3 = 3000\ \text{kg/m}^3.$$

Measurements: Precision and Trueness

Ideally, a measurement should be both *precise* and *true*.

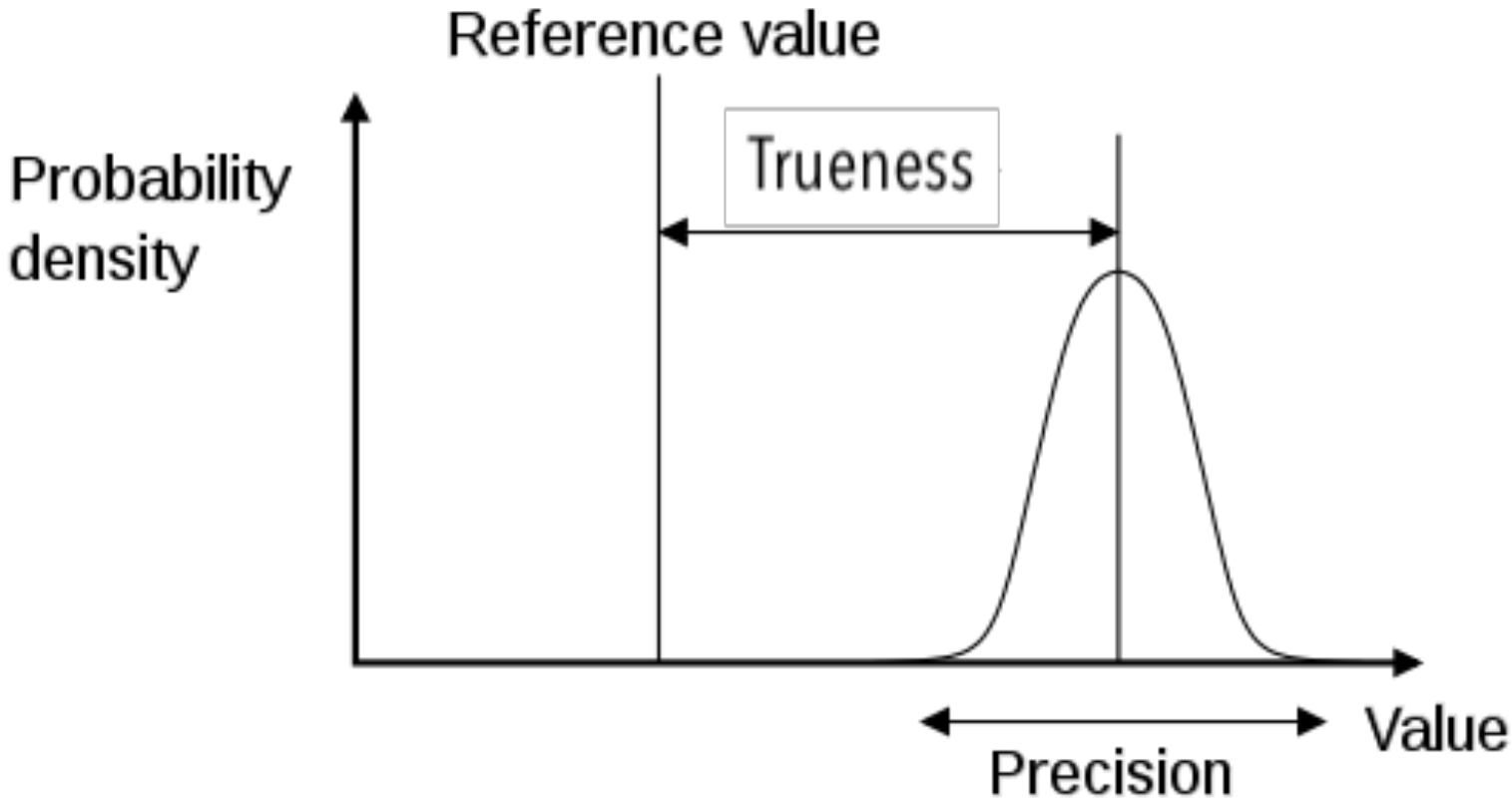
Precision

A measurement is precise if it yields very similar results when repeated.

Trueness (previously called Accuracy)

A measurement is true if it its result is very close to the actual value.

Measurements: Precision and Trueness



[1]Edited, from diagram created by Pekaje, based on PNG version by Anthony Cutler, Wikipedia.

Significant Figures

Significant Figures

The number of digits in a value that are meaningful for representing the precision of a measurement.

Summary

- symbols for scaling units
- measurement uncertainty and significant figures
- precision and trueness

Quiz *Tuesday*, in class.

Homework

- unit conversion worksheet, due *Tuesday*, Jan 13. - don't start this until tomorrow, unless you are very confident

Walker Physics: (this ↴ will not be collected)

- Ch 1, onward from page 14. Problem: 50 (changed!)

Ans for 50: $p = 1, q = -1$