

PHYS 111: GENERAL PHYSICS I

Ross Miller

University of Idaho

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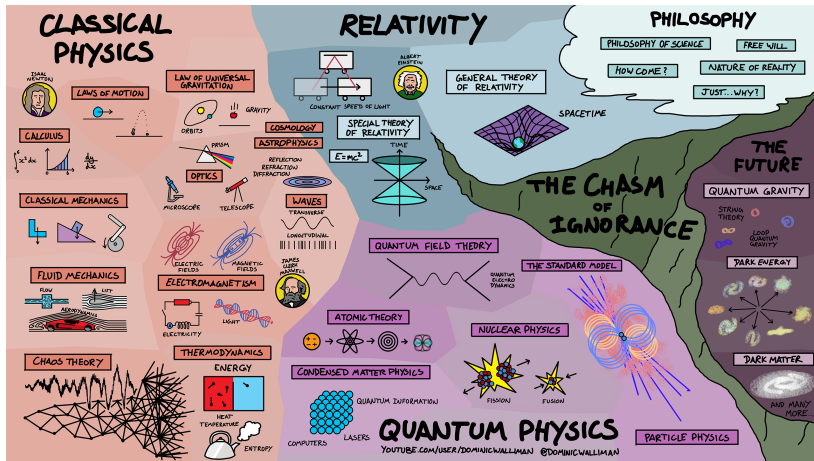
What's your first thought when you think of Physics?

- ▶ Difficult? Uber-difficult?
- ▶ That Newton-apple thing? Apple/Fig Newtons?
- ▶ Made-up Theories?
- ▶ Fun ways to describe reality?

Formally

Physics is the study of the interactions of energy, matter, space, and time. A physics type of question would be any question focused on what fundamental mechanisms underlie a phenomenon.

Map of Physics¹



Any Questions?
Please switch to the syllabus now.

¹<https://dominicwalliman.com>

Examples of Physical Quantities

Physical Quantity

SI Unit

Length

meter (m)

Time

second (s)

Mass

kilogram (kg)

Speed

meter per second (m/s)

Velocity

meter per second (m/s)

Acceleration

meter per second per second
($\text{m/s/s} = \text{m/s}^2$)

Force

newton (N)

Weight

newton (N)

Energy

joule (J)

Power

watt (W)

Temperature

kelvin (K)

Luminosity

candela (cd)

Electrical Current

ampere (A)

Magnetic Field

tesla (T)

Unit Conversions (Collecting)

Conversion Relationships

- ▶ $1.0 \text{ in.} = 2.54 \text{ cm}$
- ▶ $1.0 \text{ mi} = 1.61 \text{ km}$
- ▶ $T_F = 1.8T_C + 32$

Conversions

- ▶ $78 \text{ in.} = 6.5 \text{ ft}$
- ▶ $10 \text{ in.} = 25.4 \text{ cm}$
- ▶ $45 \text{ mi} = 72 \text{ km}$
- ▶ $85 \text{ }^\circ\text{F} = 29.4 \text{ }^\circ\text{C}$

Comparisons

- ▶ $12 \text{ in.} = 30.5 \text{ cm} < 31 \text{ cm}$
- ▶ $60 \text{ mph} = 96 \text{ kmph} > 85 \text{ kmph}$
- ▶ $-40 \text{ }^\circ\text{F} = -40 \text{ }^\circ\text{C}$
- ▶ $1000 \text{ ft}^2 = 92.9 \text{ m}^2 < 100 \text{ m}^2$

Variables

1. $4x + 20x = 24x$
2. $x + x^2 = x + x^2$ or $x(1 + x)$, not very compact
3. $3x \cdot 3y = 9xy$
4. $(3x)(3y) = 9xy$
5. $xy + 5y = (x + 5)y$, also not very compact, but doable
6. $(125a^2b^7c^{-3}) \div (10a^{-3}b^3c) = 25a^5b^4/(2c^4)$

Pre-calculus

1. $r = \ln(1/e^4) = -4$
2. $f = (x + 2)^2/(x^2 - 4) = (x + 2)/(x - 2)$
3. What does the vertical value of the vertex of a parabola tell you? Max or Min value of the output.
4. $\rho = \cos^2(28x) + \sin^2(28x) = 1$

Dimensional Analysis

I like to refer to **Dimensional Analysis** as the first sanity check of problem solving. The answer to the following question holds the significance of dimensional analysis:

Can you add miles and miles per hour for one net result?

NO!!!

Summary

- ▶ Dimensional Analysis is the act of treating all units like variables and performing all necessary algebraic operations on them.
- ▶ This means if you divide two lengths you will get a unit-less number. Ex. $13.0 \text{ m} / 26.0 \text{ m} = 0.500$
- ▶ If you divide a distance by a time then you will get a speed. Ex. $360 \text{ mi} / 6 \text{ hr} = 60 \text{ mph}$
- ▶ You can **not** add or subtract two quantities if they have **different** units!
- ▶ All quantities must have the same units to add or subtract them!

Significant Digits in Calculations

A **Significant Digit** is any digit that contributes meaning to a measurement.

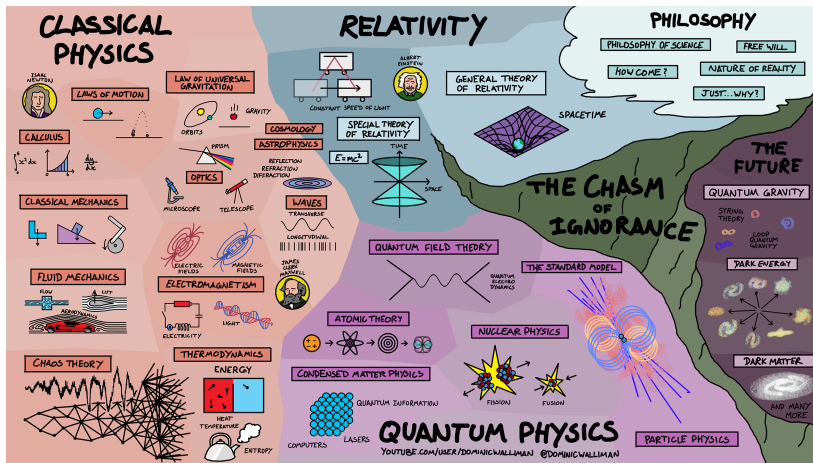
Four Concise Rules

1. All non-zero digits are significant: 1, 2, 3, 4, 5, 6, 7, 8, 9.
2. Zeros between non-zero digits are significant: 301, 7004, 80003.
3. Leading zeros are never significant: 0.04, 003.857, 0.000719.
4. In a number with or without a decimal point, trailing zeros (those to the right of the last non-zero digit) are significant provided they are justified by the precision of their derivation: 389,000; 2.02000; 5.400; 57.5400.*

Some Arithmetic Rules

- ▶ When **adding** two numbers, you must round to the least precise place value. Ex. $13.74213 + 1.2 = 14.9$
- ▶ When **multiplying** two numbers, you must round to the least **number** of significant digits. Ex. $143.02 \times 0.02 = 3$

Map of Physics¹



Any Questions?

¹<https://dominicwallman.com>