The Language of Physics

Physical Quantities and Units

The Role of Units

- The measurements of physical quantities are expressed in terms of units, which are standardized values.
  - the length of a race can be expressed in meters (for sprinters) or kilometers (for long distance runners)
- Without standardized units, it would be extremely difficult for scientists to express and compare measured values in a meaningful way.

Metric Prefixes

- Physical objects or phenomena may vary widely
  - the size of objects varies from something very small (like an atom) to something very large (like a star)
- The metric system includes many prefixes that can be attached to a unit
- Each prefix is based on factors of 10

Prefix	Symbol	Value		Prefix	Symbol	Value
tera	T	10^{12}		pico	p	10^{-12}
giga	G	10^{9}		nano	n	10^{-9}
mega	M	10^{6}		micro	μ	10^{-6}
kilo	k	10^{3}		milli	m	10^{-3}
				centi	c	10^{-2}

Converting Units

- Calculations are done using base units.
- This means that we need to convert prefixes to their numerical values before doing calculations.

$$2\ \text{nm} = 2 \times 10^{-9}\ \text{m}$$

Scientific Notation

- Scientific notation is a way of writing numbers that are too large or small to be conveniently written as a decimal
  - 840 000 000 000 000
    - scientific notation: 8.40×10^{14}
  - 0.000 000 000 000 000 84
    - scientific notation: 8.40×10^{-16}
- Scientific notation follows this general format

$$?\times 10^{?}$$

Converting Big Numbers

- Move the decimal to the left until only one digit remains to the left of the decimal point.
- The number of places the decimal was moved is the exponent

$$123.000.000.000.$$

$$1.23 \times 10^{11}$$

Converting Small Numbers

- Move the decimal to the right until the first non-zero digit appears to the left of the decimal point.
- The number of places the decimal was moved is the negative exponent

$$0.000.000.001.23$$

$$1.23 \times 10^{-9}$$