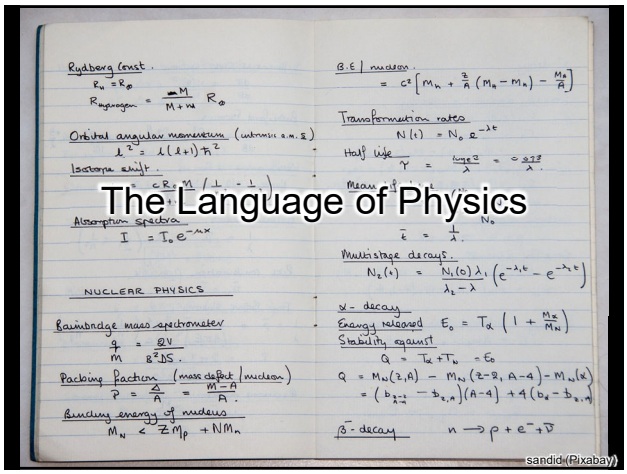


The Role of Units

- The measurements of physical quantities are expressed in terms of units, which are standardized values.
  - The length of a race can be measured in meters (m) or kilometers (km).
  - Volume of liquid can be measured in liters (L) or milliliters (mL).
  - In physics we use fundamental SI units for measurement.

Fundamental Units

- Base units that are defined by international standards.

Quantity	Name	Symbol
Length	Meter	m
Mass	Kilogram	kg
Time	Second	s
Electric current	Ampere	A
Temperature	Kelvin	K
Amount of substance	Mole	mol
Luminous intensity	Candela	cd

(All other units are derived from these units.)

SI Prefixes

- Prefixes are attached to the units to represent larger or smaller values.

Prefix	Symbol	Value
tera	T	10^{12}
giga	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}

Prefix	Symbol	Value
centi	c	10^{-2}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}

Using Prefixes

- Replace the prefix with the value.

$$15\ \text{km} \rightarrow 10^{3} \rightarrow 15 \times 10^{3}\text{m}$$

$$36\ \mu\text{m} \rightarrow 10^{-6} \rightarrow 36 \times 10^{-6}\text{m}$$

Scientific Notation

- Scientific notation is a way of writing numbers that are too large or small to be conveniently written as a decimal.
  - $840\ 000\ 000\ 000\ 000 = 8.4 \times 10^{14}$
  - $0.000\ 000\ 000\ 15 = 1.5 \times 10^{-10}$
- General format: $a \times 10^{b}$

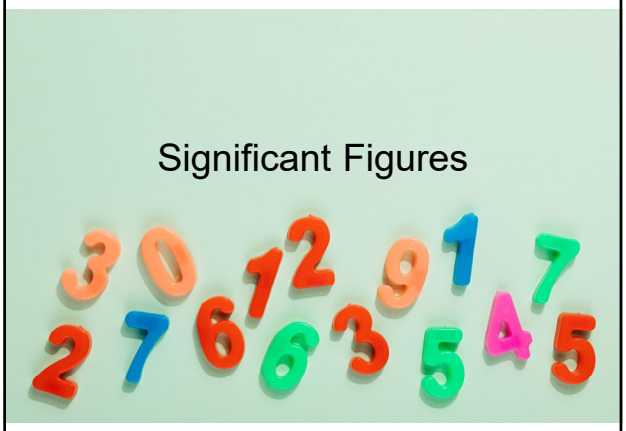
$a \times 10^b$

The value of the measurement with all placeholder zeros removed.

The number of placeholder zeros in the measurement.

Placeholder zeros are those at the end of a number that is 10 or greater, and at the beginning of a decimal number that is less than 1.

Significant Figures



Karolina Grabowska (Pexels)

- When we express measured values, we can only list as many digits as we initially measured with our measuring tool.
  - If you use a standard ruler to measure the length of a stick, you may measure it to be 36.7 cm. You could not express this value as 36.71 cm because your measuring tool was not precise enough to measure a hundredth of a centimeter.
- Significant figures are the number of digits in a number that convey meaning.

Rules

- The last digit written down in a measurement is the first digit with some uncertainty.
- To determine the number of significant digits in a value, start with the first measured value at the left and count the number of digits through the last digit written on the right.

Zeroes

- Zeros are significant except when they serve only as placekeepers.
  - The zeroes in 0.0045 are not significant as they are placekeepers that locate the decimal place.
  - The zeros in 10.01 are significant since they are not placeholders.

- The zeroes in 1200 may or may not be significant depending on the style of number.
  - It may have 2, 3, or 4 significant figures.
  - To avoid confusion, we write numbers like this in scientific notation.
    - 1.2×10^3 has 2 significant figures
    - 1.20×10^3 has 3 significant figures
    - 1.200×10^3 has 4 significant figures

Significant Figures in Calculations

- When combining measurements with different degrees of accuracy and precision, the number of significant digits in the final answer can be no greater than the number of significant digits in the least precise measured value.

- For **multiplication and division**:
  - The result should have the same number of significant figures as the quantity having the least significant figures entering into the calculation.
    - $1.1 \times 2.01 = 2.211 = 2.2$
- For **addition and subtraction**:
  - The answer can contain no more decimal places than the least precise measurement.
    - $8.05 - 2.251 = 5.799 = 5.80$