Scientific Measurement

Qualitative vs. Quantitative Measurements:

Qualitative measurement

Quantitative measurement

Accuracy vs. Precision:

Accuracy

Precision

Percent Error:

\[ \text{\% error} = \left(\frac{\text{Theoretical} - \text{Experimental}}{\text{Theoretical}}\right) \times 100 \]

Significant Figures

Rules:

1. All non-zero numbers are significant
2. Leading zeros are never significant (EVEN IF THERE IS A DECIMAL)
3. Zeros at the end of a number are only significant if there is a decimal
4. Zero “sandwiches” are always significant
5. Numbers before the “x” in scientific notation are always significant

Rounding reminder: \( \geq 5 \): Round UP \( < 5 \): Don’t change

Ex: \[ 201 \quad 3100 \quad 300 \quad 30. \quad 0.031 \quad 0.03021040 \quad 5.8 \times 10^4 \quad 60080 \]

Exact numbers and conversions are not used in determining sig figs.

Adding and Subtracting:

Look BEHIND the decimal of all numbers involved. The one with the fewest digits behind the decimal determines how digits will be behind the decimal in the final answer.

\[ 4.01 + 6.8 + 127.318 = \]
Multiplying and Dividing:

Look at the ENTIRE of sig figs in each number involved. The one with the fewest sig figs TOTAL determines how many sig figs will be in the final answer.

$120 \times 6.01 \times 0.020 =$

Measurement in Lab:

In lab, when writing down your measurement, always go one digit past what is marked on the equipment you are using.

International System of Units: (SI Units)

This is what all scientists around the world report their data in.

- Meter (m) – SI unit for length
- Liter (L) – SI unit for volume
- Gram (g) – SI unit for mass (it is actually kg, but for our purposes, we will focus on the g)

Temperature: A numerical measure of how hot and cold something is. (Average kinetic energy of a system)

Temperature Scales

- Celsius
  Sets the freezing point of water at $0^\circ$C and the boiling point at $100^\circ$C.

- Kelvin
  Absolute zero is set as the zero on the Kelvin scale. It is the temperature at which all motion theoretically ceases.

  Conversion: $K = 273 + ^\circ$C