Measurements & Calculations

Qualitative- Attributes Properties

Quantitative- Amount

Measurement

- Number (magnitude)
- Unit (measure what?)

SI Units

- Measurements (Table 1.2 of Text)
- Prefixes (Table 1.3 of Text)

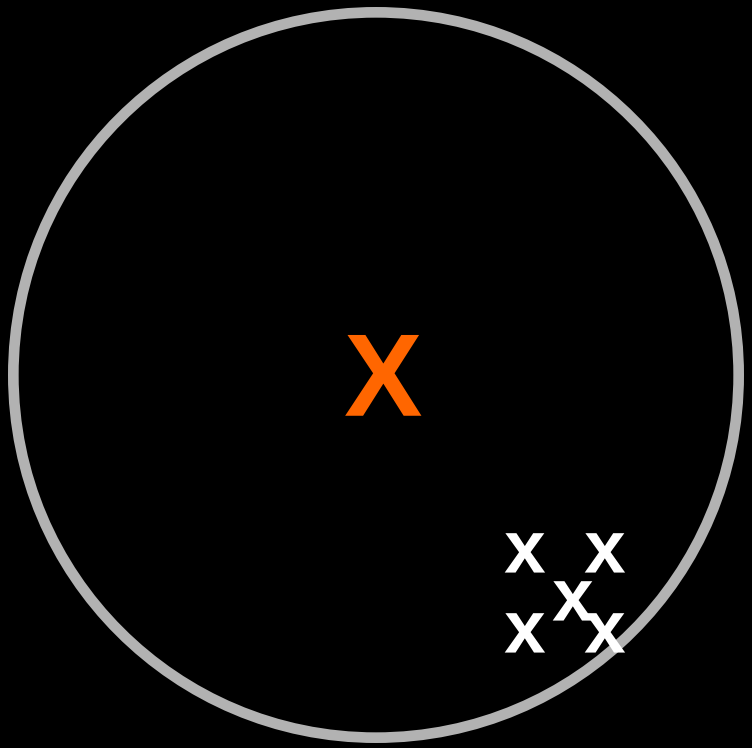
Digits

- Certain
- Uncertain (last digit recorded = first estimated digit.)
  example: 4.7<u>5</u> in.

Precision

- How close results are to each other

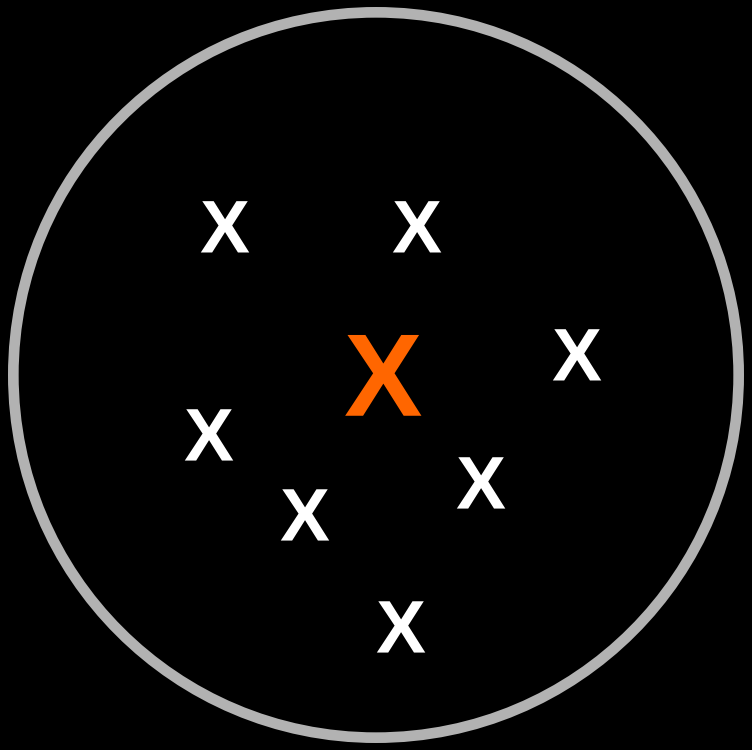
Precise



Accuracy

- How close to actual value

Accurate



(b) Good precision and poor accuracy

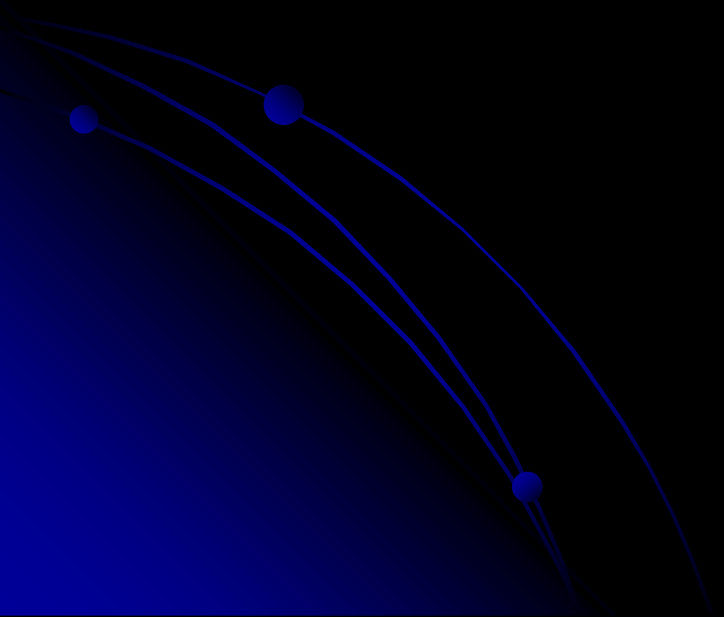
(c) Good precision and good accuracy

(a) Poor precision and poor accuracy

PRECISION

Relative error (RE)

= exp - avg



$$\%RE = \frac{exp - avg}{avg} \times 100$$

$$\% \text{ Precision} = 100 - |\%RE|$$

ACCURACY

Absolute error (AE)

= exp - known

$$\%AE = \frac{exp - known}{known} \times 100$$

$$\% \text{ Accuracy} = 100 - |\%AE|$$

Review Math Concepts Appendix A

- Exponential Notation
- Logarithms
- Graphing Functions

Familiarize yourself with Physical Concepts in Appendix B

Familiarize yourself with Abbreviations & Conversion Factors in Appendix C

Significant Figures

The certain digits and the first uncertain digit of a measurement

Significant Figures (sf)

- Non-zero digits (y)
- “in-between” zeros (y)
- “leading” zeros (n)
- “following” zeros (y)

Dot Left, Not Right Rule

- Begin counting with the first non-zero digit.
- Count all digits after it.
- If there is a decimal point, start counting from the left.
- If there is NOT a decimal point, start counting from the right.

Significant Figures

Exact Numbers: ∞ Sig Figs

2.54 cm = 1 in.

1 m = 1000 mm

4 people

How many sig. figs?

- 1000 m
- 103.0500 m
- 10.4 g
- 970 mL
- 10,600 mg
- 0.00067 km
- 6.63×10^{-34}

Sig Figs for Multiplication

The measurement with the least number of sig figs reduces the answer to its most precise allowable result.

Multiplication

2.3 x 3.01 x 4.250 x 2 =

58.8455

60

Sig Figs for Addition

one rounds the sum (or difference) to the least number of decimal places.

Addition

1.5

3.01

4.002

2.1

10.6

Rules for rounding

Look at *all* digits beyond the uncertain digit.

Round even if the number ends in 5.

1.347 g to 2 s.f. = 1.3 g

0.0272 L to 1 s.f. = 0.03 L

31.50 cm to 2 s.f. = 32 cm

32.50 cm to 2 s.f. = 32 cm

Types of Chemistry Problems

1. Those with conversion factors
2. Those that use a formula

Parts of a Problem

1. Measurements and information given
2. Question asked
3. Connection between #1 and #2

Units Follow Laws of Exponents

- Example:

$$\frac{\text{feet}}{\text{feet}} = \left(\text{feet}^{+1}\right)\left(\text{feet}^{-1}\right) = \text{feet}^{0} = 1$$

Units “Cancel”

Dimensional Analysis
“Factor Label”

Based on cancellation of units

How Many Grams in 6.5 kg?

- Given: 6.5 kg
- Need: grams
- Connection: 1000 g = 1 kg

$$6.5\,\text{kg} \times \frac{1000\,\text{g}}{1\text{kg}} = 6500\,\text{g}$$

How Many Millimeters in 6.78 inches?

- Given: 6.78 in.
- Need: millimeters
- Connections: 2.54 cm = 1 in.

$$6.78\,\text{in} \times \frac{2.54\,\text{cm}}{1\,\text{in}} \times \frac{10\,\text{mm}}{1\,\text{cm}} = 172\,\text{mm}$$

How Many Liters in 1.0 Cubic Yard?

- Given: 1 yd^3
- Need: Liters
- Connections: 1 yd = 36 in
  2.54 cm = 1 in
  1 mL = 1 cm^3

$$1\,\text{yd}^3 \times \frac{(36\,\text{in})^3}{(1\,\text{yd})^3} \times \frac{(2.54\,\text{cm})^3}{(1\,\text{in})^3}$$

$$\times \frac{1\,\text{mL}}{1\,\text{cm}^3} \times \frac{1\,\text{L}}{1000\,\text{mL}} = 764\,\text{L}$$

$$= 7.6 \times 10^2\,\text{L}$$

What is the Celsius Equivalent to 77° F?

- $T_c = (T_f - 32)\ 5/9$
- $T_c = (77^o - 32)\ 5/9$
- $T_c = 25^o\ C$

What is the Volume (m^3) of 1.50 kg of Air?

- (Density air at 25^o C = 1.12×10^{-3} g /cm^3)

$$1.50\ \text{kg} \times \frac{1000\ \text{g}}{1\ \text{kg}} \times \frac{1\ \text{cm}^3}{1.12 \times 10^{-3}\ \text{g}} \times \left(\frac{1\ \text{m}}{100\ \text{cm}} \right)^3 = 1.34\ \text{m}^3$$