ABE 20100

Module 1

Units, Precision, Accuracy, and Significant Figures

Review of Topics

- Dimensions are properties that can be measured (mass, time, etc.)
- Units are scales for measuring dimensions and can be interconverted.
- lb_f versus lb_m and g_c
- Instruments are used to measure the physical world and have three inherent properties

  Precision = significant figures

  Accuracy = conformity to standard of measurement

  Reproducibility = give same answer for repeated measurements

Force vs Mass

$$F = m \cdot a$$

Newton is a compound unit, used for convenience.

$$N = kg \times \left(\frac{m}{s^2} \right)$$

$$\frac{kW \times hr}{sol} = \frac{k\left(\frac{J}{s} \right) \times hr}{sol} = \frac{k\left(\frac{N \cdot m}{s} \right) \times hr}{sol}$$

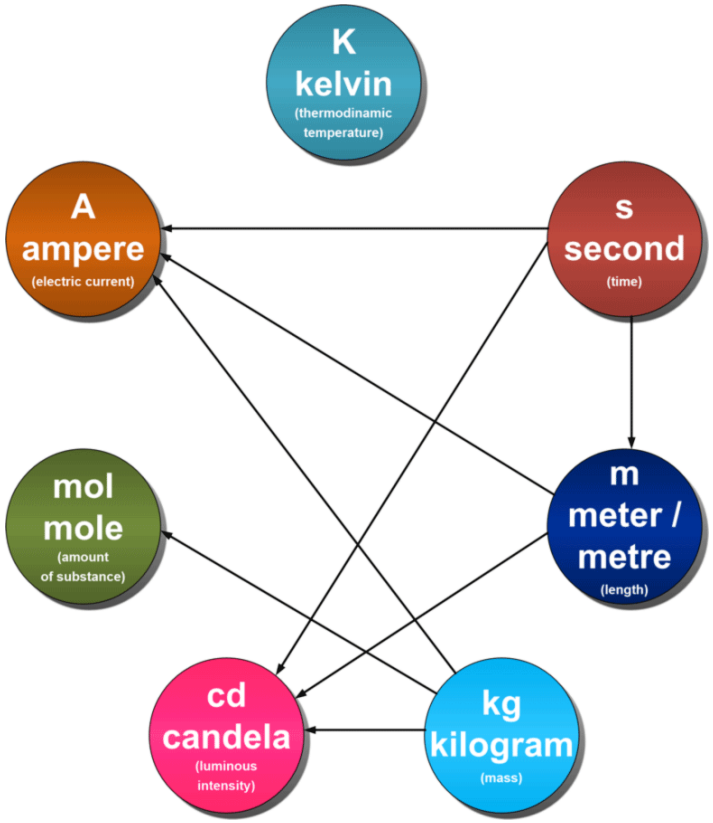
$$= \frac{k\left(\frac{kg \cdot m^2}{s^3} \right) \times hr}{sol} = \text{Pirate-Ninja}$$

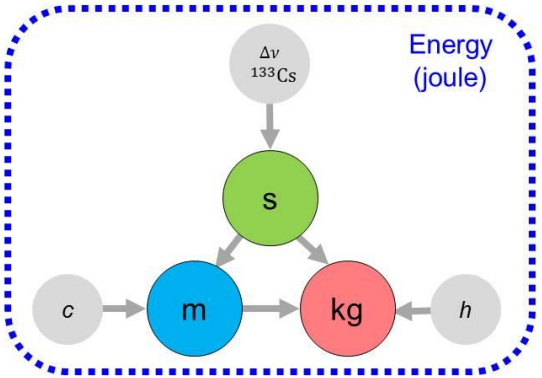
International System of Units

Le Système international d'unités

SI Units Metric System

MKS System = Meter – Kilogram - Second





The Ambiguous Pound

Pounds are Units of Mass Pounds are Units of Force

1 lbm exerts 1 lbf when accelerated by earth's gravity

The Ambiguous Pound

1 lbm exerts 1 lbf when accelerated by earth's gravity

$$F = m \cdot g$$

$$1\ \text{lbf} \neq 1\ \text{lbm} \cdot 32.2\ \frac{\text{ft}}{\text{s}^2}$$

$$1\ \text{lbf} = \frac{1\ \text{lbm} \cdot 32.2\ \frac{\text{ft}}{\text{s}^2}}{32.2\ \frac{\text{lbm} \cdot \text{ft}}{\text{lbf} \cdot \text{s}^2}}$$

$$g_c = 32.2\ \frac{\text{lbm} \cdot \text{ft}}{\text{lbf} \cdot \text{s}^2}$$

To the Moon

Neil Armstrong is in the Saturn V rocket that is launching into orbit.

During launch the Saturn V experiences a peak acceleration of 121 ft/s^2.

If Neil Armstrong weighs 182 lb, what is the force (in lb) that he experiences at the peak acceleration (with correct significant figures)?

$$F = \frac{m \cdot g}{g_c}$$

$$F = \frac{182\ \text{lbm} \cdot 121\ \frac{\text{ft}}{\text{s}^2}}{32.2\ \frac{\text{lbm} \cdot \text{ft}}{\text{lbf} \cdot \text{s}^2}}$$

$$F = 684\ \text{lbf}$$

What is the force he experiences in Newtons?

1 kg = 2.20462 lb

1 m = 3.28084 ft

$$F = m \cdot g$$

$$F = 82.5539\ \text{kg} \cdot 36.8808\ \frac{\text{m}}{\text{s}^2}$$

$$F = 3040\ \text{N}$$

If you round at each step:

$$F = 3050\ \text{N} = 686\ \text{lbf}$$

Instruments

Three balances are used to measure a mass standard (50.000 g). The results of repeated measurements are below.

A	B	C
52	52.2	49
52	49.1	52
52	52.0	50
51	50.5	49

Which balance is

a. Most accurate?
b. Most precise?
c. Most reproducible?

Instruments

	A	B	C
	52	52.2	49
	52	49.1	52
	52	52.0	50
	51	50.5	49
Average	52	51.0	50
St. Dev.	0.50	1.45	1.41
Av. Error	2	0.95	0

Which balance is

a. Most accurate? C (least error compared to standard)
b. Most precise? B (most significant digits)
c. Most reproducible? A (smallest standard deviation)