

Week 1 Physics Notes

plutonium.bmb

August 2024

1 Units and Measurements

1.1 SI Units

- What is a unit?
 - A basic, arbitrary, widely accepted reference standard.
 - Used in conjunction with a number to express the measurement of a physical quantity
- Types
 - * Fundamental Units (g, kg, ft, lb)
 - * Derived Units (Newton, Velocity, Joule)
 - Set of fundamental and derived units: system of units.
- Systems of units
 1. International System of Units
 - From French *Système international d'unités*. It was also formerly known as the meter-kilogram-second (MKS) system.
 - Developed and recommended by the General Conference on Weights and Measurement in 1971.
 - Expressed in multiple or fractional quantities in powers of 10 (SI Prefixes).
 2. Imperial System of Units
 - Also known as British System and foot-pound-second (FPS).
 3. centimeter-gram-second (CGS)
- Base SI Units

Table 1: List of base SI units

Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric Current	ampere	A
Temperature	kelvin	K
Amount of substance	mole	mol
Luminous Intensity	candela	cd

- SI prefixes and multipliers

Table 2: List of SI prefixes ($10^{n>1}$)

Prefix	Symbol	Base 10
quetta	Q	10^{30}
ronna	R	10^{27}
yotta	Y	10^{24}
zetta	Z	10^{21}
exa	E	10^{18}
peta	P	10^{15}
tera	T	10^{12}
giga	G	10^9
mega	M	10^6
kilo	k	10^3
hecto	h	10^2
deca	da	10^1

Table 3: List of SI prefixes ($10^{n<1}$)

Prefix	Symbol	Base 10
deci	d	10^{-1}
centi	c	10^{-2}
mili	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}
femto	f	10^{-15}
atto	a	10^{-18}
zepto	z	10^{-21}
yocto	y	10^{-24}
ronto	r	10^{-27}
quecto	q	10^{-30}

1.2 Conversion Factors

- Distance

– Imperial-Metric

- * inches-centimeters:

$$\frac{1in}{2.54cm}$$

- * feet-meters:

$$\frac{1ft}{0.30m}$$

- * miles-kilometers:

$$\frac{1mi}{1.61km}$$

– Imperial-Imperial

- * feet-inches:

$$\frac{1ft}{12in}$$

- * yards-feet:

$$\frac{1yd}{3ft}$$

- * miles-yards:

$$\frac{1mi}{1760yd}$$

- Area

– Non-SI Unit to Metric

- * acres-kilometers:

$$\frac{1ac}{4.046m^2}$$

- * hectare-kilometer:

$$\frac{1ha}{10km^2}$$

- Volume

– Metric Units

- * liters-m³:

$$\frac{1L}{1dm^3}$$

- * mililiters-cc:

$$\frac{1mL}{1cc}$$

– Imperial Units

- * gallon-liters³:

$$\frac{1gal}{4.55L}$$

- * quart-gallon:

$$\frac{4qt}{1gal}$$

- * pint-gallon:

$$\frac{8pt}{1gal}$$

- * ounce-gallon (imperial):

$$\frac{160floz}{1gal}$$

- * ton-ft³:

$$\frac{1ton}{35ft^3}$$

– Kitchen Units

- * cup-gallon:

$$\frac{16c}{1gal}$$

* tablespoon-ounce (imperial):	• Mass	* ton (metric):
	– Imperial and Metric	$\frac{1t}{1000kg}$
$\frac{8tbsp}{5floz}$	* kilograms-pounds:	• Time
		• Temperature
* teaspoon-ounce (imperial):	$\frac{1kg}{2.2lb}$	– Fahrenheit-Celsius:
	* ounce-pounds:	$F \text{ deg} = (\frac{9}{5}C \text{ deg}) + 32$
$\frac{6tsp}{1floz}$	$\frac{16oz}{1lb}$	$C \text{ deg} = \frac{5}{9}(F \text{ deg} - 32)$

1.3 Percent Error

- Percent Error Formula

$$\% \text{ error} = \frac{|\text{actual value} - \text{theoretical value}|}{\text{theoretical value}}$$

- Definitions

– Actual Value

- * Also known as the experimental value.
- * It is the value that came up from an experiment's results.

– Theoretical Value

- * It is the calculated ideal value of the result if an experiment were to be conducted perfectly in an ideal environment.

– Percent Error

- * Determines the margin of error of the actual value from the theoretical value.
- * This may tell if the experiment was conducted successfully.

1.4 Accuracy vs. Precision

- Definitions

– Accuracy

- * degree of conformity of a measure to a standard or a true value (*Merriam-Webster Dictionary*)

– Precision

- * the quality of strictly conforming to a pattern, standard, or convention (*Merriam-Webster Dictionary*)

- Graphical Explanation

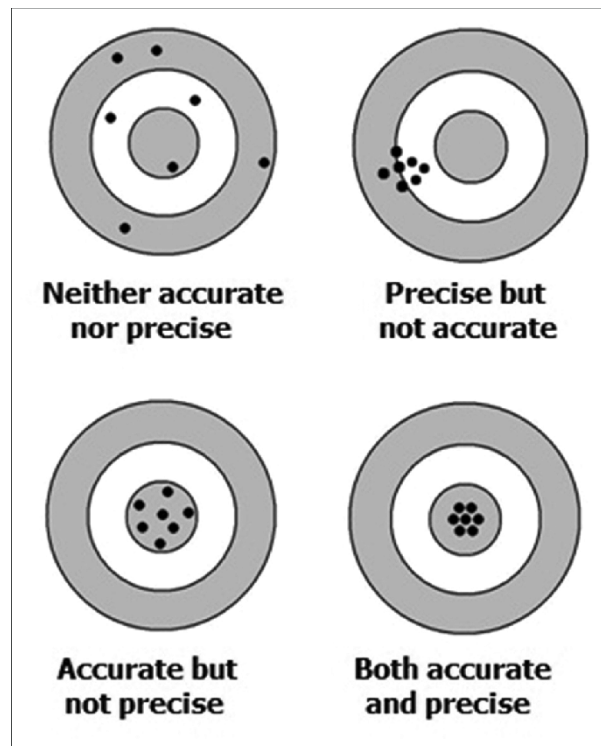


Figure 1: a diagram showing the permutations of accuracy and precision (Hazra, 2017)