Chapter 1.4 Measurment

Measurment = Value & Unit

Value ↑ decimal or Scientific notation

Unit ↑ SI or English

Units without units the value is meaningless

Two major Systems

	English	SI (System International)
mass	lbs	grams
Volume	gal	Liters
Length	ft	meters

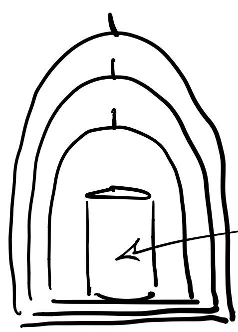
Convert? lbs ⟷ grams

7 fundamental SI base units (definitions)

Type of Measure	Unit	Abbreviation
Length	meter	m
Mass	Kilogram	kg
Time	Second	s
Temp	Kelvin	K
Current	Ampere	A
Amount of Substance	mole	mol
Luminousity	Candela	cd

Length - The distance that light travels in $\frac{1}{299,792,458}$ seconds = 1 meter

Mass - A platinum/Irridium Cylinder



Le Grand K

Kilogram

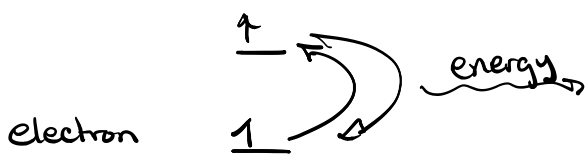
planks Constantant

New definition $h = 6.62607015 \times 10^{-34}\ \underline{Kg}\, m^2/s$

an exact value

a definition

Time - 9,192,631,770 periods of radiation emitted by a cesium ^{133}Cs atom



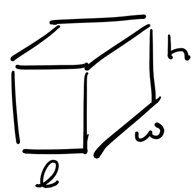
Temp - $\frac{1}{273.15}$ divisions between Absolute Zero and the triple point of water

Kelvin

mol - $\underline{\underline{\text{Exactly}}}$ $6.02214076 \times 10^{23}$ things

Derived Units → Derived from base Units

Volume



$l \times w \times h = \text{Volume}$

$\underbrace{cm \times cm \times cm}_{\text{Length}} = \underset{\text{volume}}{cm^3}$

$1m \times 1m \times 1m = 1\,m^3 = 1000\,L$

$\text{Liter} = \frac{1}{1000} \text{ of } m^3$

<u>Density</u>

$\frac{\text{Mass}}{\text{Volume}}$ Ratio

$\frac{\text{grams}}{\text{mL}} = g/mL$ units of density

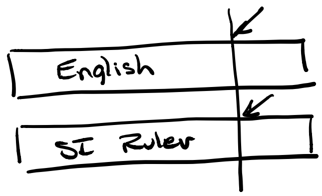
SI system is based in units of 10 & uses a series of prefixes to change the size of base unit

Tera	T	10^{12}
Giga	G	10^{9}
Mega	M	10^{6}
kilo	k	10^{3}
deci	d	10^{-1}
Centi	c	10^{-2}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}
femto	f	10^{-15}

larger than 1

Smaller than 1

We need a key to translate between English & SI Systems



sets up an equality between the two Systems

3 Key ⟹ memorize

	English		SI	
			Exact	
Length	1 in	=	2.54 cm	Definintion
			4 sig fig	
mass	1 lbs	=	453.6 g	not a def. measured
			4 sig figs	
Volume	1 gal	=	3.785 L	not a def. measured

Two types of values

Those with uncertainty

All measurments

All have Sig figs because Sig figs are a measure of uncertainty

Those without uncertainty

Counted Values

Definitions

No uncertainty

⟹ They have infinite Sig figs

⟹ They are exempt from Sig figs

Application of Metric Prefixes

Examples

2.3 cm

centi $\times 10^{-2}$

$1\text{ cm} = 1 \times 10^{-2}\text{ m}$

$2.3 \times 10^{-2}\text{ m}$

7.62 Km

kilo $= \times 10^{3}$

$7.62 \times 10^{3}\text{ m}$

$\underbrace{9,324.}_{3\ 2\ 1}\text{ m} = 9.324 \underbrace{\times 10^{3}}_{k}\text{ m}$

9.324 km

Chapter 1.5 Measurment & Uncertainty

Values

Exact | uncertainty

definitions | Counted

$1000 mL = 1 L$

or

$1 mL = 1 \times 10^{-3} L$

$100 cm = 1 m$

or

$1 cm = 1 \times 10^{-2} m$

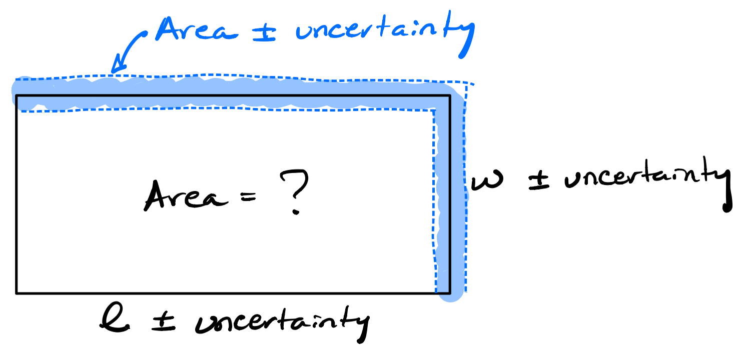
Counted: whole #'s with no possibility of fraction

3 cans
21 pens
4 Car
people

uncertainty: All measurements obtained with a measuring device

Examples

		Exact or Measured
A)	$2.73 mL$	measured
B)	3ft = 1 yard (same system)	definition ⇒ exact
C)	$10^{6} \mu L = 1 L$	definition ⇒ exact
D)	$102.73 g$	measured
E)	* $2.54 cm = 1 in$ (different systems)	But this was made a definition ⇒ exact
F)	$3.785 L = 1 gal$ (different systems)	measured
G)	85 students	Counted ⇒ exact
H)	$173 g$	measured



Area = $l \times w$ ± Some uncertainty

need a system to estimate

<u>Significant figures</u> – A system for estimating uncertainty both in an individual measurement <u>and</u> a calculated result

Two types of place holders in values

2,300,000 ft ⇒ 2.3×10^{6} ft

0.0000632 km ⇒ 6.32×10^{-5} km

These are place holders and not part of the measurement

Zeros Removed

In counting significant figures place holders are <u>not</u> counted.

Trouble makers

Three types of zeros

bound or Captive, Trailing, leading

Part of measurement

Sometimes placeholders

always placeholders

Examples — Significant Figures

A) 0.00639 L = 6.39×10^{-3} L — 3 sig figs

B) 2034.9 ft = 2.0349×10^{3} ft — 5 sig fig

bound

C) 3.00×10^{-19} s — Already in Sci. Not. Could be 3×10^{-19} s — 3 sig figs

Trailing after decimal

D) 0.0072̲00 mL = 7.200×10^{-3} mL — 4 sig figs

leadin — Trailing after decimal

E) 2900 g = 2.9×10^{3} g — 2 sig figs

Ambiguous

F) 2900. g = 2.900×10^{3} g — 4 sig figs

treat like non zero

bound

G) 2.90×10^{3} g — 3 sig figs

H) 1300 Cars — Exact ⟹ Infinite

precision ~ $\frac{1}{\text{uncertainty}}$

Least precise 3 sig figs →

5 sig figs →

Never effects outcome

Most precise Exact ∞ →

Least precise 3sigfigs →

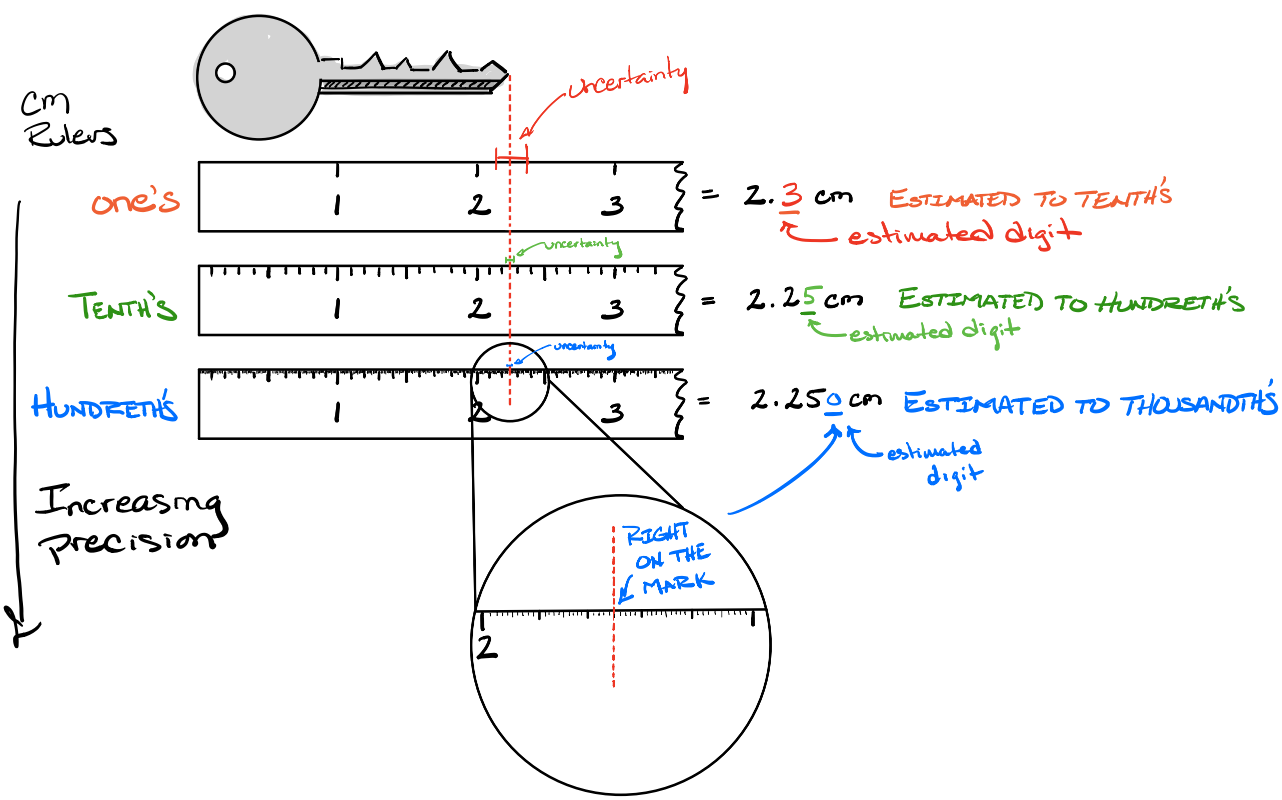
Computation
× ÷ + −

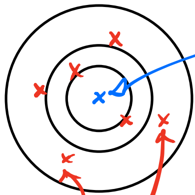
→ ~ 3 sig figs

Answer uncertainty need to match the data with ~~Least~~ precisim

Precisition - A measure of how much uncertainty there is in a measurment or group of measurements.

Accuracy - How close a measurement is to the true value

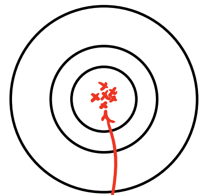




Average of all readings may be accurate

Individual readings not precise

2 sig figs



Individual Readings precise

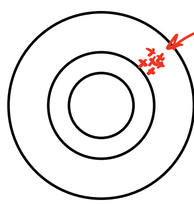
4 sig figs

Up in sig fig

Up in precision

High uncertainty

Low Uncertianty



high precision but It's not accurate

Possible to have high precision <u>but</u> bad accuracy