Big Picture of Physics § Chpt 1

Physics 6

* Units of measure, techniques of measure
* Kinematics : Motion : displacement, speed, acc'ln
* Newtons Laws: $F = Ma$ ← acc'ln
  - force
  - mass
  - → Law of Gravity
* Momentum :
* Energy
* Rotational Mechanics
* Oscillations
* Statics & Elasticity
* Thermodynamics : Heat { Chpt 13 – Chpt 15

Physics 7

* Electricity
* Magnetism
* Maxwell's Eqn
* Optics
* Atomic Phys
* Nuclear Physics
* Cosmology
* ((Special Relativity))

Chapter 1 Units and Measurement

⊛ Measurements and Units

There are two "competing" systems of measurement

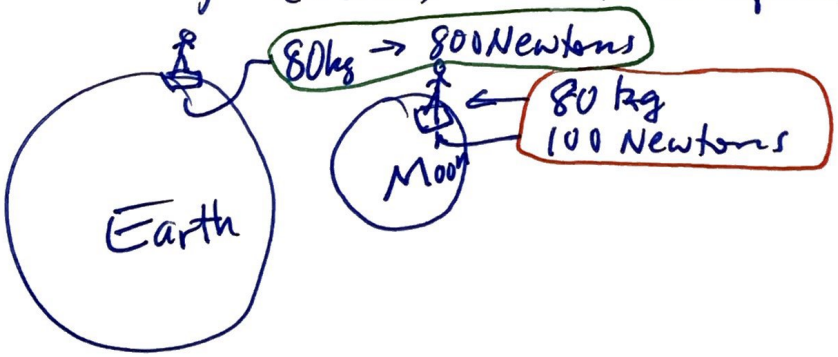
→ • SI : Systeme International aka. metric

• USCS : United States Customary System.

	Length	Mass, Force (weight)	Time
SI →	m, cm, mm, nm	kg, Newton	s, hrs, day, yr
USCS →	ft, yds, miles	slug, pounds	s, hrs, day, yr {dictated by Earth's rotation}

* mass is commonly refered to as "initia"
mass is independent of the planet you reside on

* weight (force) : This is dependent on the planet your on



* Electrostatics : units are charge → coulomb
electric potential → volt
current → amp

* Temperature : K, °C
↑ Kelvin ↖ Centigrade (Celsius)

⊗ Unit conversions

- Equivalent values ⇒

Conversion Factor

$1\text{ in} = 2.54\text{ cm}$

centi $\frac{1}{100}$ meter

EX Convert 12 inches to cm:

$$12\text{ in}\left(\frac{2.54\text{ cm}}{1\text{ in}}\right) = 30.48\text{ cm}$$

Equiv. Values

12 in = 1 ft
1 mi = 5280 ft 1 hr = 3600 s
1000 m = 1 km

EX Convert 60 mi/hr to km/s

$$60\frac{\text{mi}}{\text{hr}}\left(\frac{5280\text{ ft}}{1\text{ mi}}\right)\left(\frac{12\text{ in}}{1\text{ ft}}\right)\left(\frac{2.54\text{ cm}}{1\text{ in}}\right)$$

$$= 9{,}656{,}064\frac{\text{cm}}{\text{hr}}\left(\frac{1\text{ m}}{100\text{ cm}}\right)\left(\frac{1\text{ km}}{1000\text{ m}}\right)$$

$$= 9654.064\frac{\text{km}}{\text{hr}}\left(\frac{1\text{ hr}}{3600\text{ s}}\right)$$

$$= 0.0268\text{ km/s}$$

EX $60\frac{\text{mi}}{\text{hr}} \longrightarrow ??\text{ ft/s}$

$$60\frac{\text{mi}}{\text{hr}}\left(\frac{1\text{ hr}}{3600\text{ s}}\right)\left(\frac{5280\text{ ft}}{1\text{ mi}}\right) = 88\text{ ft/s}$$

⊛ powers of 10

- In physics we talk about the Grand size of the Galaxy as well as the interior of an proton
- To cover all these distances we use powers of 10:

Big Stuff

1 meter

$10\,m = 1.\times10^{1}\,m$

$100\,m = 1\times10^{2}\,m$

$1000\,m = 1\times10^{3}\,m = 1\,km$ (kilo)

⋮

$1{,}000{,}000\,m = 1\times10^{6}\,m \rightarrow$ or $(10^{6}\,m) = 1\,Mm$ (mega)

$2{,}000{,}000\,m = 2\times10^{6}\,m$ (2 million m)

↑ order of magnitude

$2{,}000{,}000{,}000\,m = 2\times10^{9}\,m$ (2 billion m)

$= 2\,Gm$ ← "Giga"

10^{13} solar system

Small Stuff

1 m

$0.1\,m = 1.\times10^{-1}\,m$

$0.01\,m = 1.0\times10^{-2}\,m \rightarrow 1\,cm$ (centi)

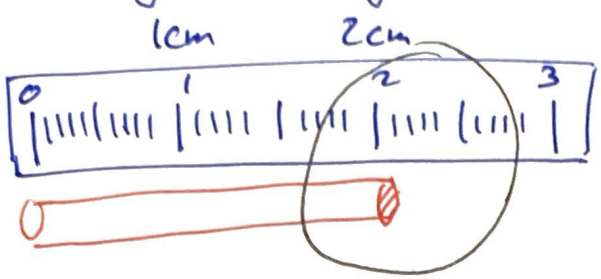
$0.001\,m = 1\times10^{-3}\,m \rightarrow 1\,mm$ (milli)

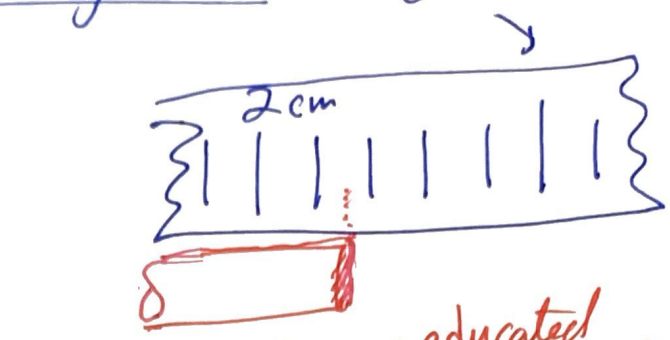
$0.000001 \rightarrow 1\times10^{-6}\,m \rightarrow 1\,\mu m$ (micro)

(1 2 3 4 5 6)

$0.000000001 \rightarrow 1\times10^{-9}\,m \rightarrow 1\,nm$ (nano)

⊛ Accuracy and Significant Figures





$l = 2.15$ ← educated guess

accurate

$\frac{1}{2} = 0.05$

$\frac{1}{3} = 0.03$

$\frac{1}{4} = 0.025 \approx 0.03$

The last digit is intended to be an educated estimate.

2.15 has <u>three significant figures</u>

But the last is the estimate

EX Significant Figures

0.0062 cm ← 2 sig. figs

↳ do not count as sig. figs.

EX

- 50.1 cm ← 3 sig. figs, 0.1 is the est.
- 50.10 cm ← 4 sig figs.
  ↑ count this ~~zero~~.
- 50,600 cm
  ↳ 3 sig figs.

If actual measurement: 50612 → 50,612 (acct) est. if told to round to the unit (digit).

round to nearest tens.

50612 → 50,610

round to nearest hundred.

50612 → 50,600

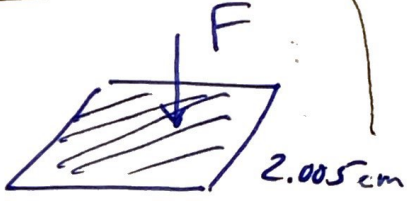
IF the number is actually 50,600 then place a decimal to show it is not rounded 50600.

✱ Sig Figs in Physics

Rule 1: The number of sig. fig. in a $*\{\div$ calc'n is the number with the least sig. figures

EX

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$



$$= \frac{45\,N}{(3.22)(2.005)\,cm^2}$$

least s.f. (only 2)

Calculator strokes...

45 [+/-] 3.22 [=] [÷] 2.005 [=]

$$= 0.15489\,2272 \text{ Pascals}$$

↑ answer.

Rule 2: When adding / subtracting we keep the number of decimal places of the least accurate number:

Ex $9.65\text{ cm} + 8.4\text{ cm} - 2.89\text{ cm} = \boxed{15.16}$

↑ one decimal point acc'y

Ans: $\boxed{15.2}$ ← round up.

Ex

Combined examples:

$$8.71 + \left(\frac{8.71\text{ cm}}{3.2\text{ cm}}\right) 1.1\text{ cm}$$

(2 sig. figs)

$= 8.71 + \boxed{2.}9940625\text{ cm}$

$= 8.71 + 3.0$

$= \boxed{11.7}1$

ans. $\boxed{11.7\text{ cm}}$

⊛ Rounding Numbers

Rules:

1. If the remainder beyond the desired digits of acc'y is less than 5 drop the last digit

Ex Round to 3 sig figs.

4.99499 → **4.99 cm**

2. If the remainder is greater than 5 the increase the last digit by 1

Ex Round to 3 sig. figs:

0.08757 → **0.0876**

3. If the digit beyond the desired acc'y is a 5 then round the number to the closest even number.
{To prevent rounding bias}

Ex Round to 3 sig. figs

3.77500 → **3.78**

↑ remainder = 5

3.76500 → **3.76**

3.78500 → **3.78**

Examples: Round to 3 sig. figures

$0.09403 \longrightarrow 0.0940$

$95,632 \longrightarrow 95\,600$

$0.02032 \longrightarrow 0.0203$

$2.3452 \longrightarrow 2.34$

$4.99502 \longrightarrow 5.00$

$0.024450 \longrightarrow 0.0244$

$96,650 \longrightarrow 96600$

$5.09500 \longrightarrow 5.10$

Note: In this class we keep more than 3 or 4 digits but in the end round to 3 decimal places.