Data handling

Variables have units

SI Système International

Mass	kg	kilogram
Length	m	metre
time	s	second
electric current	A	ampere
temperature	K	kelvin

Best to use standard form

$e = 1.60 \times 10^{-19}\,C = 0.000\,000\,000\,000\,000\,000\,160\,C$

* Always give final answer to number of sig fig of data used with lowest number of sig figs *

1 m is 1 significant figure — 1.00 m is 3 significant figures

100 m is 1 significant figure — 1.00×10^{2} m is 3 significant figures

BUT we could assume 100m is actually 3 significant figures

Button on calculator : E , Exp , $\times 10^{\square}$, $\times 10^{x}$

(3.11×10^{9}) ← some calculators assume these brackets

$(3.11 \times 10^{9}) \div (6.22 \times 10^{9}) = 0.5$, $0.5 \times 10^{18} = 5 \times 10^{17}$

(6.22 × 10^9 interpreted as numerator)

Never harm in using brackets — the advice is always use them.

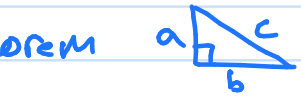
Log Button

$10^{3} = 1000$ (3 ← logarithm; base: 10; value: 1000)

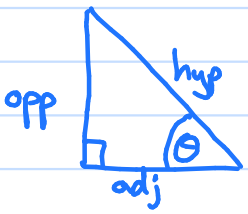
$\log_{10} 1000 = 3$ (3 ← logarithm; base: 10; value: 1000)

Trigonometry

Pythagorean theorem



$c^2 = a^2 + b^2$



- $\sin\theta = \frac{opp}{hyp}$ — $\theta = \arcsin\left(\frac{opp}{hyp}\right)$
- $\cos\theta = \frac{adj}{hyp}$ — $\theta = \arccos\left(\frac{adj}{hyp}\right)$
- $\tan\theta = \frac{opp}{adj}$ — $\theta = \arctan\left(\frac{opp}{adj}\right)$

$1 = \sin^2\theta + \cos^2\theta$

area $= \frac{1}{2}$ base × height

2π radians $= 360°$

Algebra

$\propto$ means proportional to

Δ means discrete change

$\langle x \rangle$ mean mean $x = \sum_{i=1}^{N} x_i / N$

$y \propto x \rightarrow y = kx$ (k: constant of proportionality)

Square root: $\sqrt{x} = x^{1/2}$

cube root : $\sqrt[3]{x} = x^{1/3}$

Straight line graphs

Straight lines are easy – we want all our graphs to be straight

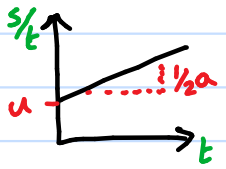
$y = mx + c$ (y-axis, gradient, x-axis, y-intercept)

for direct proportionality, $c = 0$

we try to get all relationship into: Variable = constant × variable + constant

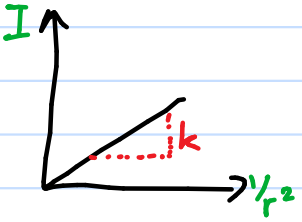
Examples $s = ut + \frac{1}{2}at^2$ (time, displacement, initial velocity, acceleration, time) → Var = con × var + con × var

If we ÷t: $\frac{s}{t} = u + \frac{1}{2}at$ → var = con + con × var



Example $I \propto 1/r^2 \rightarrow I = k/r^2$

$I = k \cdot \frac{1}{r^2}$ (I: var; k: con; $\frac{1}{r^2}$: var)



Example $T = kr^n$ (T: var; k: con; r: var; n: con)

POWER LAW

$\log T = \log kr^n = \log k + \log r^n = \log k + n \log r$ (T: var; k: con; r: var; n: con)

- $10^{\text{intercept}} = k$
- gradient = n

Gradients

- Measure gradient using as big a range as possible
- Data must occupy more than ½ available space vertically & horizontally
- Range on graph paper for gradient measurement should be at least 8x8cm
- Gradient = $\frac{\Delta y}{\Delta x}$
- Tangents to curves, gradient of tangent at particular value.

Areas between line & x-axis

- for regular shapes – use geometry
- for irregular shapes – count the squares