1st October

1 2 3

1. Calculate the **diameter**, in m, of a:
   a. Circle with an area of 1.0 m^2

   $d = \sqrt{\frac{4A}{\pi}}$ $d = 1.1\ m$

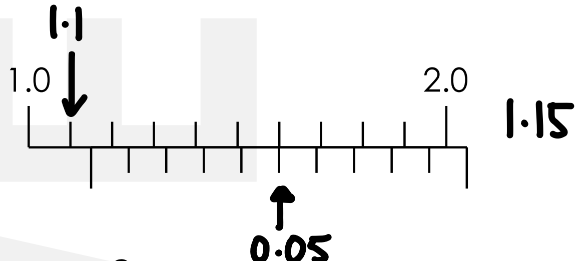
   b. Sphere with a surface area of 1.0 m^2

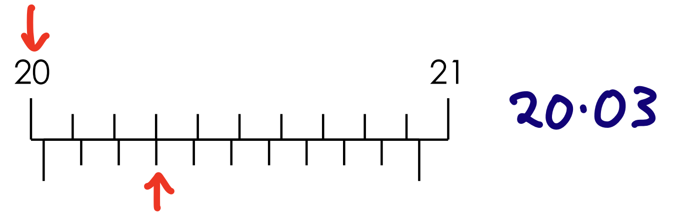
   $d = \sqrt{\frac{A}{\pi}}$ $d = 0.56\ m$

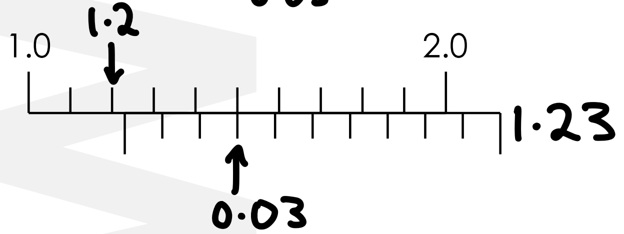
   c. Sphere with a volume of 1.0 m^3

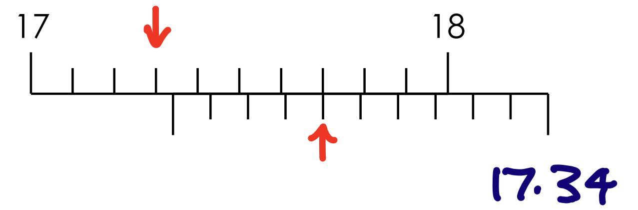
   $d = \sqrt[3]{\frac{6V}{\pi}}$ $d = 1.2\ m$

2. Read the **quantity** measured in the following diagrams of vernier scales.









3. Calculate the **current** if 1.0 x 10^{-2} moles of electrons pass a point in 1.0 hour.

charge per e$^-$

$$I = \frac{Q}{t} = \frac{1.0\times10^{-2} \times 6.02\times10^{23} \times 1.60\times10^{-19}}{60\times60}$$

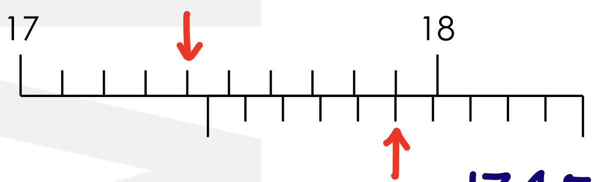
$I = 0.27\ A$

2nd October

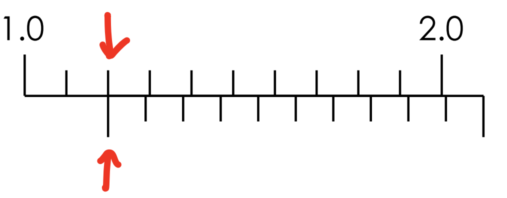
1 2 3

1. Write down the **mass** in kg, to 4 sf, of:
   a. An electron — 9.109×10^{-31} kg
   b. A proton — 1.673×10^{-27} kg
   c. A neutron — 1.675×10^{-27} kg
   d. An alpha particle — 6.645×10^{-27} kg

2. Read the **quantity** measured in the following diagrams.



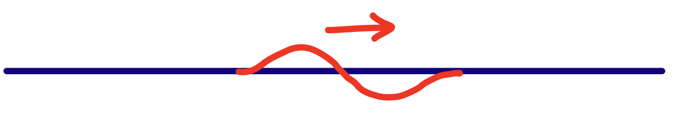
17.45



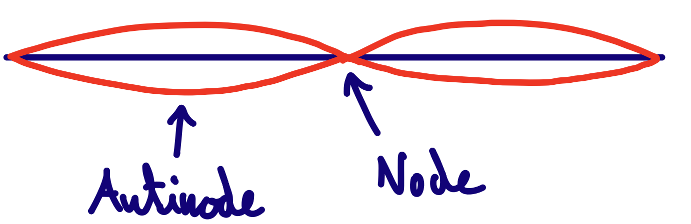
1.20

3. Describe the differences between two waves propagated on two strings with the same wavelength and amplitude but one is **stationary** (also called a standing wave) and the other is **progressive**.

A progressive wave transfers energy from one place to another.



A stationary wave stores energy.

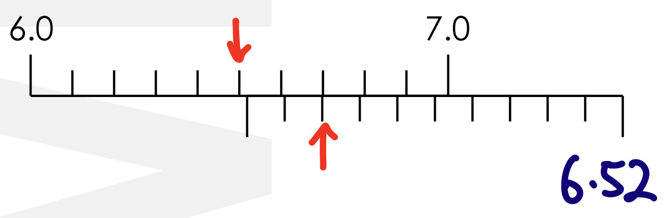


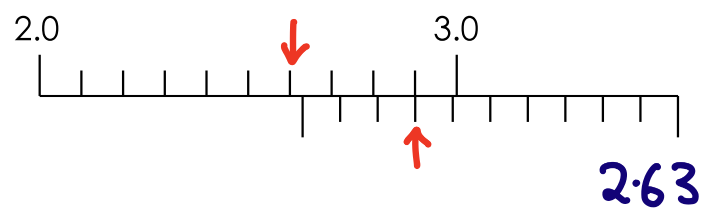
3rd October

1 2 3

1. Rearrange the following to make **d** the subject:
   a. $E = V / d$ $\quad d = V/E$
   b. $A = \pi d^2 / 4$ $\quad d = \sqrt{\frac{4A}{\pi}}$
   c. $n\lambda = d\sin\theta$ $\quad d = n\lambda/\sin\theta$

2. Read the **quantity** measured in the following diagrams.





3. Calculate the **refractive index** of a material if light travels at 2.6×10^8 m s^{-1} through it.

$$n = \frac{c}{v} = \frac{3.00\times10^8}{2.6\times10^8} = 1.2$$ no units

4th October

1 2 3

1. Rearrange the following to make **M** the subject:

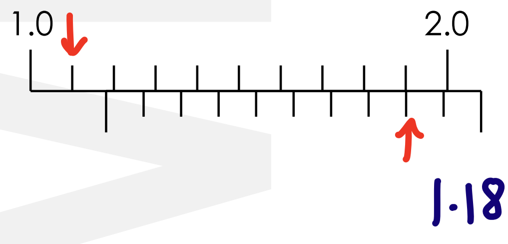
   a. $V_g = -GM / r$ $M = -rV_g / G$

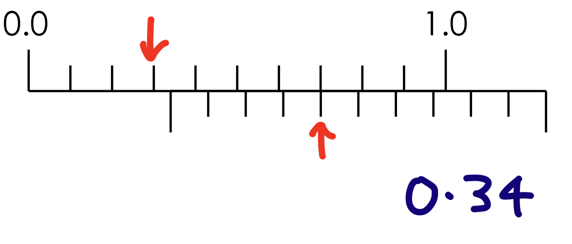
   b. $g = -GM / r^2$ $M = -r^2 g / G$

   c. $F = -GMm / r^2$ $M = -r^2 F / Gm$

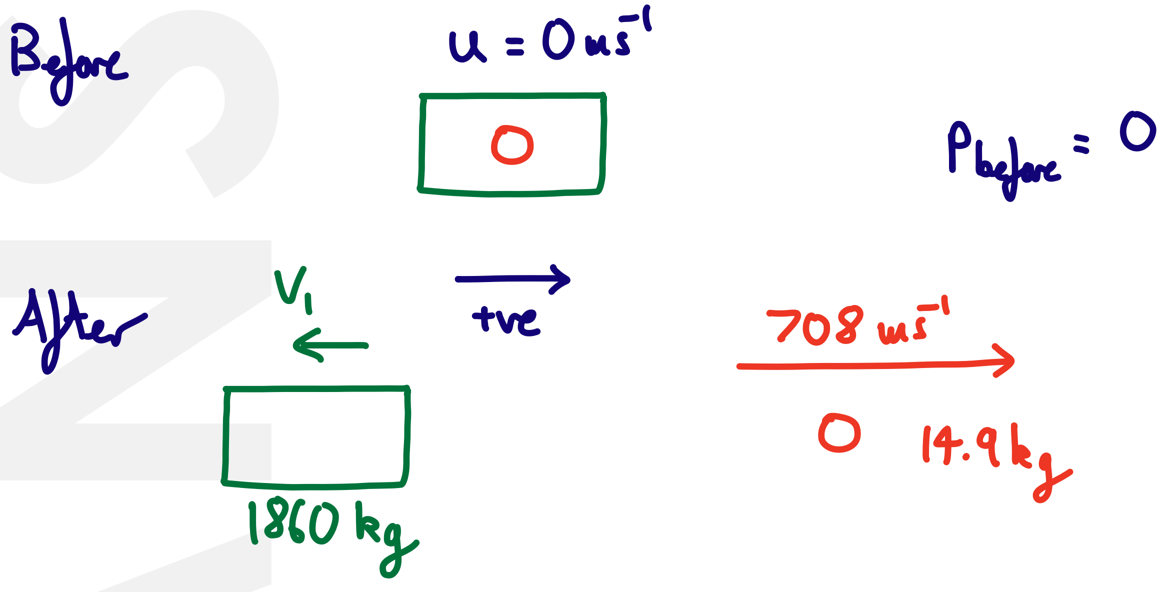
The negative sign shows that gravity is an attractive force.

2. Read the **quantity** measured in the following diagrams.





3. An artillery gun of mass 1860 kg is initially at rest. It fires a shell of mass 14.9 kg with a muzzle velocity of 708 m s^{-1}. Calculate the **recoil velocity** of the gun.



$P_{after} = 0 = m_1 v_1 + m_2 v_2 = (1860 \times v_1) + (14.9 \times 708)$

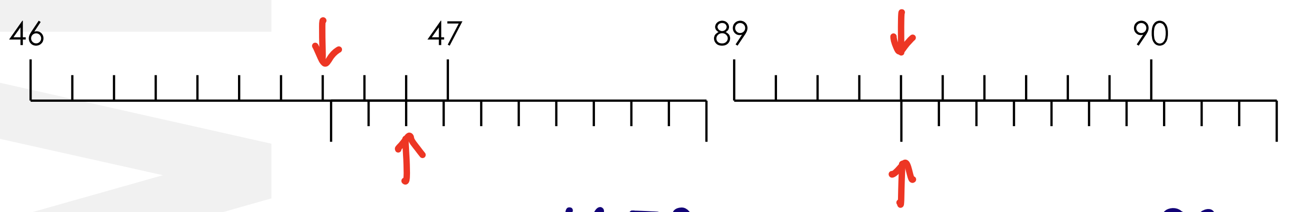
$v_1 = -5.67\ ms^{-1}$ (left)

5th October

1 2 3

1. Write the following distances in **standard form** to **3 significant** figures – and find out what they represent.
   a. 149 597 871 000 m — 1.50×10^{11} m — Astronomical unit
   b. 30 856 775 800 000 000 m — 3.09×10^{16} m — Parsec
   c. 9 460 730 473 000 000 m — 9.46×10^{15} m — Lightyear

2. Read the **quantity** measured in the following diagrams.



46.72

89.40

3. Explain why **electricity** is transmitted at very high AC voltages in overhead cables across the country.

Power losses → $P = I^2R$

I: This can be changed with a transformer

R: This is due to the cable

If I reduced by 10, I^2 reduced by 100, so the power losses also reduced.

6^{th} October

1 2 3

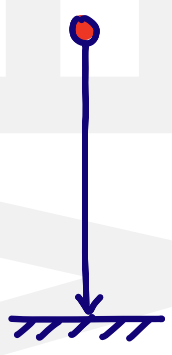
1. Write the following quantities in **standard form** to **3 significant** figures – and find out what they represent.

   a. 6 378 100 m — 6.38×10^{6} — r_{Earth}

   b. 5 972 200 000 000 000 000 000 000 kg — 5.97×10^{24} — m_{Earth}

   c. 1 988 470 000 000 000 000 000 000 000 000 kg — 1.99×10^{30} — m_{Sun}

2. A ball bearing is released from a height of 1.62 m. Calculate how **long** it will take to reach the ground.



$s = 1.62\,m$

$u = 0\ ms^{-1}$

~~v~~

$a = 9.81\ ms^{-2}$

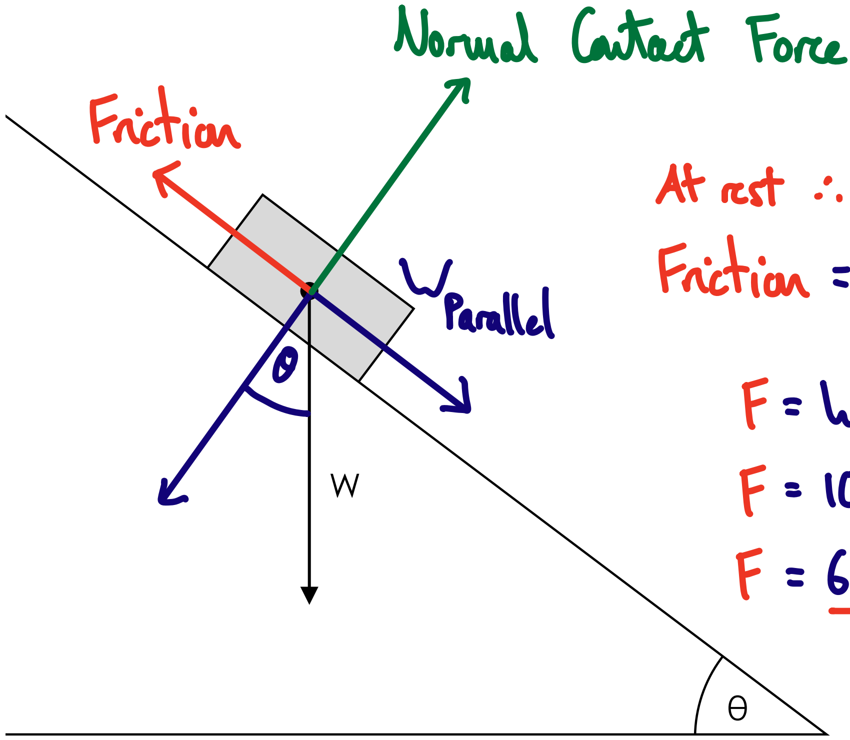
$t = ?$

$s = \cancel{ut} + \frac{1}{2}at^2$

$t = \sqrt{\frac{2s}{a}} = \sqrt{\frac{2 \times 1.62}{9.81}}$

$t = \underline{0.575}\,s$

3. The block is at **rest** on a slope. Calculate the size of the **friction** acting up the slope if the block's weight is 10 N and θ = 38˚.



At rest $\therefore \Sigma F = 0$

Friction $= W_{Parallel}$

$F = W \sin\theta$

$F = 10 \sin 38$

$F = \underline{6.2}\ N$

7th October

1 2 3

1. Calculate the **mean**, **mode** and **median** of the following set of numbers:

102, 103, 100, 99, 91, 111, 104, 102, 104, 104

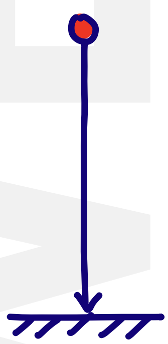
91, 99, 100, 102, 102, 103, 104, 104, 104, 111

Mean = 102

Mode = 104

Median = 102.5

2. A ball bearing is released from a height of 1.62 m. Calculate its **velocity** as it reaches the ground.



$s = 1.62\,m$

$u = 0\ ms^{-1}$

$v = ?$

$a = 9.81\ ms^{-2}$

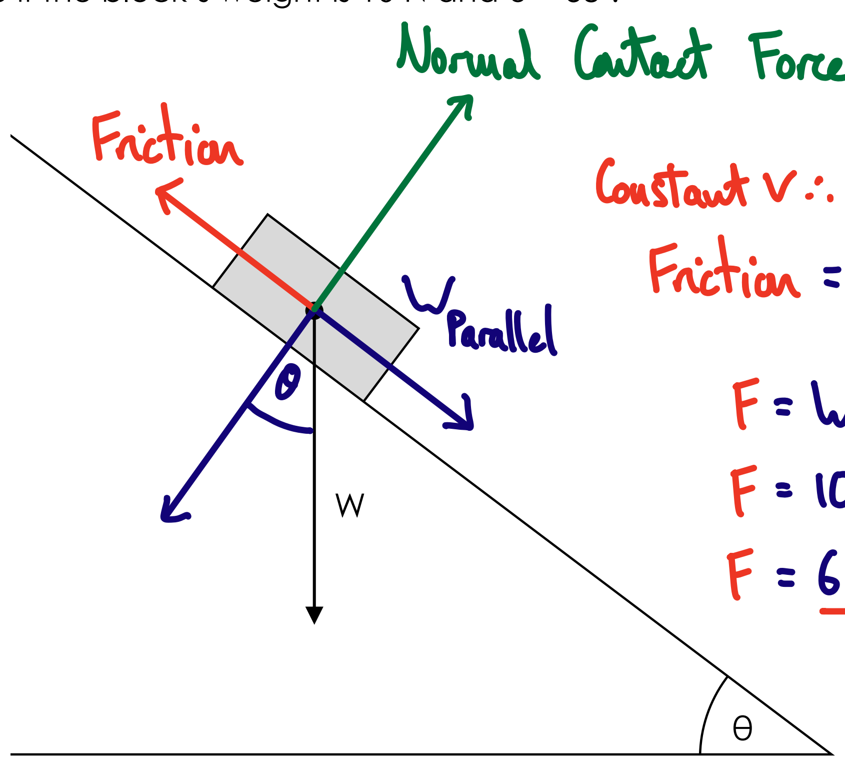
~~t~~

$v^2 = u^2 + 2as$

$v = \sqrt{2 \times 9.81 \times 1.62}$

$v = 5.64\ ms^{-1}$

3. The block is **sliding** down the slope at a constant velocity. Calculate the size of the **friction** acting up the slope if the block's weight is 10 N and θ = 38°.



Constant v ∴ ΣF = 0

Friction = $W_{Parallel}$

$F = W \sin\theta$

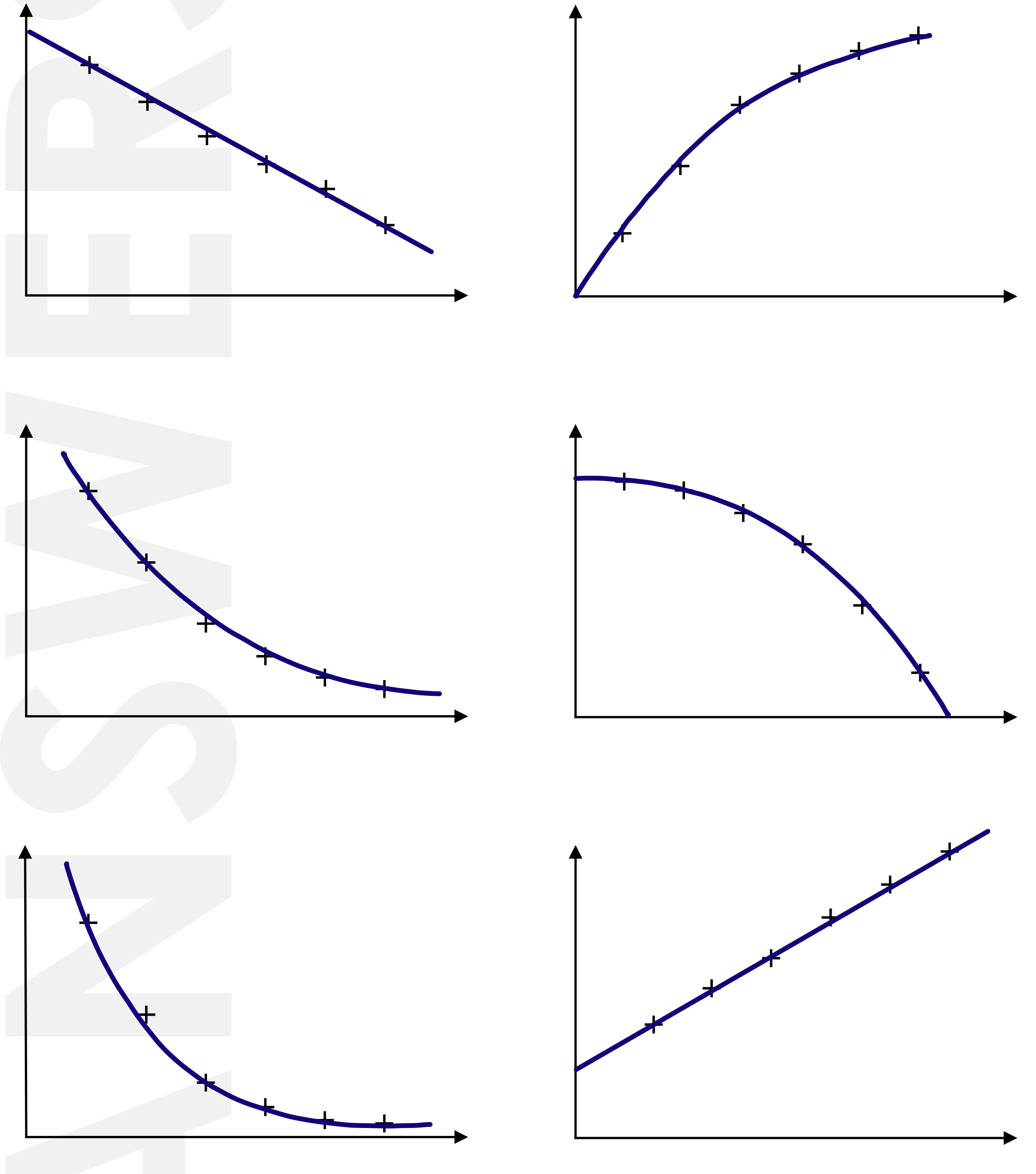
$F = 10 \sin 38$

$F = 6.2\ N$

8th October (part 1)

1

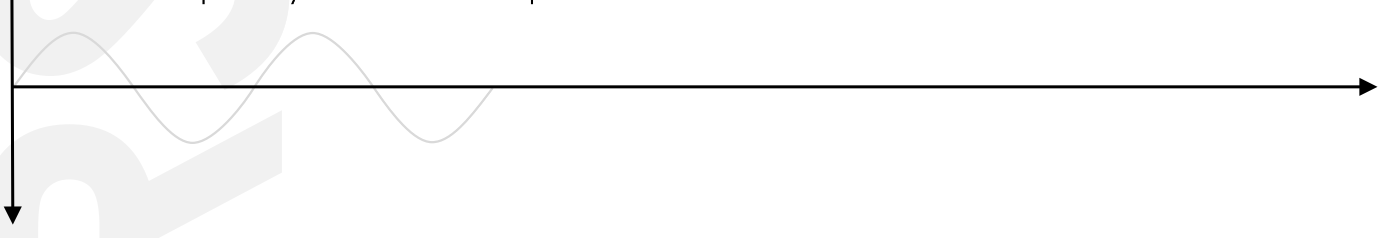
1. Draw an appropriate **line of best fit** for the following graphs.



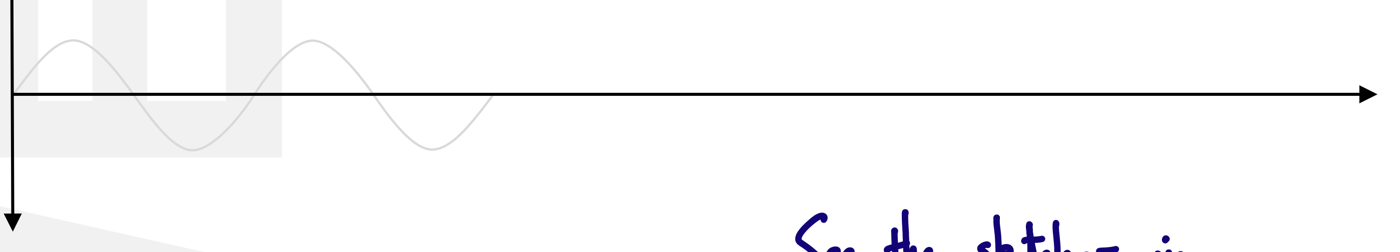
8th October (part 2)

2. Sketch a **sinusoidal** curve for the following graphs:

Same frequency and same amplitude

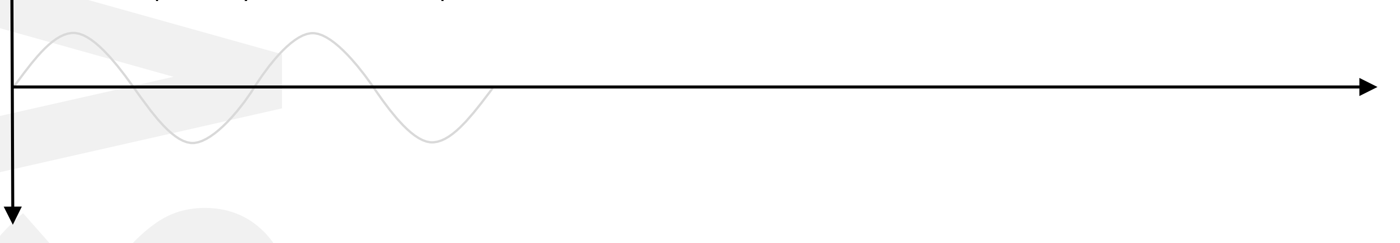


2 x frequency and same amplitude

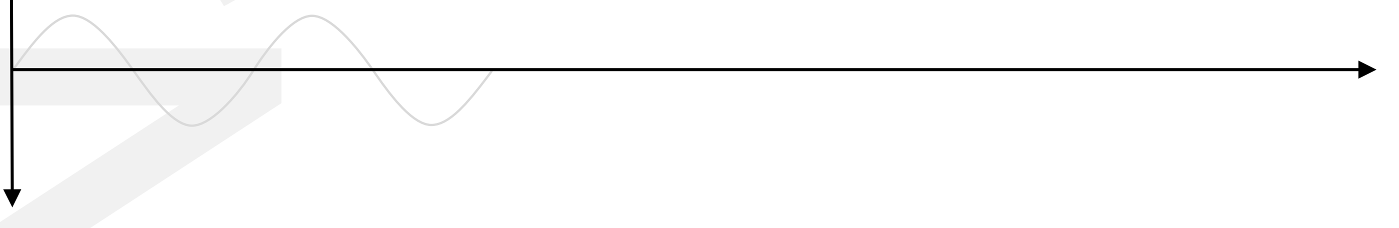


See the sketches in the back of the book.

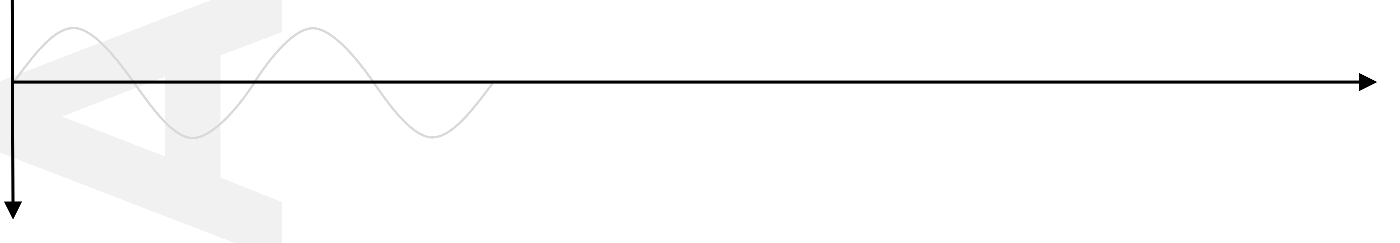
2 x frequency and 2 x amplitude



Half the frequency and 2 x amplitude



Half the frequency and half the amplitude



9th October

1 2 3

$A = 4\pi r^2 = 4\pi \frac{d^2}{4} = \pi d^2$

1. Calculate the **surface area**, in m², of a sphere with a diameter of:

   a. 2.00 m
   b. 1.00 m
   c. 0.50 m
   d. 0.25 m

   $A = \pi d^2$

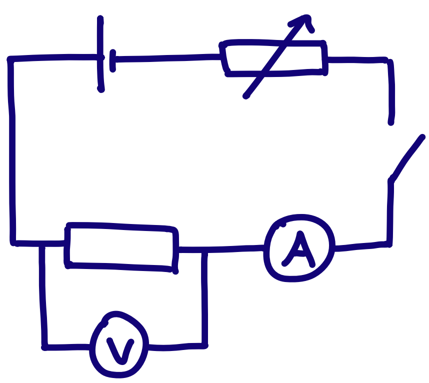
   $12.6\ m^2$
   $3.14\ m^2$
   $0.785\ m^2$
   $0.196\ m^2$

2. Describe what is meant by **accuracy**.

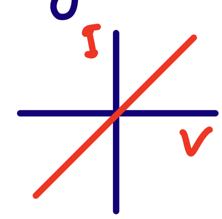
   An accurate result is close to the true, or accepted, value.

   If you measure 'g' as 9.6 that is close to $9.81\ ms^{-2}$, the true value.

3. Briefly describe how you would investigate the **IV characteristics** of a **resistor**. Include a suitable circuit diagram, measurements recorded and how uncertainties would be reduced.



Use the variable resistor to change V and I, making sure to only close the switch when taking a reading.
Take +ve and −ve values of V and I.



10th October

1 2 3

1. Calculate the **volume**, in m³, of a sphere with a radius of:

    a. 6.37 x 10³ km

    b. 6.96 x 10⁸ m

    c. 0.10 nm

    d. 1.0 fm

$V = \frac{4}{3}\pi r^3$

1.08×10^{21} m³ Earth

1.41×10^{27} m³ Sun

4.2×10^{-30} m³ Atom

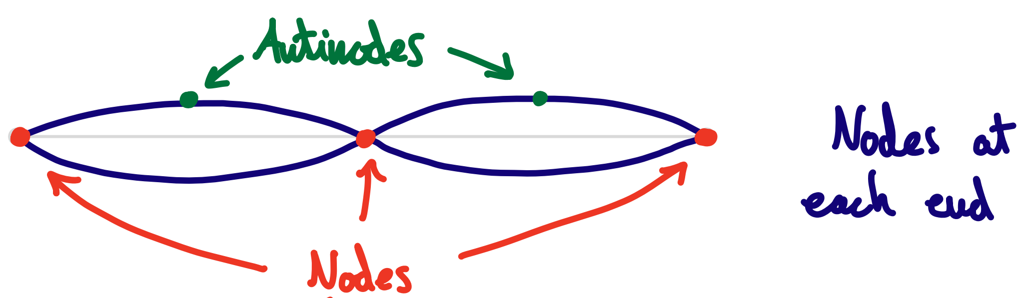
4.2×10^{-45} m³ Nucleus

2. Describe what is meant by **resolution**.

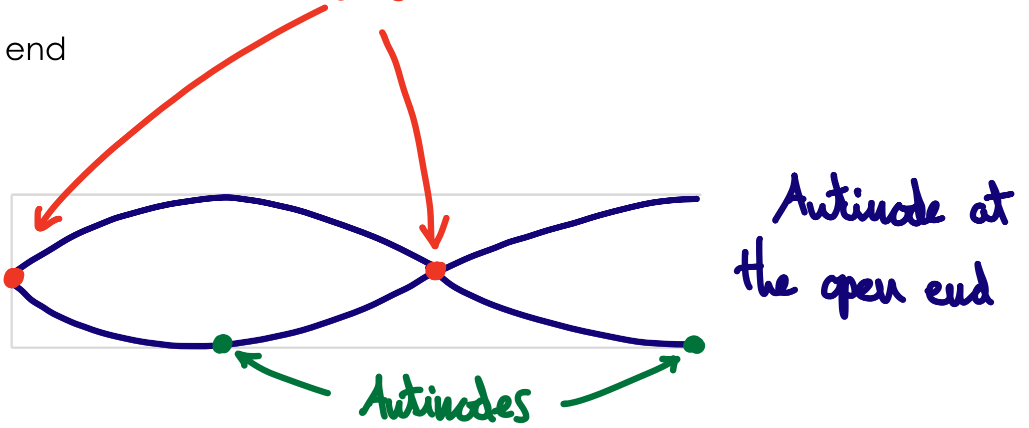
The smallest scale division on a measuring instrument.

3. Draw a simple diagram of a **stationary/standing** wave and label the nodes and antinodes:

    a. On a string



b. In a tube open at one end

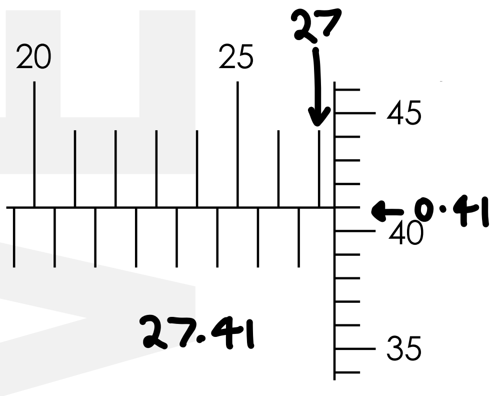


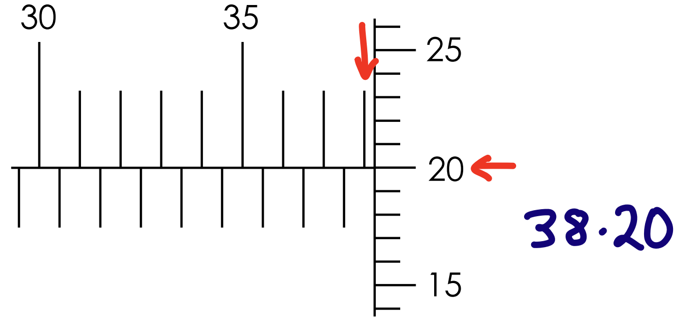
11th October

1 2 3

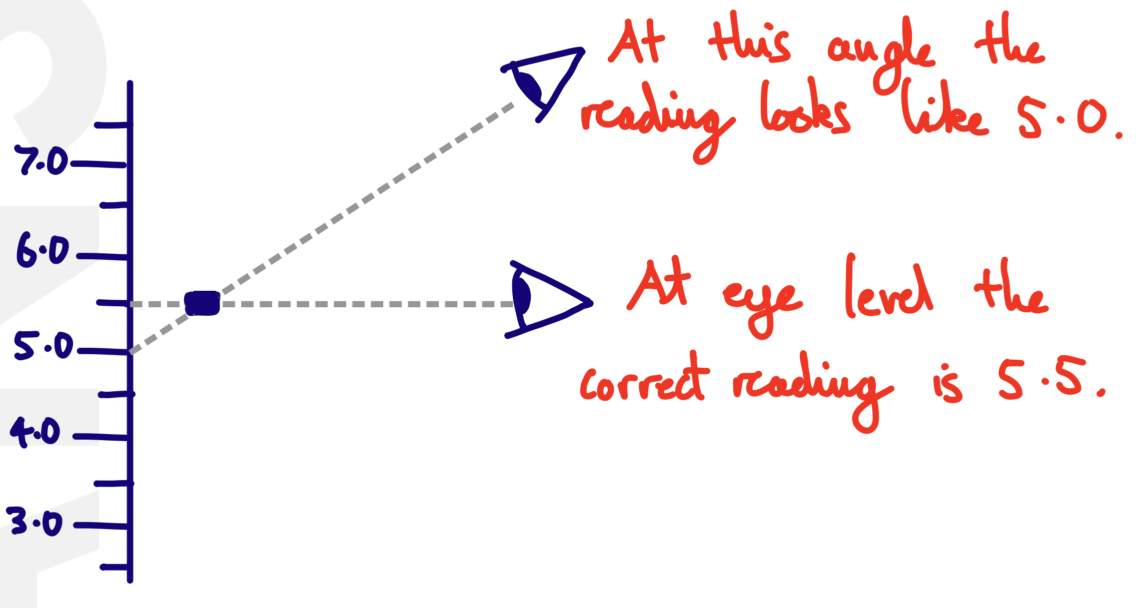
1. Convert the following distances to **metres**:
   a. 3.14×10^4 mm — 31.4 m
   b. 31.4×10^{-6} µm — 3.14×10^{-11} m
   c. 0.0314×10^6 km — 3.14×10^7 m
   d. 31.4×10^{14} cm — 3.14×10^{13} m
   e. 3.14×10^{-3} mm — 3.14×10^{-6} m

2. Read the **quantity** measured in the following diagrams for a screw gauge micrometer.





3. When reading any scale in experimental physics, describe what can be done to minimise **parallax error**. Include a description of what parallax error is.

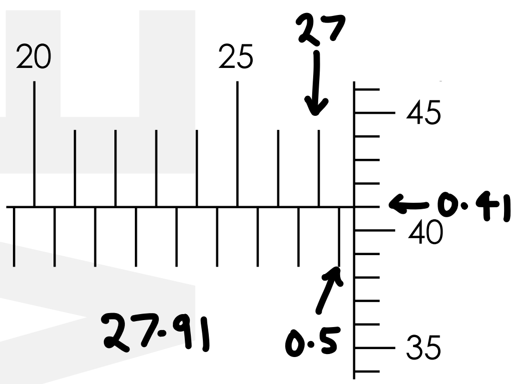


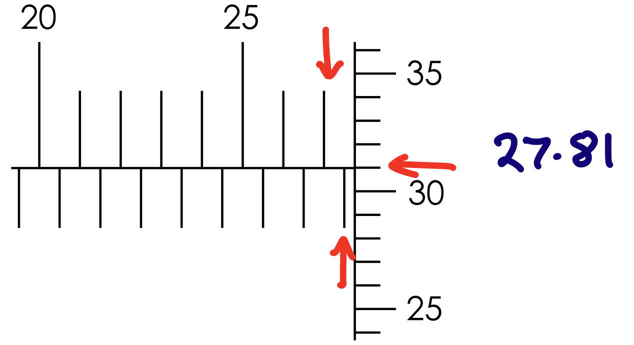
12th October

1 2 3

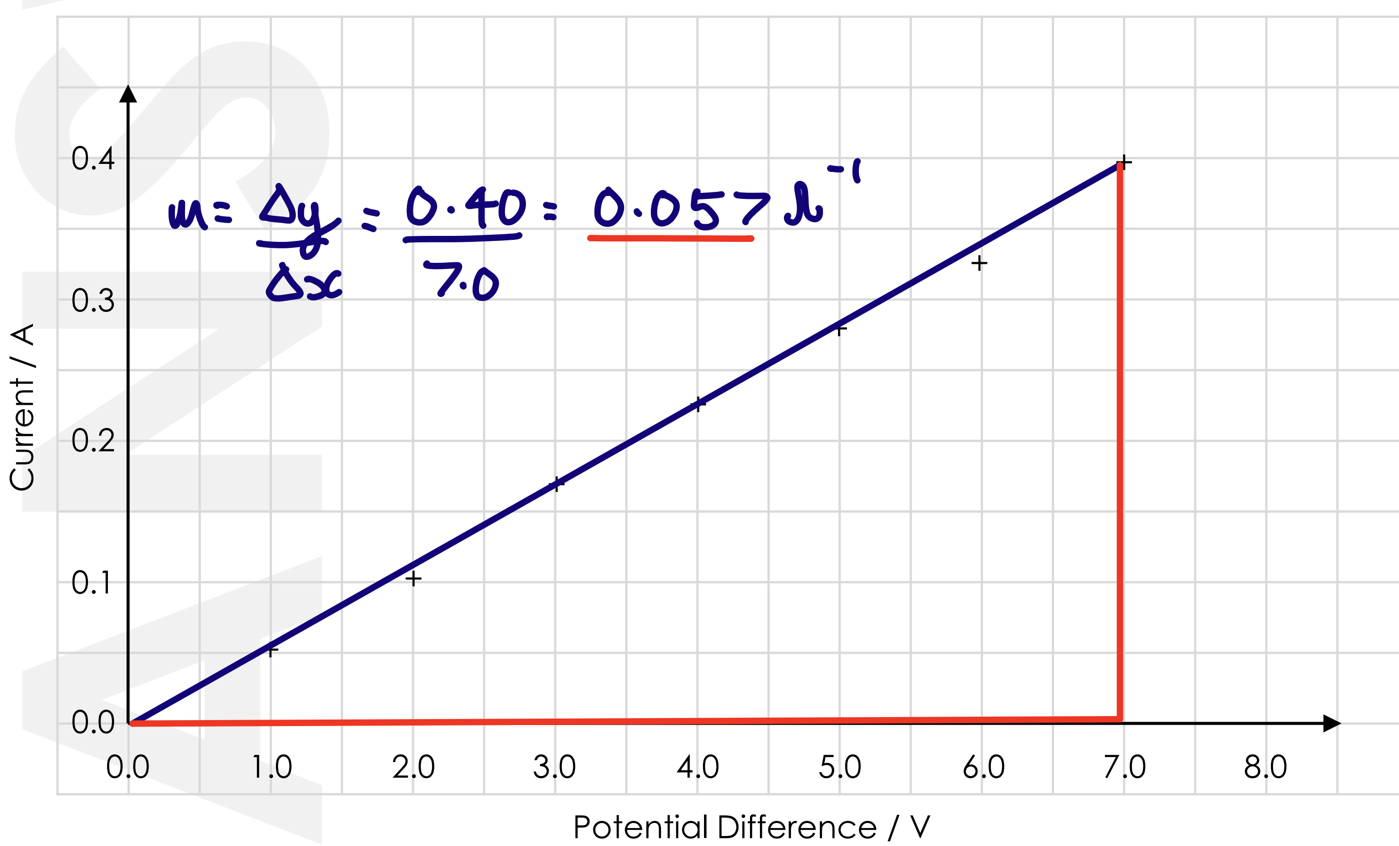
1. Convert the following distances to **metres**:
   a. 3.14×10^{-4} nm — 3.14×10^{-13} m
   b. 314×10^{-6} pm — 3.14×10^{-16} m
   c. 0.0314×10^{4} km — 3.14×10^{5} m
   d. 31.4×10^{14} fm — 3.14 m
   e. 3140×10^{-8} Mm — 31.40 m

2. Read the **quantity** measured in the following diagrams.





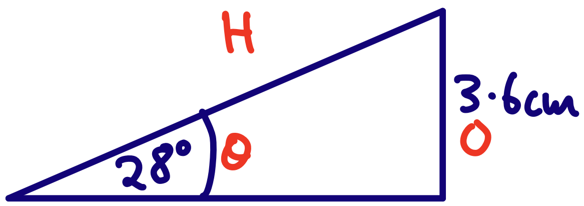
3. Calculate the **gradient** of the following data, giving an appropriate unit.



13th October

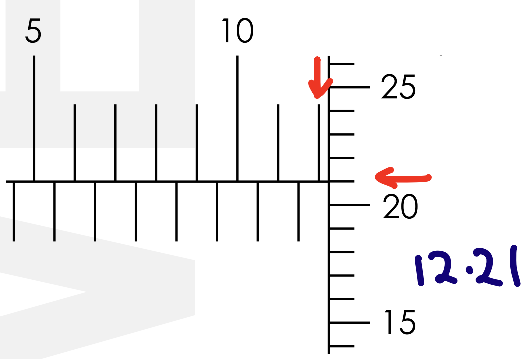
1. Calculate the length of the hypotenuse of a right-angled triangle if the opposite side to an angle of 28˚ is 3.6 cm.

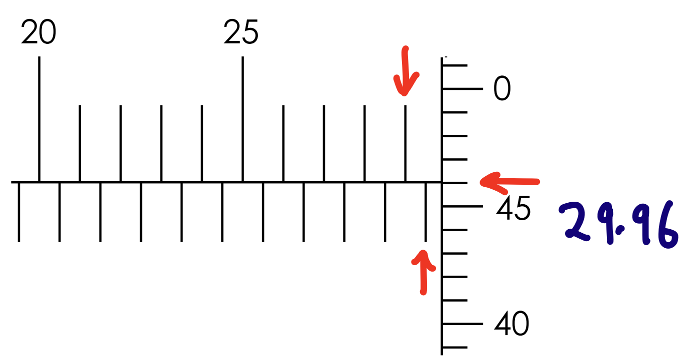
$\sin\theta = \frac{O}{H}$



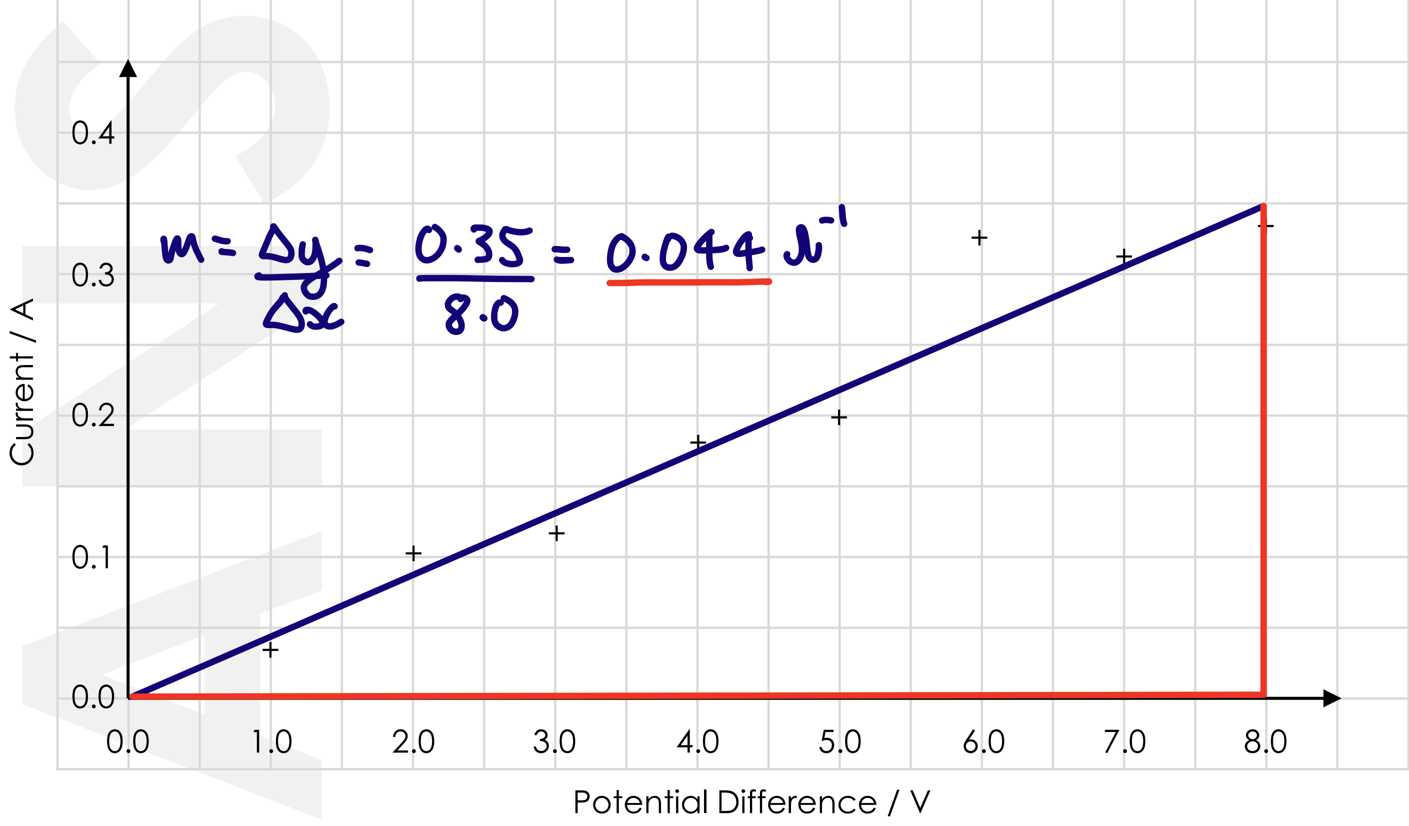
$H = \frac{3.6}{\sin 28} = 7.7\,\text{cm}$

2. Read the **quantity** measured in the following diagrams.





3. Calculate the **gradient** of the following data, giving an appropriate unit.

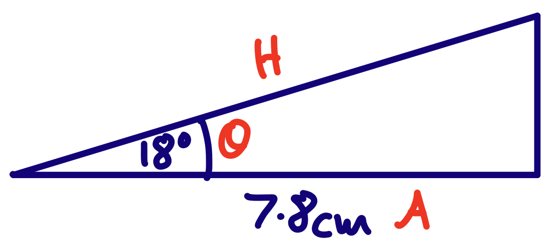


14th October

1 2 3

1. Calculate the length of the hypotenuse of a right-angled triangle if the adjacent side to an angle of 18° is 7.8 cm.

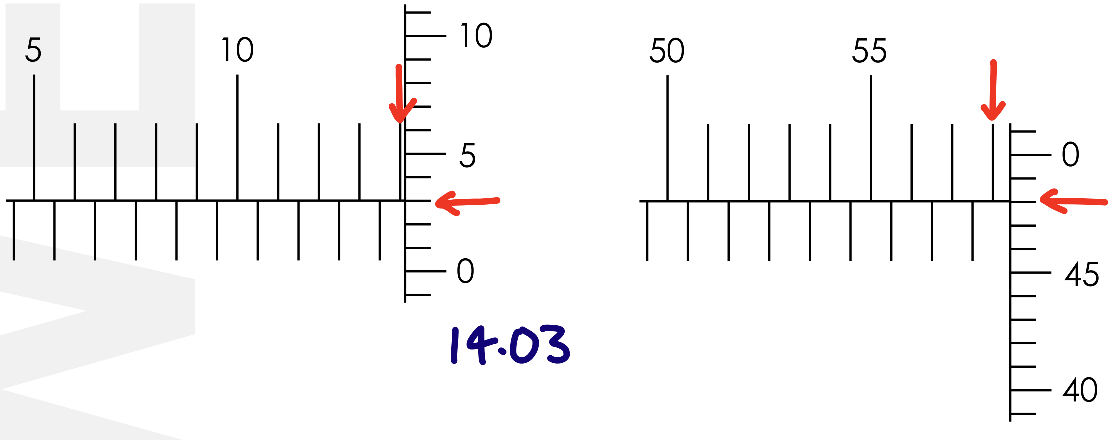
$\cos\theta = \frac{A}{H}$



$H = \frac{7.8}{\cos 18}$

$H = 8.2\text{cm}$

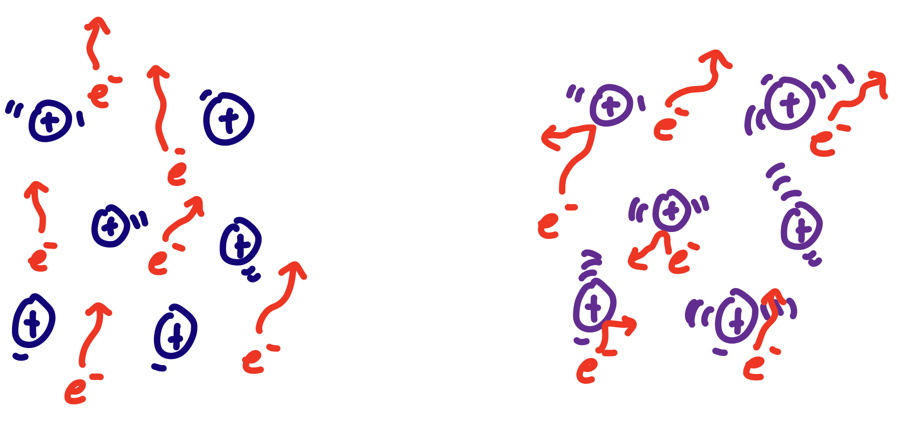
2. Read the **quantity** measured in the following diagrams.



14.03

58.48

3. Describe and explain how the **resistance** of a wire changes with temperature.



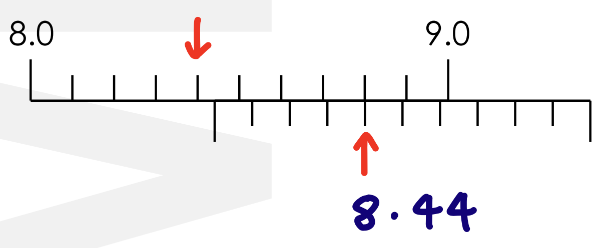
T↑ R↑

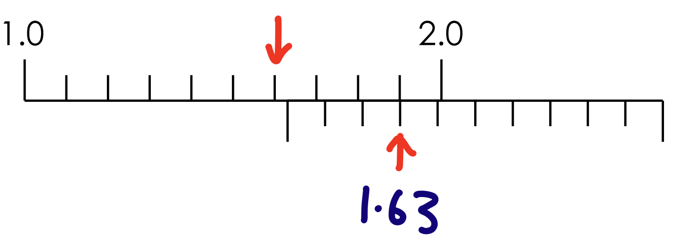
15th October

1 2 3

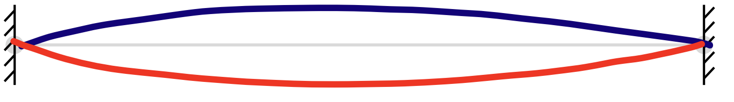
1. Calculate **sinθ** and **cosθ** for the following values of θ (to 2 d.p.).
   a. 23˚ 0·39 0·92
   b. 67˚ 0·92 0·39
   c. 34˚ 0·56 0·83
   d. 56˚ 0·83 0·56
   e. 45˚ 0·71 — 0·71

2. Read the **quantity** measured in the following diagrams.

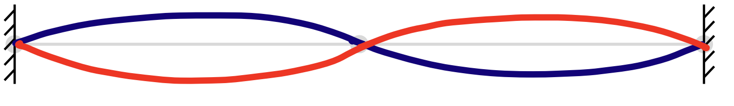




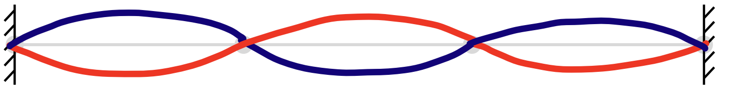
3. Sketch the **standing** wave formed on a string fixed at both ends:
   a. First harmonic



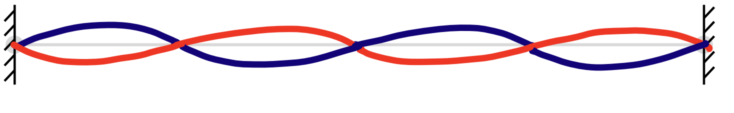
   b. Second harmonic



   c. Third harmonic



   d. Fourth harmonic



16th October

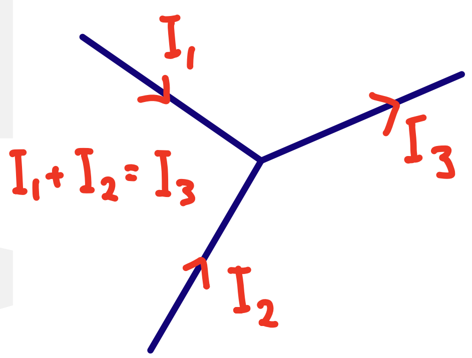
1. Write the following numbers in **standard form** to **3 significant** figures:

   a. 3 600 s — 3.60×10^3 s — hour

   b. 86 400 s — 8.64×10^4 s — day

   c. 31 556 557 s — 3.16×10^7 s — year

2. State and explain the effect of **Kirchhoff's 1st law** (the current law).



$I_{in} = I_{out}$

$\Sigma I = 0$

3. A student takes the following repeated readings of potential difference at a certain current and resistance.

   Calculate the **value** that should be quoted for the voltage, including the **absolute uncertainty** in this measured value.

Mean = 9.20

Voltage / V
9.22
9.83
9.25
9.17
9.20
9.16

Ignore the anomaly (9.83)

Absolute uncertainty in multiple readings is equal to half the range.

$$= \frac{9.25 - 9.16}{2} = 0.045$$

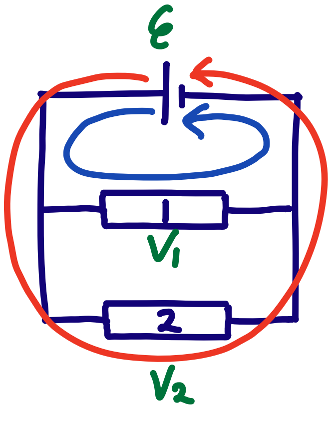
9.20 ± 0.05V

17th October

1 2 3

1. Convert the following volumes into **m³**:
   a. 1.0 cm³ — $(1.0\times10^{-2})^3$ — $1.0\times10^{-6}\ m^3$
   b. 1.0 mm³ — $(1.0\times10^{-3})^3$ — $1.0\times10^{-9}\ m^3$
   c. 568 ml — $1\ ml = 1\ cm^3$ — $5.68\times10^{-4}\ m^3$
   d. 22.4 ltr — $1\ ltr = 1000\ ml$ — $2.24\times10^{-2}\ m^3$

2. State and explain the effect of **Kirchhoff's 2nd law** (the voltage law).



$\varepsilon = V_1$

$\varepsilon = V_2$

(ε or E for emf)

3. In an investigation to calculate the resistance of a wire, a student measures the voltage as 12.03 ± 0.05 V and the current as 0.25 ± 0.01 A.

   Calculate the value that should be given for the resistance, including the **percentage uncertainty**.

$R = \frac{V}{I} = 48.12 \approx 48\ \Omega$ (2 sf)

% uncertainty in V = $\frac{0.05}{12.03} \times 100 = 0.42\%$

% uncertainty in I = $\frac{0.01}{0.25} \times 100 = 4.0\%$

Total % uncertainty in R = $4.0 + 0.42 = 4.4\%$

$48\ \Omega \pm 4.4\%$

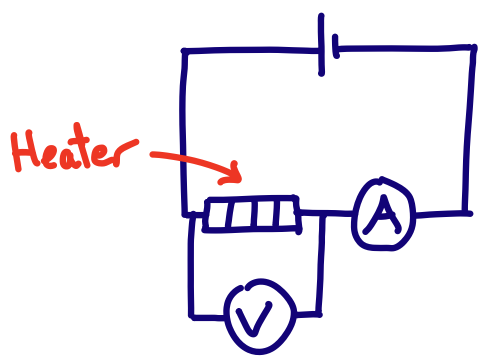
18th October

1 2 3

1. Convert the following distances into **m**:
   a. 1.609 km — 1609 m
   b. 630 nm — 6.30×10^{-7} m
   c. 0.833 femtometres — 8.33×10^{-16} m
   d. A light-year — 9.46×10^{15} m

2. Rearrange $f = \frac{1}{2L}\sqrt{\frac{T}{\mu}}$ to make:
   a. **L** the subject — $L = \frac{1}{2f}\sqrt{\frac{T}{\mu}}$
   b. **T** the subject — $T = 4f^2L^2\mu$
   c. **μ** the subject — $\mu = \frac{T}{4f^2L^2}$

3. State the laboratory equipment required to measure the **specific heat capacity** of water. Include a circuit diagram and how significant sources of error can be minimised.



$E = Pt$ $P = VI$ $E = mc\Delta\theta$

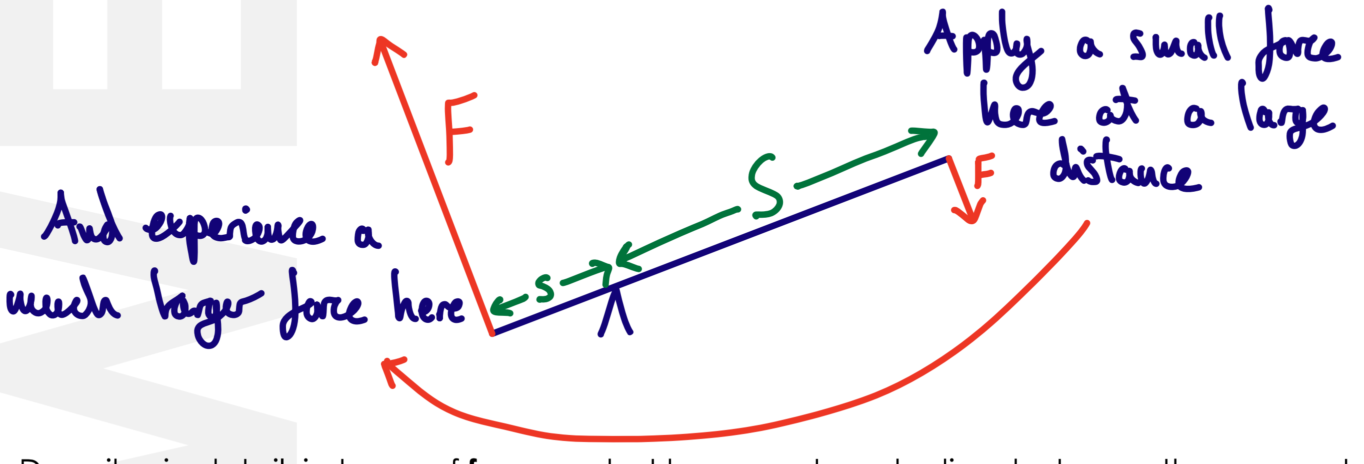
$VIt = mc\Delta\theta$ — Thermometer

V: Ⓥ
I: Ⓐ
t: Stopwatch
m: Mass balance

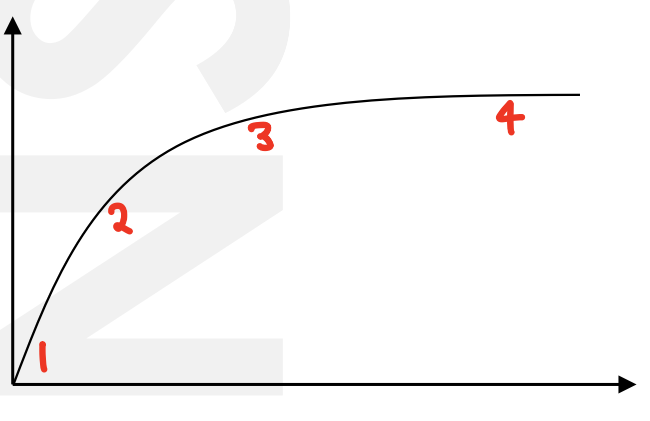
19th October

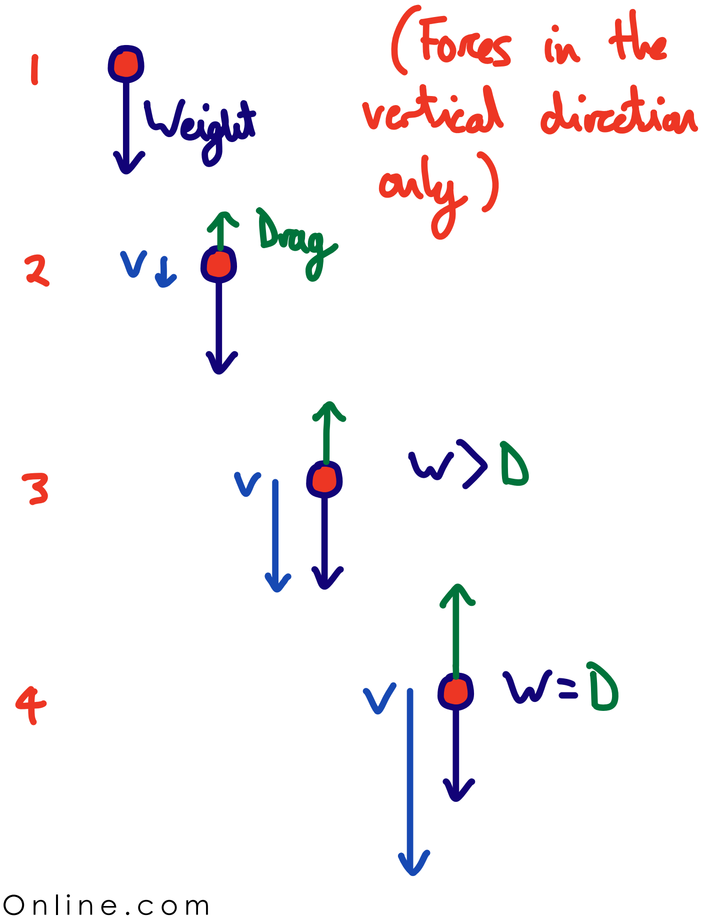
1. Convert the following masses into **kg**:
   a. 1 tonne — 1000 kg
   b. 240 g — 0.240 kg
   c. 3 560 mg — 3.560×10^{-3} kg
   d. 937.4×10^{-7} Mg — 93.74 kg

2. Describe what is meant by a '**force multiplier**' and how we can multiply a force without violating the law of conservation of energy.



3. Describe in detail, in terms of **forces**, what happens to a skydiver between the moment they jump out of a plane and the moment they reach terminal velocity.





20th October

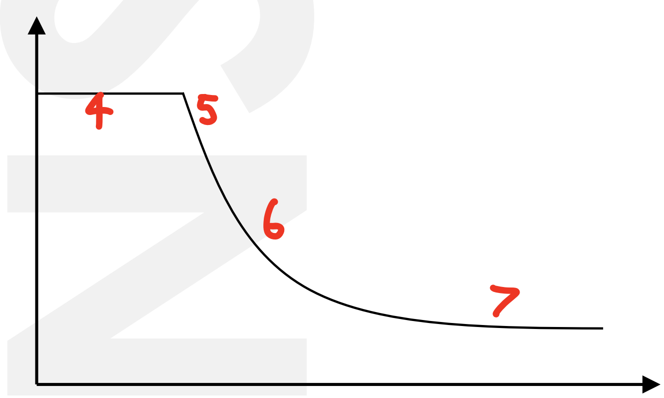
1 2 3

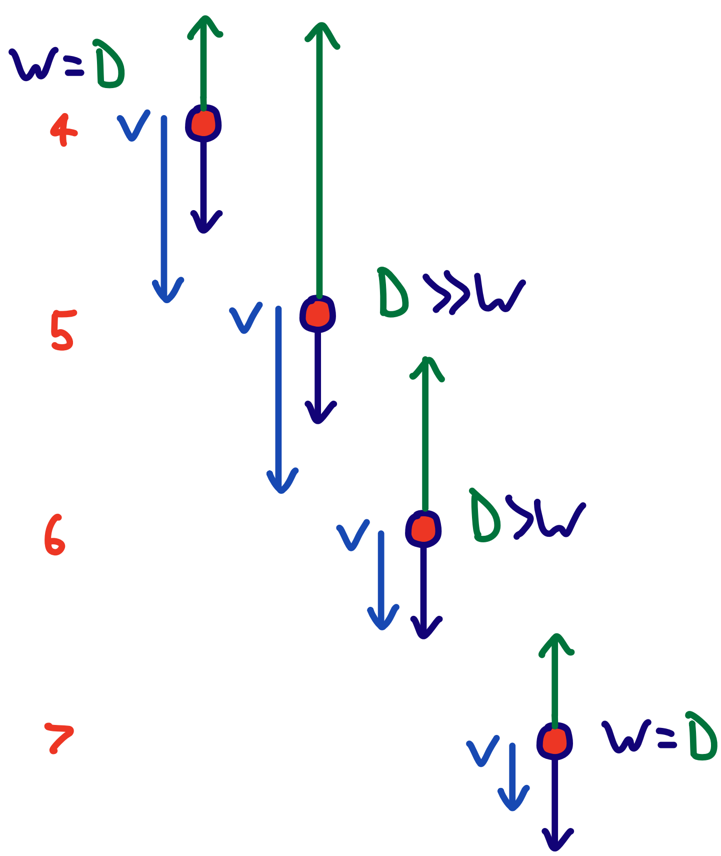
1. Write down the **units** for:
   a. Momentum — kg m s^{-1}
   b. Resistivity — Ω m
   c. Electromotive force — V
   d. Mass per unit length — kg m^{-1}

2. State the **masses** (in kg), **charges** (in C) and **penetrating** ability of alpha, beta minus and gamma radiation.

Alpha	6.64×10^{-27} kg	$+3.20 \times 10^{-19}$ C	Low
Beta$^-$	9.11×10^{-31} kg	-1.60×10^{-19} C	Medium
Gamma	0 kg	0 C	High

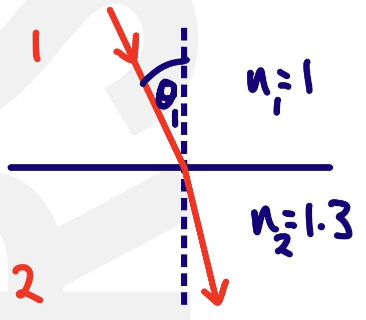
3. Describe in detail, in terms of forces, what happens to a skydiver travelling at **terminal velocity** between the moment they release their parachute and the moment they reach terminal velocity again.





21st October

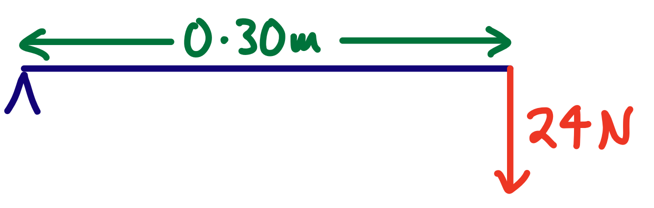
1. Calculate the **angle of refraction** of a wave that crosses from air into a transparent material, with a refractive index of 1.3, at an angle of incidence of 24˚.



$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$

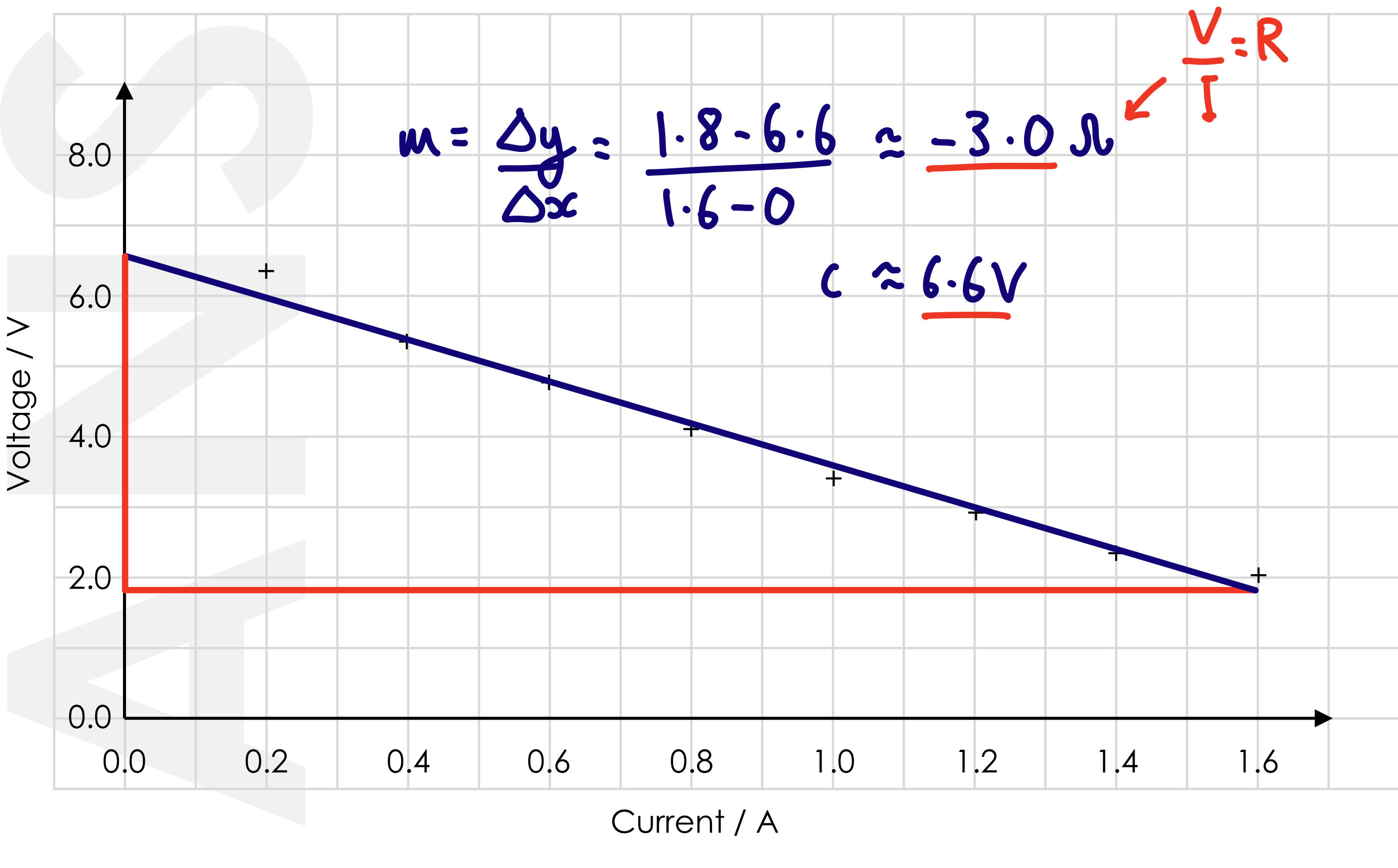
$$\theta_2 = \sin^{-1}\left(\frac{\sin 23}{1.3}\right) = \underline{17^\circ}$$

2. Calculate the **moment** of a 24 N force acting at a perpendicular distance, to a pivot, of 30 cm.



$$M = Fd = 24 \times 0.30 = \underline{7.2}\ \text{Nm}$$

3. Calculate the **gradient** and **intercept** of the following data, giving an appropriate unit.



$$m = \frac{\Delta y}{\Delta x} = \frac{1.8 - 6.6}{1.6 - 0} \approx \underline{-3.0}\ \Omega \quad \left(\frac{V}{I} = R\right)$$

$$c \approx \underline{6.6\text{V}}$$

22nd October

1 2 3

1. Write down the charge, in **coulombs**, of:
   a. A positron $+1.60 \times 10^{-19}$ C
   b. An alpha particle $+3.20 \times 10^{-19}$ C
   c. A neutron 0
   d. An up quark $+1.07 \times 10^{-19}$ C

2. Define the **centre of mass** of an object.

A point where the mass acts through.

3. Describe what is usually assumed to be the **resistance** of a wire, an ammeter and a voltmeter in any circuit question.

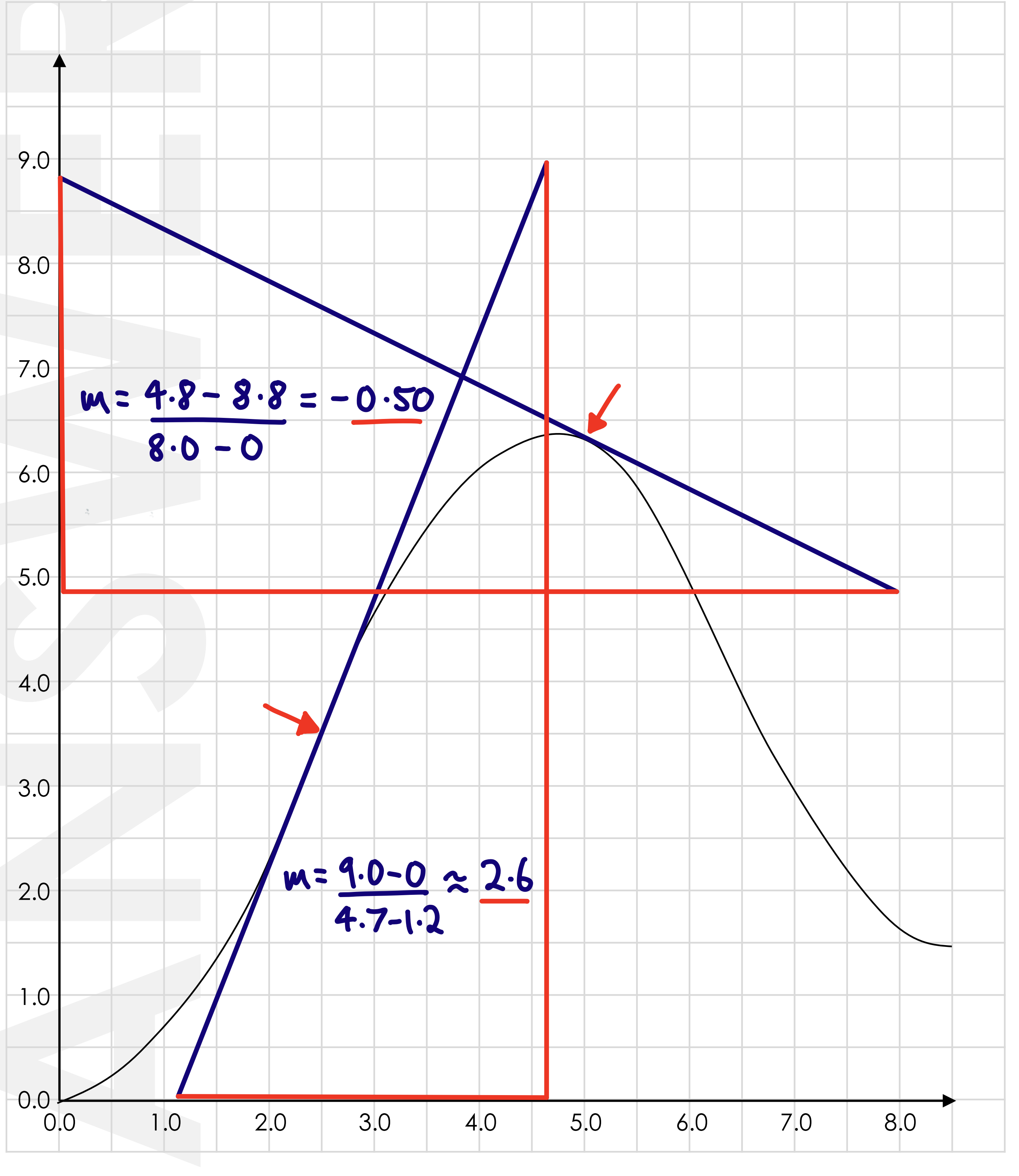
Wire: $R = 0$

(A) $R = 0$ Connected in series, so all the current passes through it.

(V) $R = \infty$ Connected in parallel, with no current going through it.

23rd October - Part 1

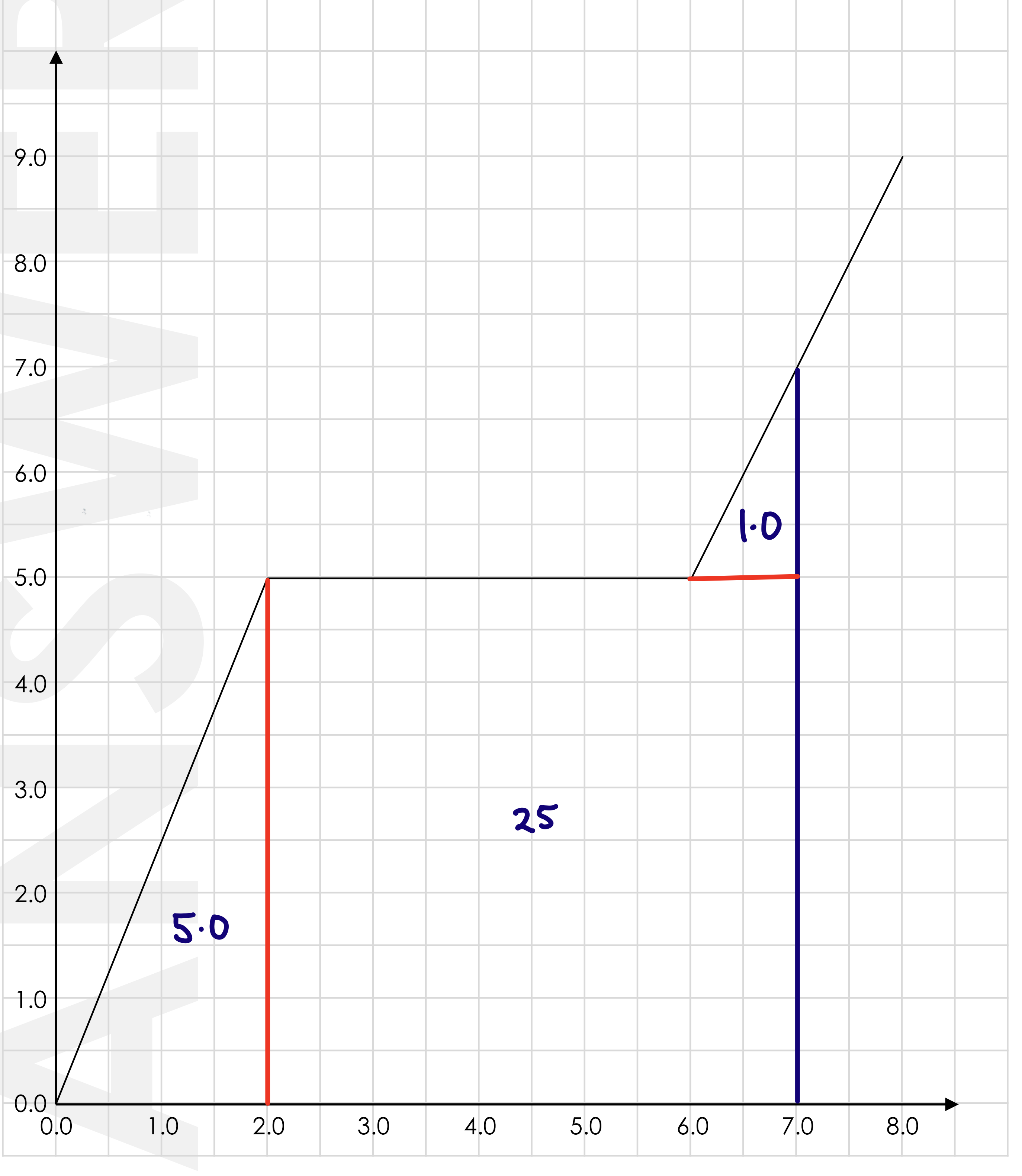
1. Draw a **tangent** and calculate the **gradient** at:
   a. x = 2.5
   b. x = 5.0



23rd October - Part 2

2. Calculate the **area** under the line between x = 0 and x = 7.0.

$5.0 + 25 + 1.0 = 31$



24th October

1 2 3

1. Describe what the area underneath a **force-time** graph represents.

The change in momentum, or impulse of a force.

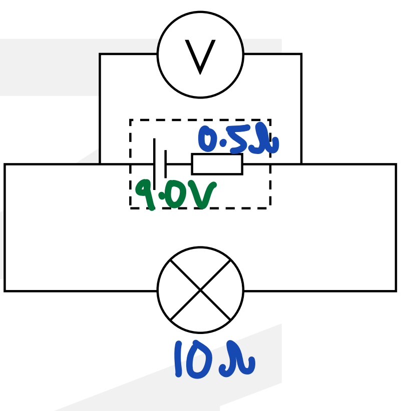
2. In A Level Physics we class waves as either **progressive** or **stationary** (standing). Describe the main difference between the two.

Progressive - Transfer energy

Stationary - Store energy

3. A battery has an e.m.f of 9.0 V and an internal resistance of 0.50 Ω. The battery is in series with a bulb of resistance 10 Ω.

Calculate the **potential difference** across the terminals of the battery.



$$\varepsilon = I(R + r)$$

$$I = \frac{\varepsilon}{(R + r)} = \frac{9.0}{(10 + 0.50)} = 0.857\text{A}$$

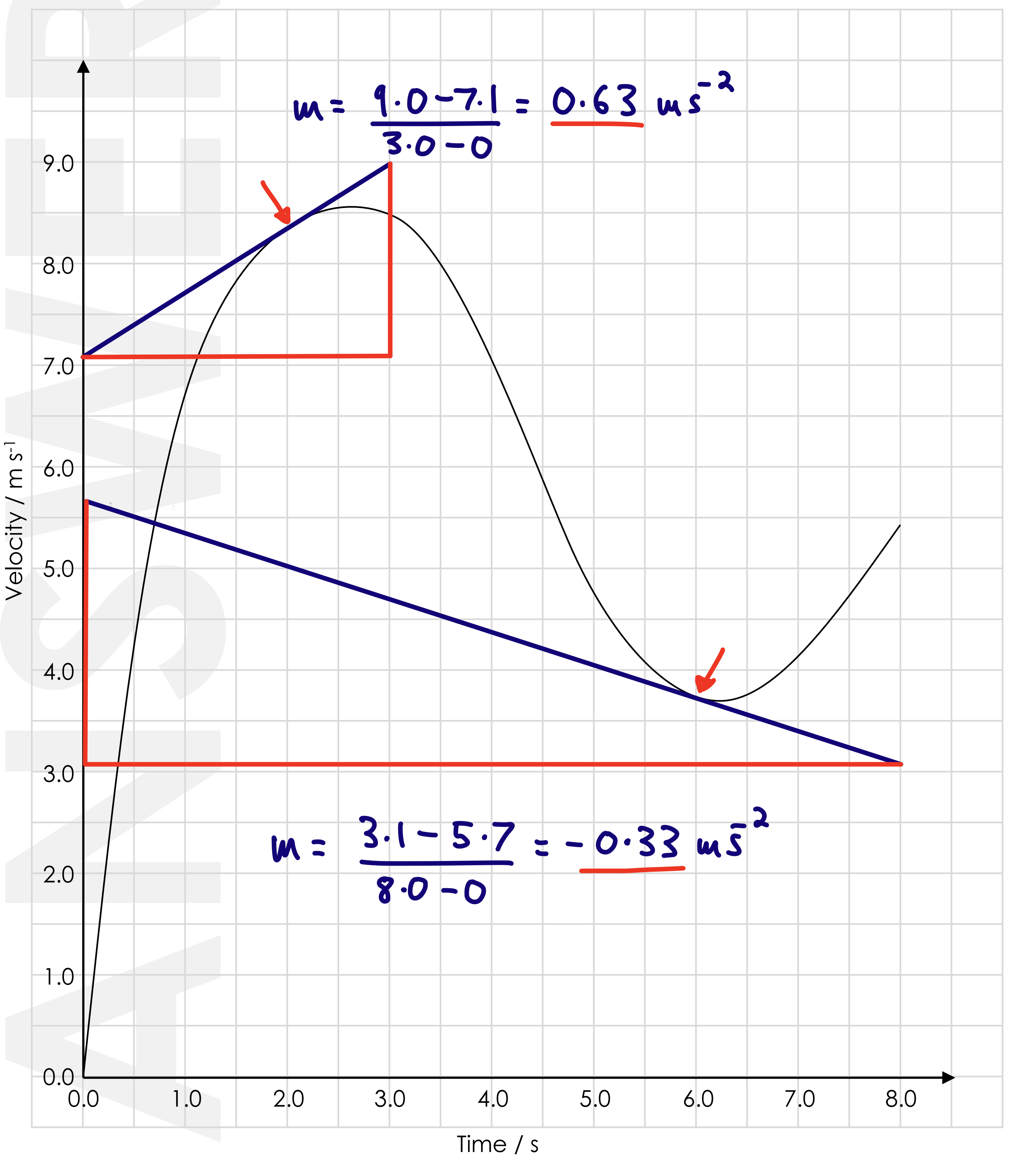
$$\varepsilon = V + Ir$$

$$V = \varepsilon - Ir$$

$$V = 9.0 - (0.857 \times 0.5) = \underline{8.6}\ \text{V}$$

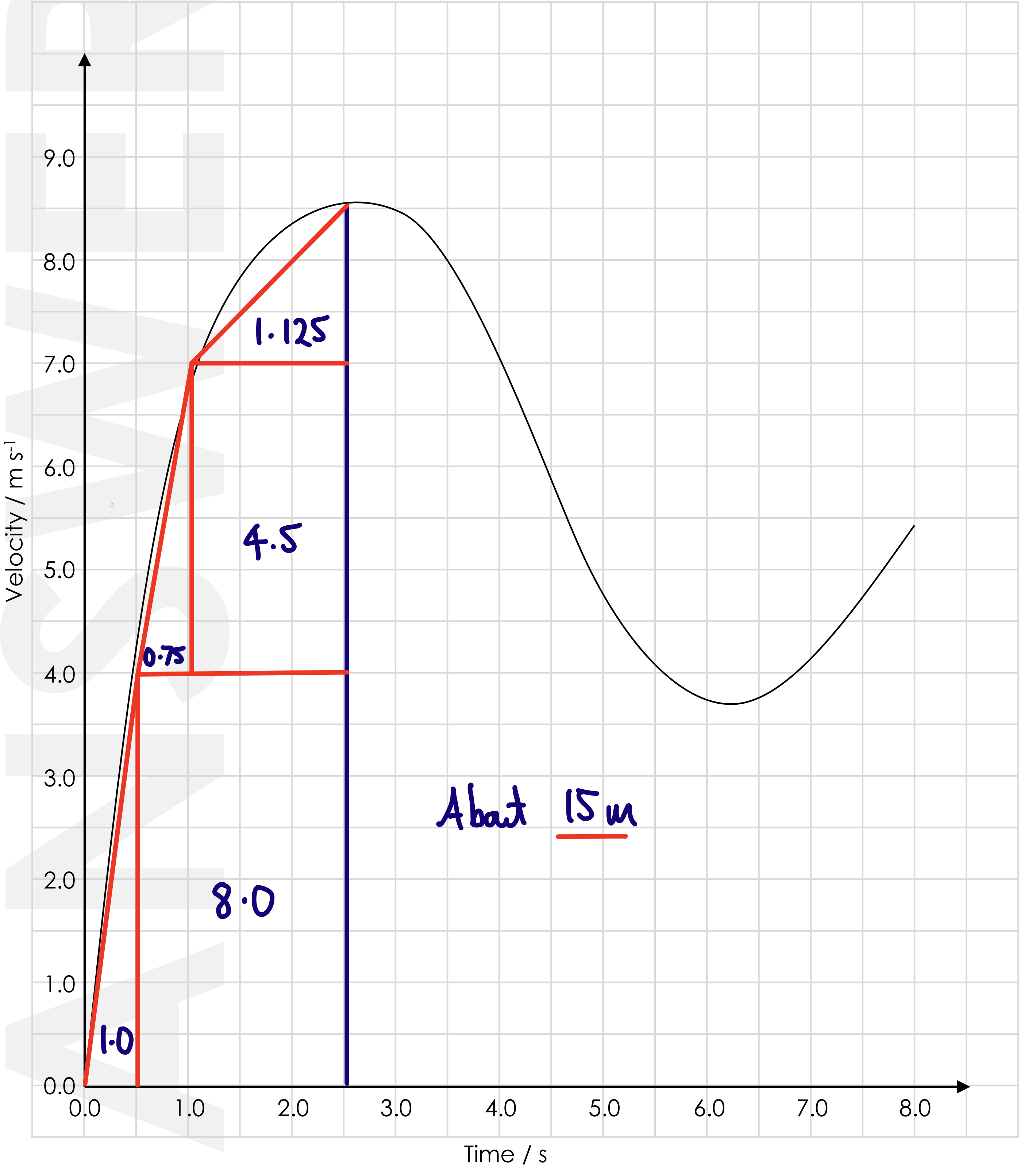
25th October - Part 1

1. Calculate the **acceleration** at:
    a. t = 2.0 s
    b. t = 6.0 s



25th October - Part 2

2. Estimate the **displacement** between t = 0.0 and t = 2.5 s.

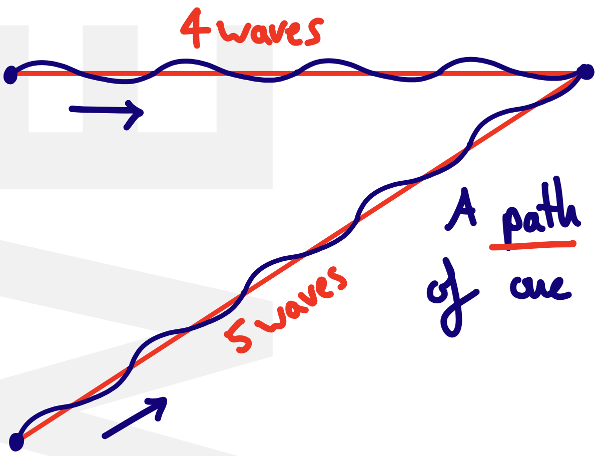


26th October

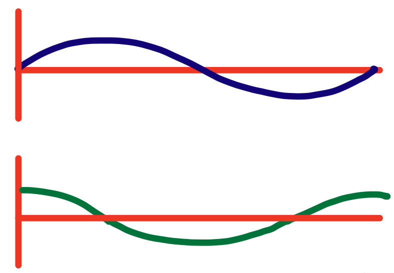
1 2 3

1. Calculate **tanθ** for the following values of θ (to 2 d.p.).
   a. 0˚ 0·00
   b. 30˚ 0·58
   c. 45˚ 1·00
   d. 60˚ 1·73
   e. 90˚ Infinity

2. Describe what is meant by the terms '**path difference**' and '**phase difference**' for waves.

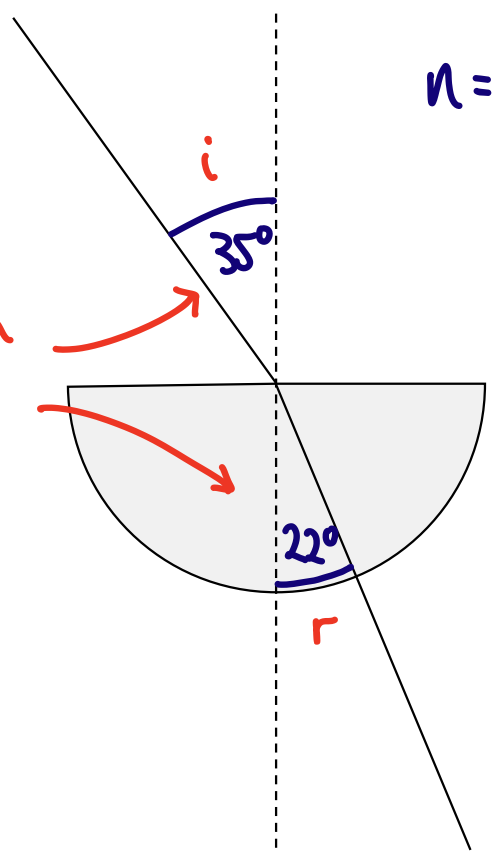


A path difference of one wavelength.



These two waves have a phase difference of 90° (¼ of a wave cycle).

3. Calculate the **refractive index** of the semi-circular block.



Measure with a protractor.

$$n = \frac{\sin i}{\sin r} = \frac{\sin 35}{\sin 22}$$

$n = 1.5$ (2sf)

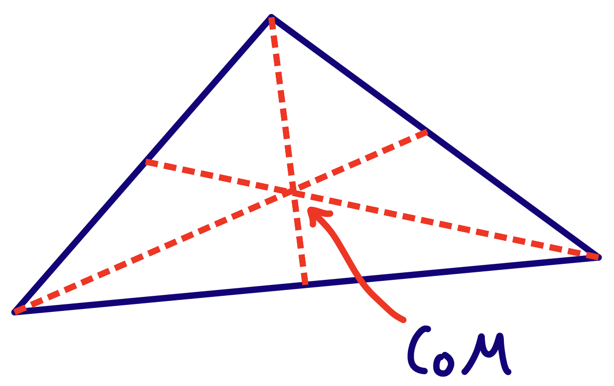
27th October

1 2 3

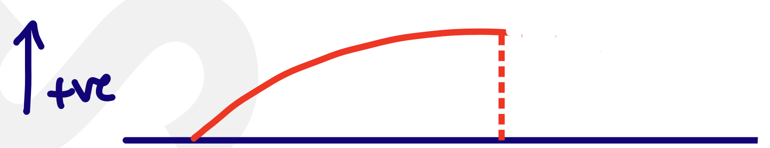
$360° = 2\pi$ rad $180° = \pi$ rad

1. Convert the following angles from degrees to **radians**. Give your answer to 2 d.p.
   a. 0˚ 0.00 rad
   b. 30˚ 0.52 rad
   c. 45˚ 0.79 rad
   d. 60˚ 1.05 rad
   e. 90˚ 1.57 rad

2. Describe how you could find the **centre of mass** of a **regular** 2D shape.



3. Work out the **time of flight** for a javelin thrown with a vertical component of velocity of 20 m s^{-1}. Ignore air resistance.



Vertical direction

~~s~~

$u = 20\ ms^{-1}$

$v = 0$

$a = -9.81\ ms^{-2}$

$t = ?$

$v = u + at$

$t = \frac{v-u}{a} = \frac{0-20}{-9.81} = 2.04$ s

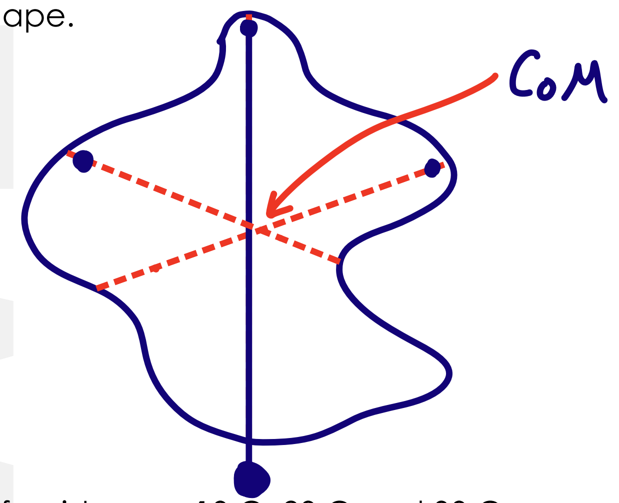
$t_{total} = 2 \times t = 4.1$ s

28th October

1 2 3

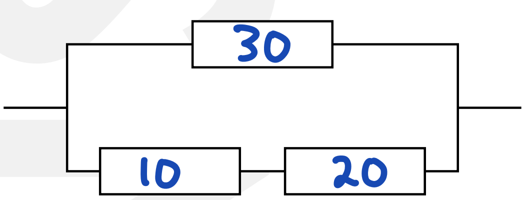
1. Convert the following angles from degrees to **radians**. Give your answer to 2 d.p.
    a. 5˚ — 0.09 rad
    b. 57˚ — 0.99 rad
    c. 82˚ — 1.43 rad
    d. 172˚ — 3.00 rad
    e. 326˚ — 5.69 rad

2. Describe a **practical investigation** you could carry out in order to find the **centre of mass** of an **irregular** 2D shape.



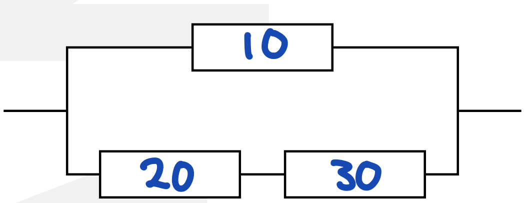
3. Three resistors, of resistances 10 Ω, 20 Ω and 30 Ω, are connected in a circuit. Two are connected in series and one is in parallel.

    Calculate the **greatest** resistance and the **least** resistance possible.



$$\frac{1}{R_T} = \frac{1}{30} + \frac{1}{10+20}$$

$$R_T = \underline{15\ \Omega}$$



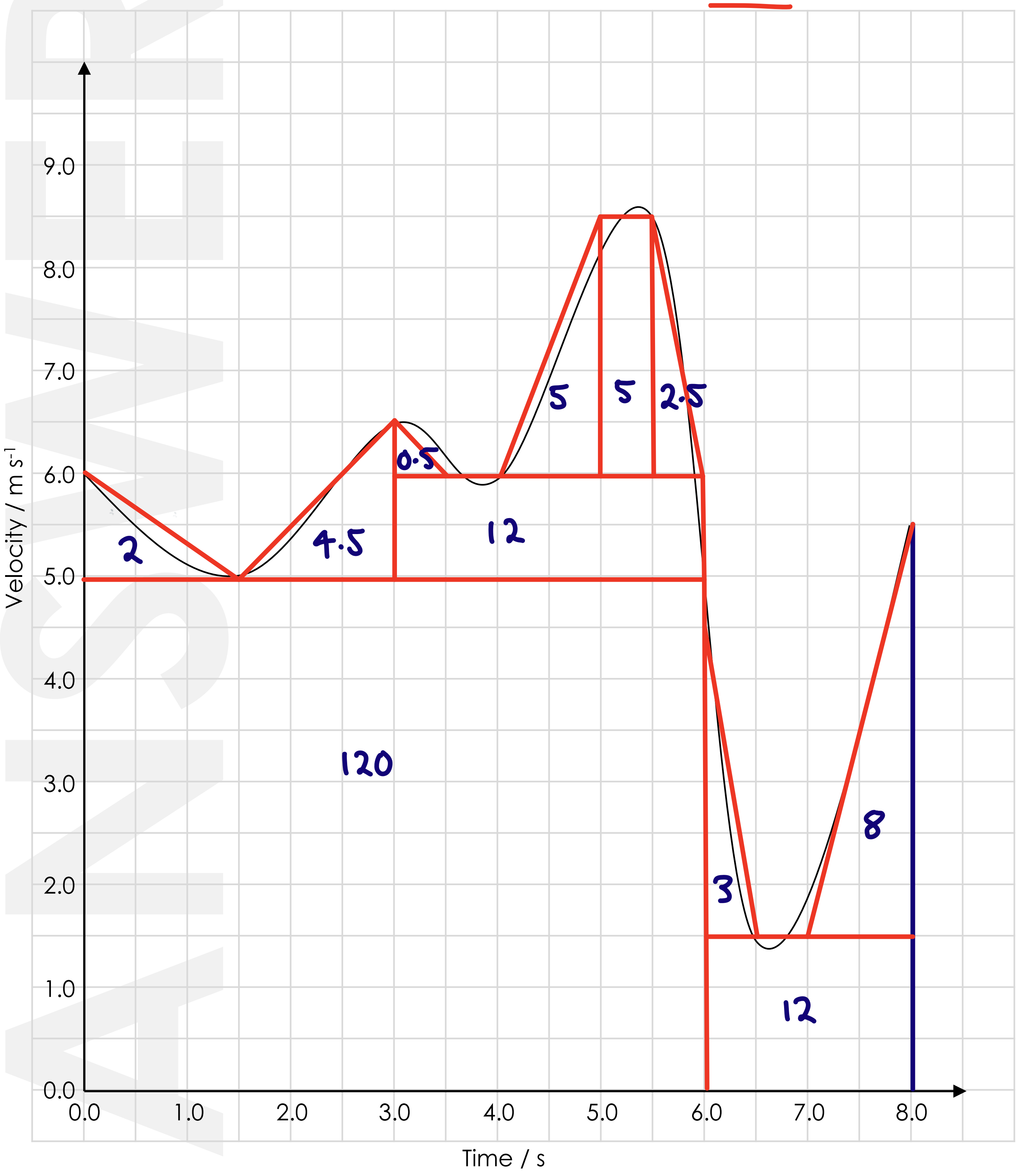
$$\frac{1}{R_T} = \frac{1}{10} + \frac{1}{20+30}$$

$$R_T = \underline{8.3\ \Omega}$$

29th October

1. Estimate the **displacement** during the first 8.0 s.

174.5 small squares = 43.625
≈ 44m



30th October

1 2 3

1. Draw a beautiful freehand **sine** curve.

2. The efficiency of a hairdryer is 87%. It is connected to a 230 V supply and draws a current of 1.0 A.

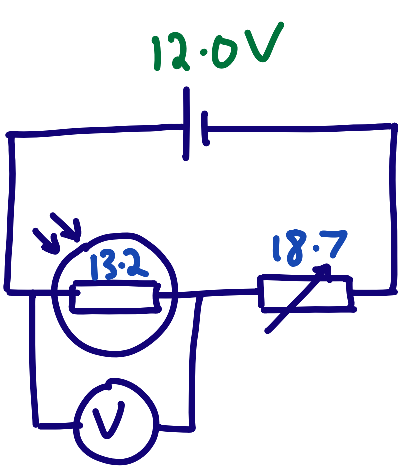
   Calculate the **output power** of the hairdryer.

$$P_{in} = VI = 230 \times 1.0 = 230 \text{ W}$$

$$P_{out} = 230 \times 0.87 = \underline{200} \text{ W}$$

3. A cell of e.m.f 12.0 V is in series with an LDR of resistance 13.2 Ω and a variable resistor set to 18.7 Ω.

   Draw a circuit diagram and calculate the **potential difference** across the LDR. Assume the cell has negligible internal resistance.



$$V \propto R$$

$$V = 12.0 \times \left(\frac{13.2}{13.2 + 18.7}\right) = \underline{4.97} \text{ V}$$

31^{st} October

1 2 3

1. A 0.200 m^3 block of copper is extruded into a wire of diameter 0.90 mm. Calculate how **long** it is.

$$V = \frac{\pi d^2 L}{4} \qquad L = \frac{4V}{\pi d^2} = \frac{4 \times 0.200}{\pi \times (0.90 \times 10^{-3})^2} = \underline{3.1 \times 10^5} \text{ m}$$

2. The efficiency of a bouncy ball is 0.58. It is dropped from a height of 1.00 m. Calculate the **height** the ball reaches after 7 bounces.

no. bounces

$$1.00 \times 0.58^7 = \underline{0.022} \text{ m}$$

efficiency

3. Define **critical angle** and calculate the critical angle for a glass block with n = 1.4.

$$\sin \theta_c = \frac{1}{n}$$

$$\theta_c = \sin^{-1}\left(\frac{1}{1.4}\right)$$

$$\theta_c = \underline{46°}$$