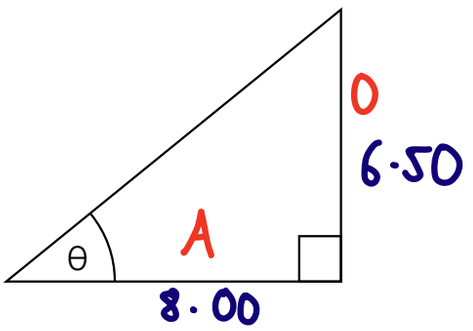
1st September

1. Calculate the **angle**, θ, in the triangle with an opposite side length of 6.50 m and an adjacent side length of 8.00 m.

$\tan\theta = \frac{O}{A}$



$\theta = \tan^{-1}\left(\frac{6.50}{8.00}\right)$

$\theta = 39.1°$

2. Write the following derived unit in terms of SI Base Units (kg, m, s etc): **newton**

$F = ma$

$N = kg \times m\,s^{-2}$

$N = kg\,m\,s^{-2}$

3. Describe the **similarities** and **differences** between transverse and longitudinal waves giving examples of each.

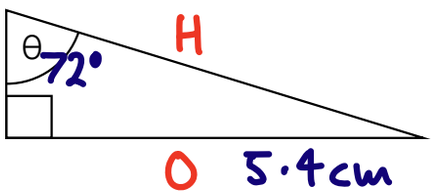
Many similar properties including they transfer energy and can be reflected, refracted and diffracted.

But only transverse waves can be polarised.

2nd September

1. Calculate the length of the **hypotenuse** of a triangle with an angle θ of 72˚ and an opposite side length of 5.4 cm.

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



$H = \frac{5.4}{\sin 72}$

$H = 5.7\text{cm}$

2. Write the following derived unit in terms of SI Base Units: **joule**

$E_K = \frac{1}{2}mv^2$

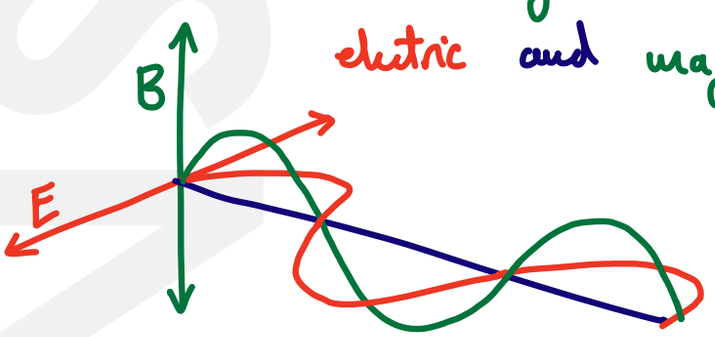
$J = kg \times (ms^{-1})^2$

$J = kg \times m^2 s^{-2}$

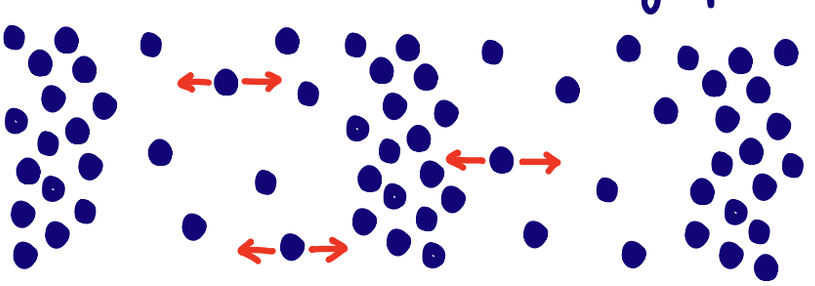
$J = kg\, m^2 s^{-2}$

3. Describe the **similarities** and **differences** between mechanical and electromagnetic waves giving examples of each.

Electromagnetic waves have oscillating electric and magnetic fields.

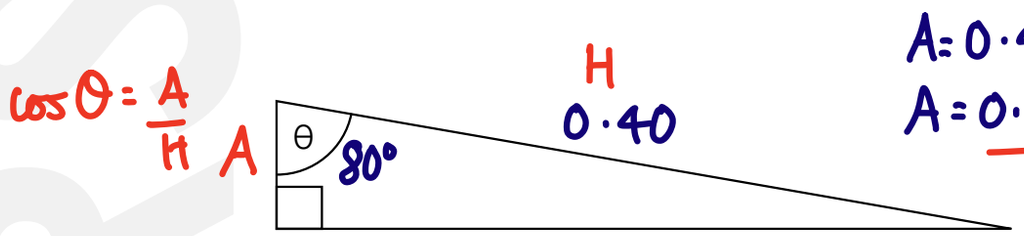


Mechanical waves have oscillating particles.



3rd September

1. Calculate the length of the **adjacent** side of a triangle with an angle θ of 80° and a hypotenuse length of 0.40 m.



$A = 0.40 \times \cos 80$

$A = 0.069\ m$

2. Write the following derived unit in terms of SI Base Units: **volt**

$V = \frac{E}{Q}$ ← $Q = It$

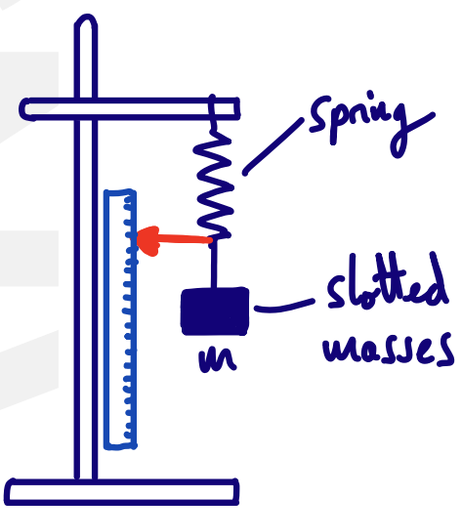
$C = A \times s = As$

Yesterday

$V = \frac{J}{C} = \frac{kg\ m^2\ s^{-2}}{As} = kg\ m^2\ s^{-3}\ A^{-1}$

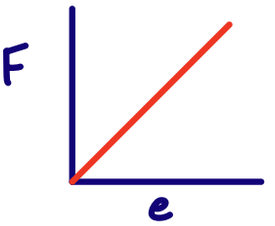
3. State **Hooke's Law** and describe how it could be investigated in the lab.

$F \propto e$ provided the limit of proportionality has not been exceeded.



WEAR EYE PROTECTION!

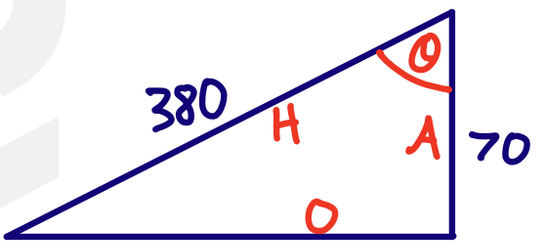
- Change m
- Measure e
- Plot F vs e ($F = W = mg$)



- Gradient = k

4th September

1. Calculate the length of the **opposite** side of a right-angled triangle if the hypotenuse is 380 mm and the adjacent side is 70 mm. Draw a diagram to help.



$O = \sqrt{380^2 - 70^2}$

$O = 373.5$

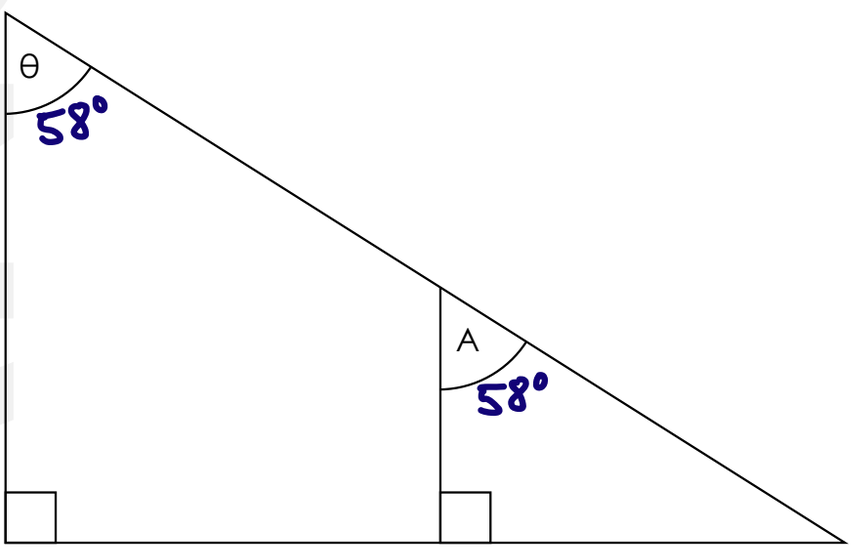
$O \approx 370$ mm

2. Write the following derived unit in terms of SI Base Units: **pascal**

$p = \frac{F}{A}$ From 1st September

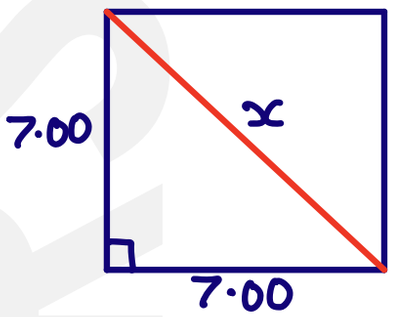
$Pa = \frac{kg\ m\ s^{-2}}{m^2} = kg\ m^{-1}\ s^{-2}$

3. Determine **θ** if A = 58˚.



5th September

1. Calculate the **diagonal** length of a square with a side length of 7.00 cm.



$x = \sqrt{7.00^2 + 7.00^2}$

$x = 9.90\text{cm}$

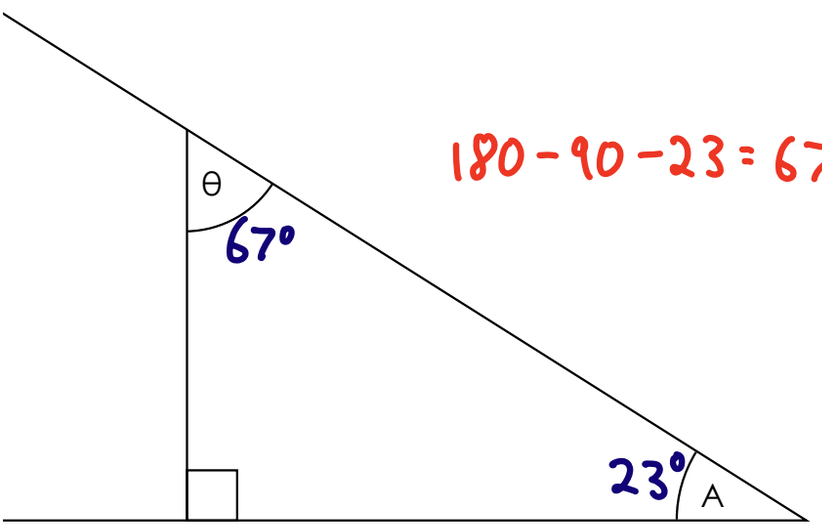
2. Write the following derived unit in terms of SI Base Units: **tesla**

$F = BIL$ $\quad B = \frac{F}{IL}$

$T = \frac{kg\ m\ s^{-2}}{A \times m}$

$T = kg\ s^{-2} A^{-1}$

3. Calculate **θ** if A = 23˚.



$180 - 90 - 23 = 67$

6th September

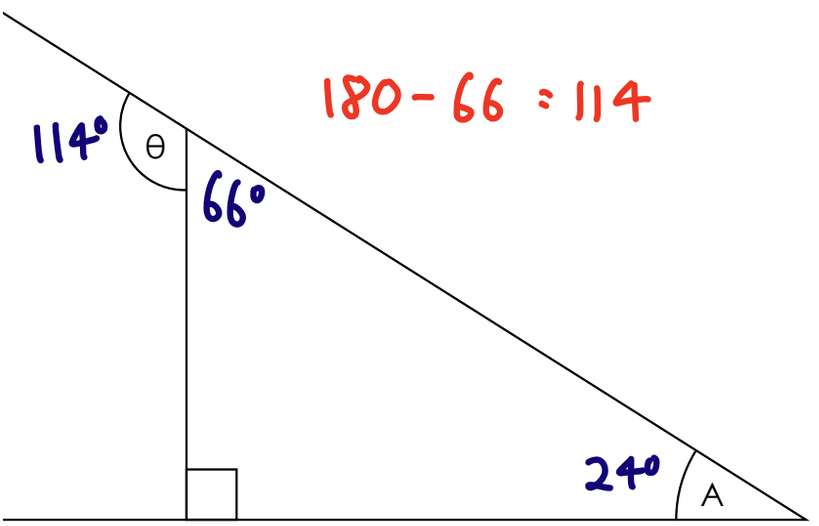
1. Calculate, **without** using a calculator:
   a. 3.0×10^4 multiplied by 3.0×10^7 9.0×10^{11}
   b. 4.0×10^5 multiplied by 2.0×10^7 8.0×10^{12}
   c. 3.0×10^{-2} multiplied by 3.0×10^{-7} 9.0×10^{-9}
   d. 3.0×10^4 multiplied by 4.0×10^{-6} $12 \times 10^{-2} = 1.2 \times 10^{-1}$

2. Define what is meant by a **vector** and list six vector quantities.

Magnitude and direction

There are plenty of vectors at A Level!

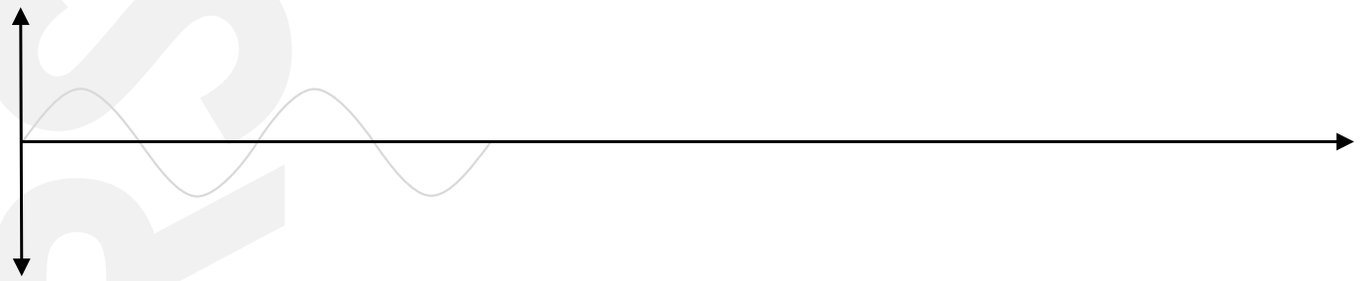
3. Calculate θ if A = 24˚.



180 - 66 = 114

7th September

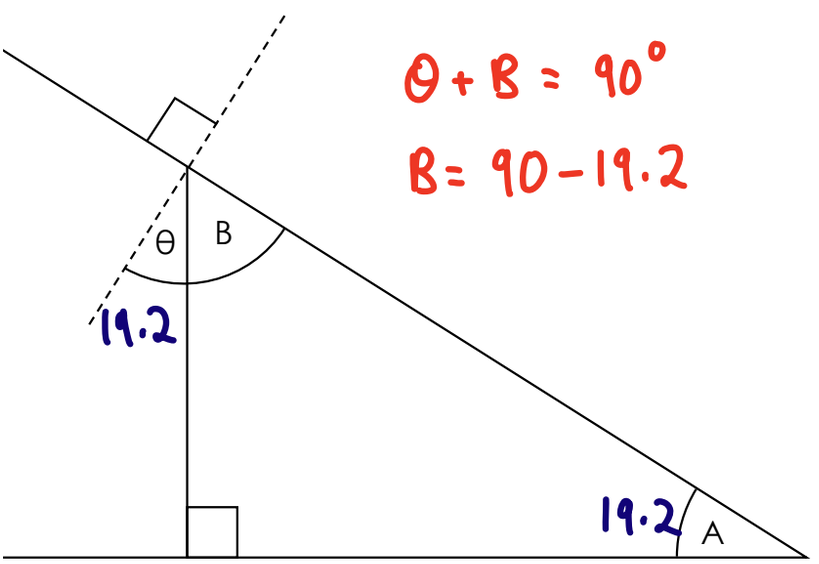
1. Sketch a **sinusoidal** curve on the axis below.



2. Define the **work done** on an object.

Work done is equal to the force applied multiplied by the distance moved in the direction of the force.

3. Calculate **θ** if A = 19.2˚.



θ + B = 90°

B = 90 − 19.2

8th September

1. Calculate the **wavelength** of a wave that is travelling at 520 m s^{-1} and has a time period of 13.0 s.

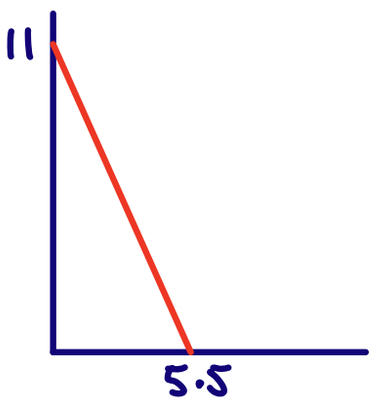
$v = f\lambda = \frac{\lambda}{T}$

$\lambda = vT$

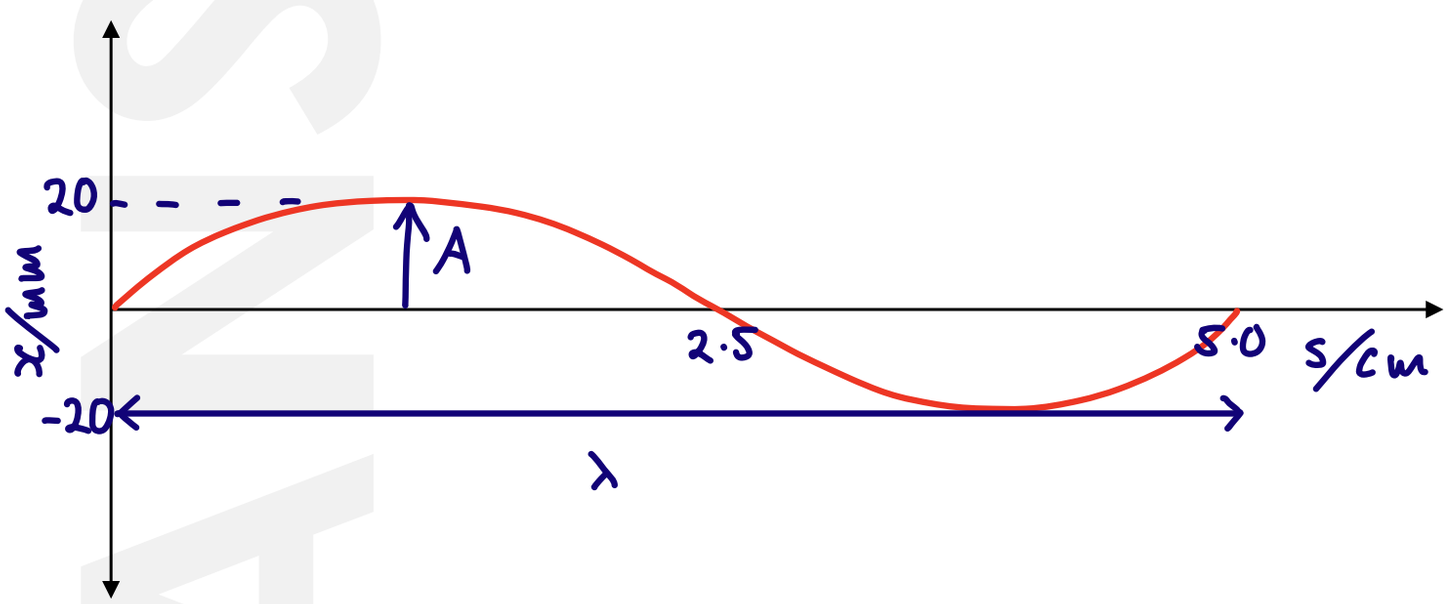
$\lambda = 520 \times 13.0$

$\lambda = 6760\,m$

2. **Sketch** the graph of y = -2x + 11.



3. Draw a sinusoidal wave on a **displacement-distance** graph with a wavelength of 5.0 cm and amplitude 20 mm. Label the wavelength and amplitude on your diagram.

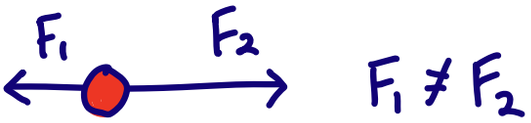


9th September

1. State **Newton's three laws of motion** (from memory if you can).

- 1st Law

- 2nd Law



- 3rd Law

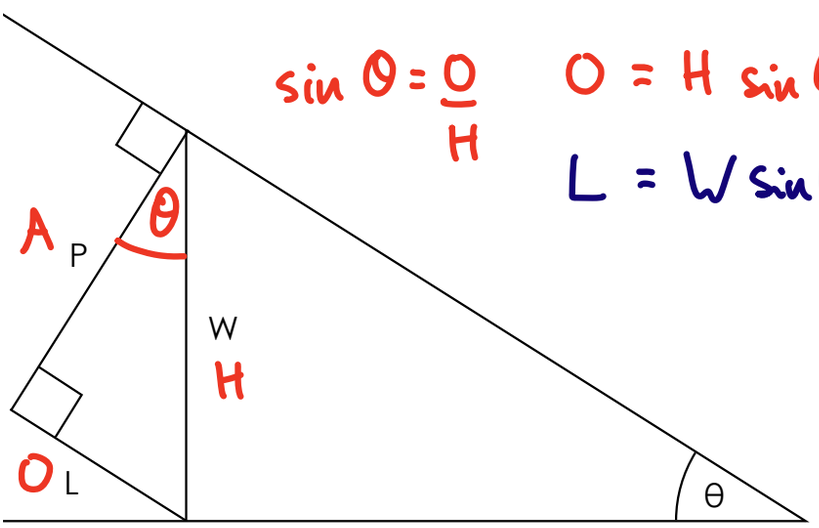
2. Form expressions for sides **P** and **L** in terms of θ and W.

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

$P = W\cos\theta$

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

$L = W\sin\theta$



10th September

1. Solve $\frac{1}{x} = \frac{1}{2} + \frac{1}{3}$ for **x**.

$$\frac{1}{x} = \frac{3}{6} + \frac{2}{6} = \frac{5}{6}$$

$$x = \frac{6}{5} = 1.2$$

2. Find out what these numbers **represent**:

a. 9.11×10^{-31} kg — Mass of an electron

b. 8.85×10^{-12} F m^{-1} — Permittivity of free space

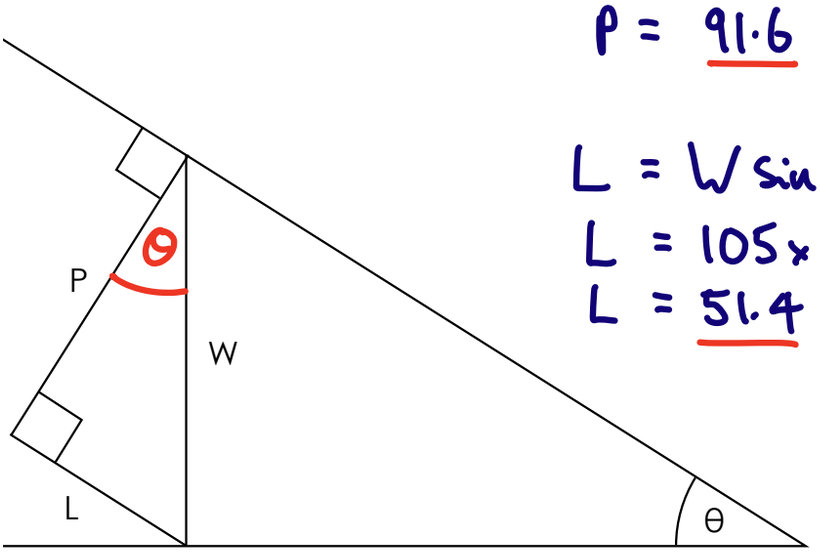
c. 1.661×10^{-27} kg — Atomic mass unit

d. 1.60×10^{-19} C — Elementary charge

e. 6.63×10^{-34} J s — Planck's constant

f. 1.60×10^{-19} J — One electronvolt

3. Calculate the **magnitude** of P and L if θ = 29.3° and W = 105.



$$P = W \cos\theta$$
$$P = 105 \times \cos 29.3$$
$$P = 91.6$$

$$L = W \sin\theta$$
$$L = 105 \times \sin 29.3$$
$$L = 51.4$$

11th September

1. Solve $\frac{1}{x} = \frac{1}{20} + \frac{1}{60}$ for **x**.

$$\frac{1}{x} = \frac{60}{1200} + \frac{20}{1200} = \frac{80}{1200} = \frac{1}{15}$$

$$x = 15$$

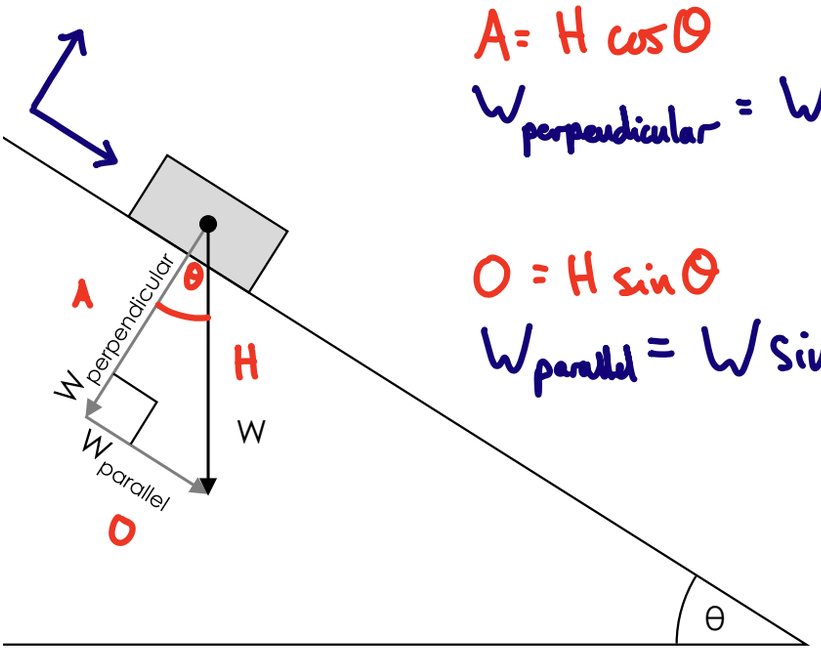
2. Identify what the **area** underneath the following graphs represents:

   a. A force-extension graph — Elastic potential energy

   b. A velocity-time graph — Displacement

   c. A force-time graph — Impulse or change in momentum

3. Form expressions for the **parallel** and **perpendicular** components (relative to the slope) of the block's weight, W, in terms of θ.



$$A = H\cos\theta$$

$$W_{perpendicular} = W\cos\theta$$

$$O = H\sin\theta$$

$$W_{parallel} = W\sin\theta$$

12th September

1. Solve $\frac{1}{x} = \frac{1}{45} + \frac{1}{25} + \frac{1}{15}$ for **x**.

$$x = \frac{1}{\frac{1}{45} + \frac{1}{25} + \frac{1}{15}} = 7.8$$

2. Identify the following electrical **components**:

a. 

Resistor

b. 

LDR

c. 

Fuse

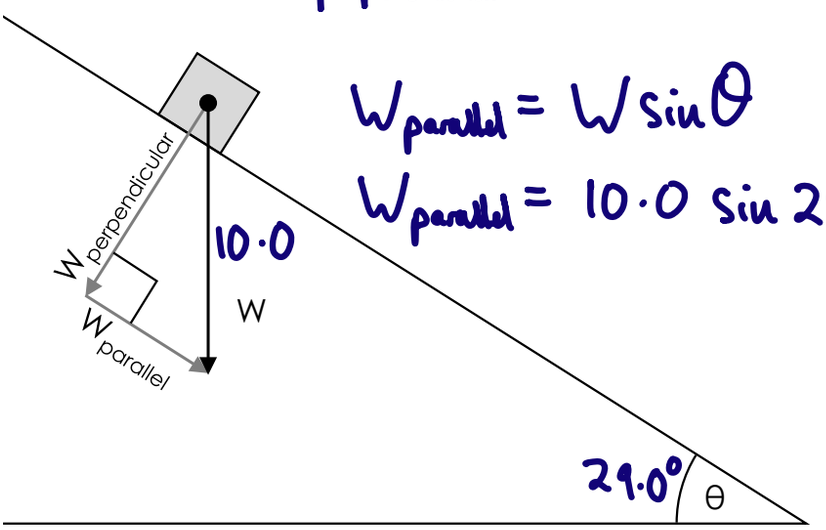
3. Calculate the **parallel** and **perpendicular** components of the weight of the block if it has a weight of 10.0 N and the slope is at an angle of 29.0° to the bench.

$W_{perpendicular} = W \cos\theta$

$W_{perpendicular} = 10.0 \cos 29.0 = 8.58\,N$

$W_{parallel} = W \sin\theta$

$W_{parallel} = 10.0 \sin 29.0 = 4.76\,N$



13th September

1. Combine into one fraction and rearrange $\frac{1}{x} = \frac{1}{A} + \frac{1}{B}$ to make **x** the subject.

$\frac{1}{x} = \frac{1}{A} + \frac{1}{B}$

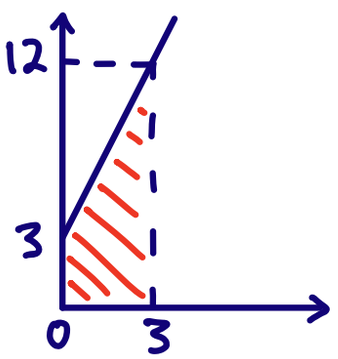
$\times A \quad \frac{A}{x} = 1 + \frac{A}{B}$

$\times B \quad \frac{AB}{x} = B + A$

$AB = x(B + A)$

$x = \frac{AB}{A+B}$

2. Calculate the **area** under the graph of y = 3x + 3 between x = 0 and x = 3. Sketching the graph may help.



$\left(\frac{3+12}{2}\right) \times 3 = 22.5$

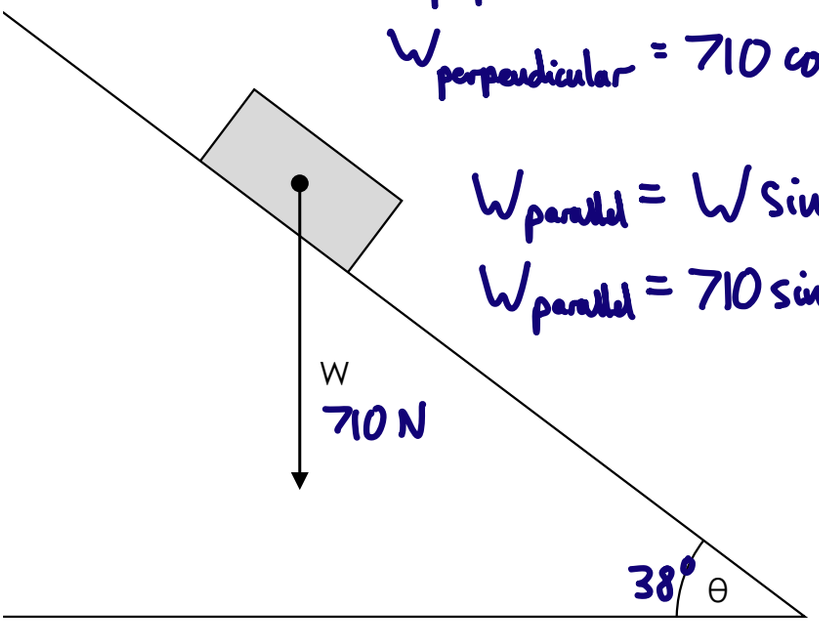
3. Calculate the **parallel** and **perpendicular** components of the block's weight if W = 710 N and θ = 38˚.

$W_{perpendicular} = W \cos\theta$

$W_{perpendicular} = 710 \cos 38 = 559\ N$

$W_{parallel} = W \sin\theta$

$W_{parallel} = 710 \sin 38 = 437\ N$



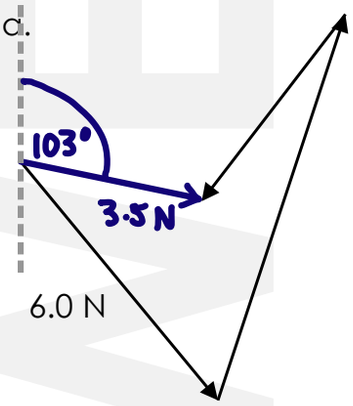
14th September

1. Write down a definition for an **ohmic conductor**.

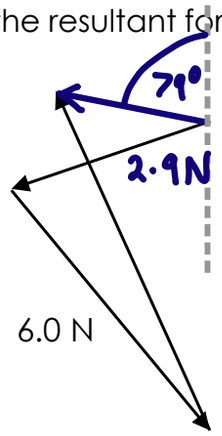
$I \propto V$ (if T constant)

2. Complete the **tip-to-tail** vector diagrams by drawing in the resultant vector and working out the magnitude and direction of the resultant force.

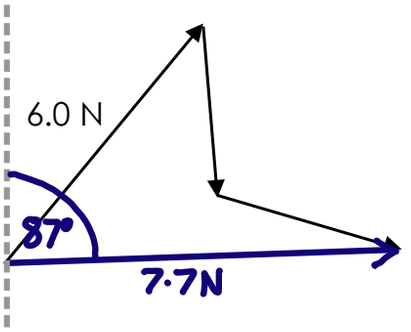
a.



b.

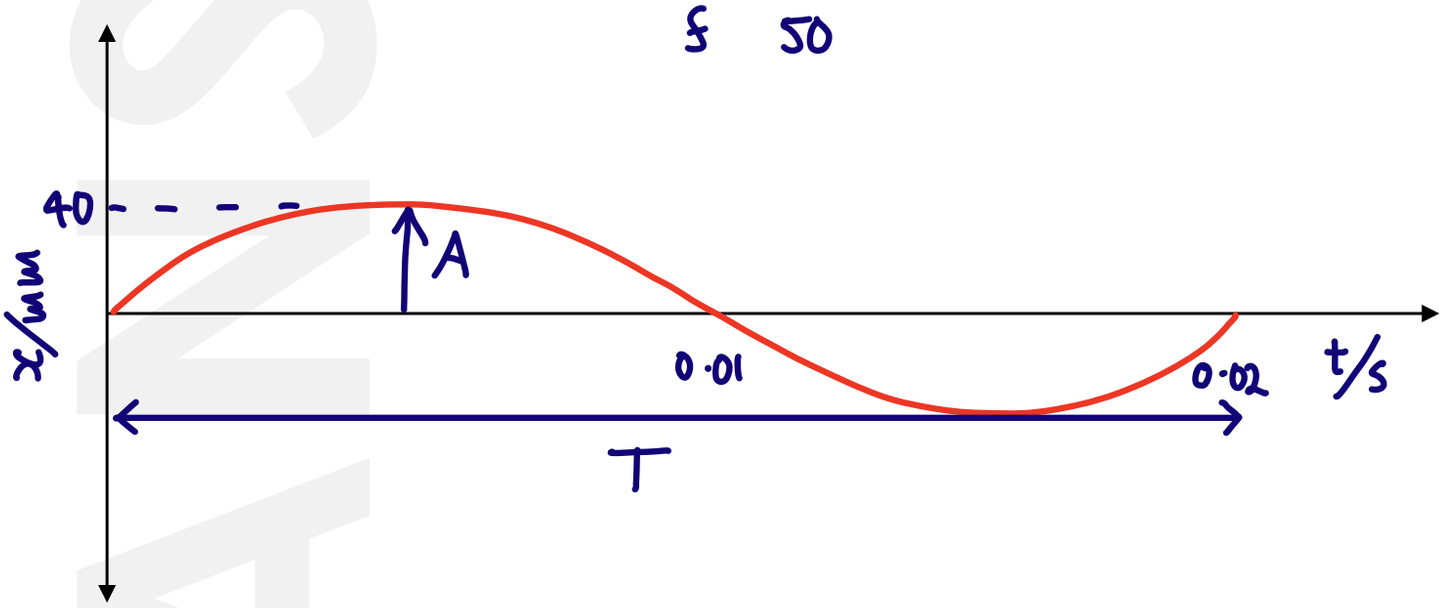


c.



3. Draw a sinusoidal wave on a **displacement-time** graph with a frequency of 50 Hz and amplitude 40 mm. Label the time period and amplitude on your diagram.

$T = \frac{1}{f} = \frac{1}{50} = 0.020$ s



15th September

1. Complete the **circuit symbol** for:

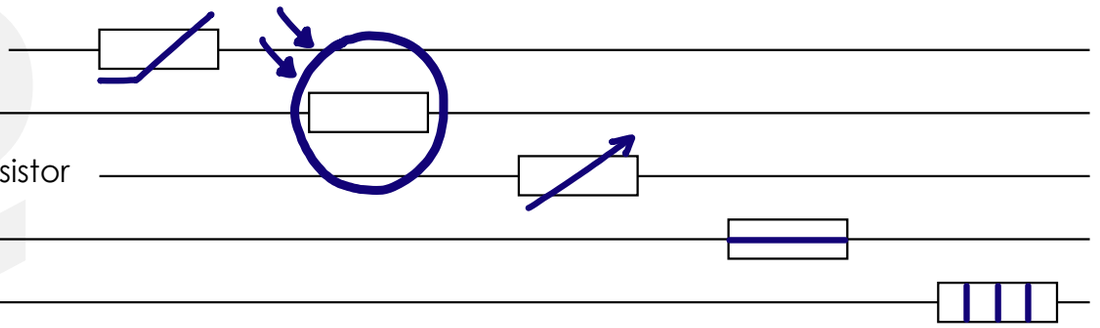
a. A thermistor

b. An LDR

c. A variable resistor

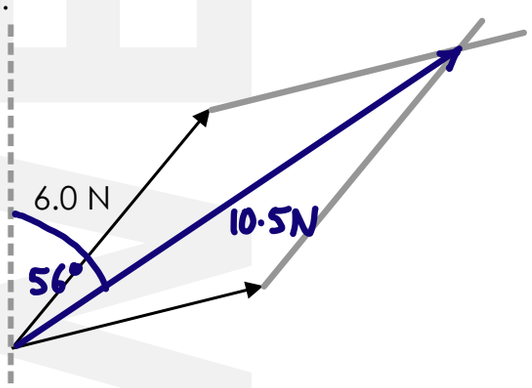
d. A fuse

e. A heater

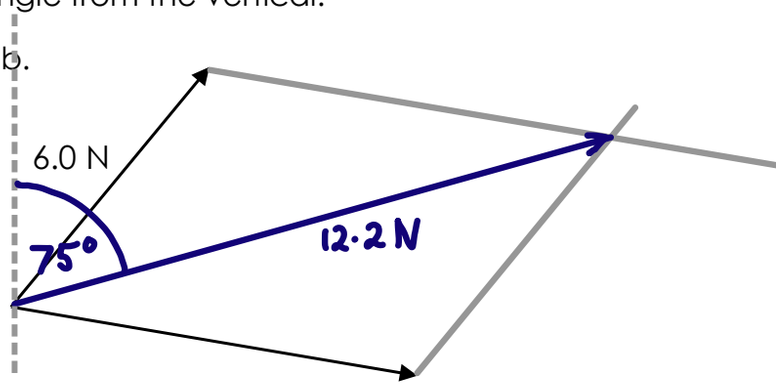


2. Complete the vector diagram by using the **parallelogram** method to draw in the resultant vector. Write in its magnitude (to 1 d.p.) and angle from the vertical.

a.



b.



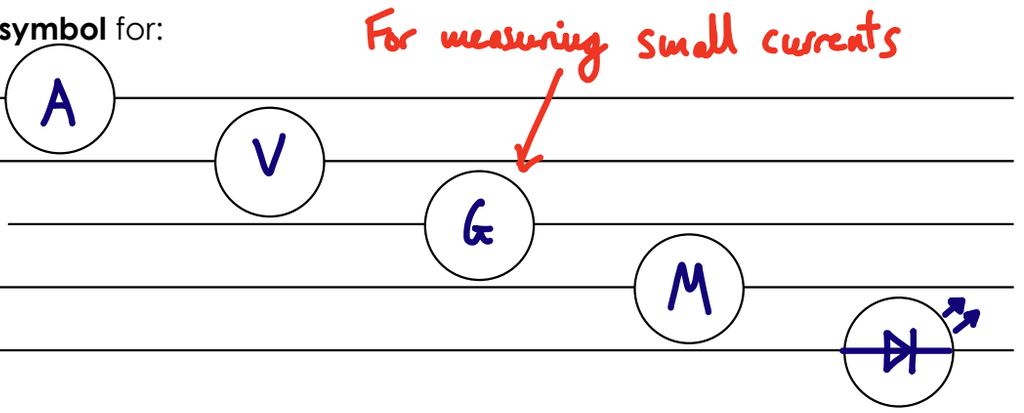
3. Describe the difference between **scalars** and **vectors** and give six examples of each.

Scalars have magnitude.

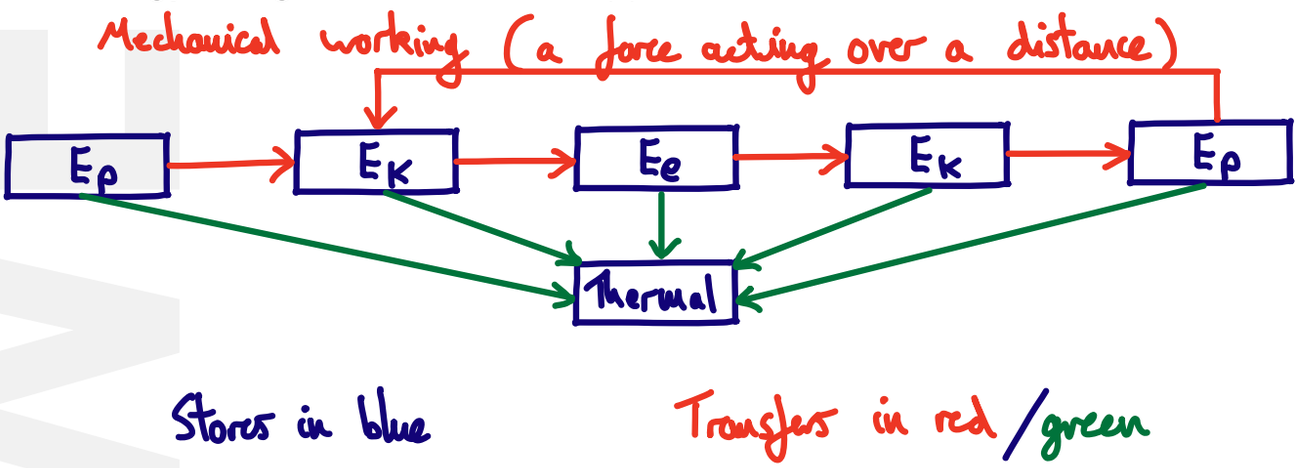
Vectors have magnitude and direction.

16th September

1. Complete the **circuit symbol** for:
   a. An ammeter
   b. A voltmeter
   c. A galvanometer
   d. A motor
   e. An LED

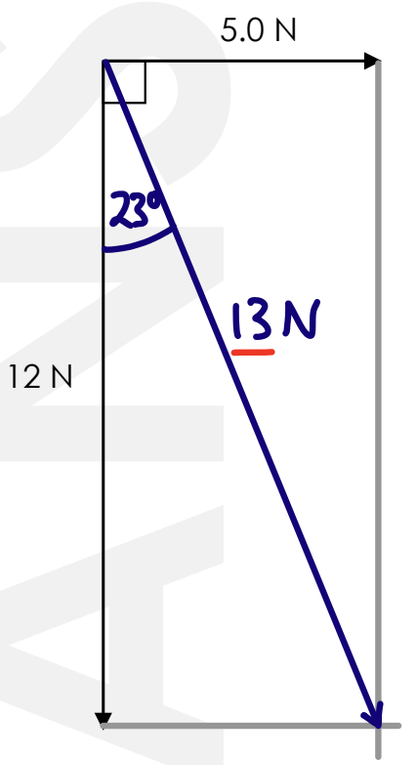


2. Discuss the **energy changes** in a ball that is dropped and then bounces.

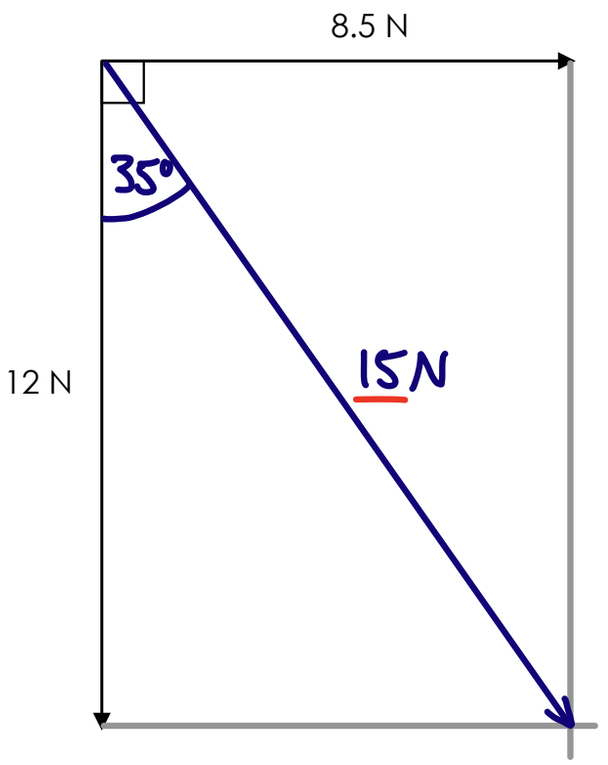


3. Calculate, using a **graphical** method, the size and angle to the vertical of the resultant force produced by these two perpendicular forces:

a.



b.



17th September

1. Use one of the following symbols, <, <<, > or >>, to describe the relationship between the **momentum** of a flying flying squirrel and the **momentum** of a flying bee.

Flying squirrel, m + v higher

$p_{squirrel} \gg p_{Bee}$

2. Calculate the **speed** a 162 g hockey ball will be travelling when it hits the ground from the top of the Shard if you ignore air resistance. The Shard is 310m tall.

   Explain why, in reality, the ball will never reach this speed.

$s = 310\,m$
$u = 0\ ms^{-1}$
$v = ?$
$a = 9.81\ ms^{-2}$
~~t~~

$v = \sqrt{u^2 + 2as}$

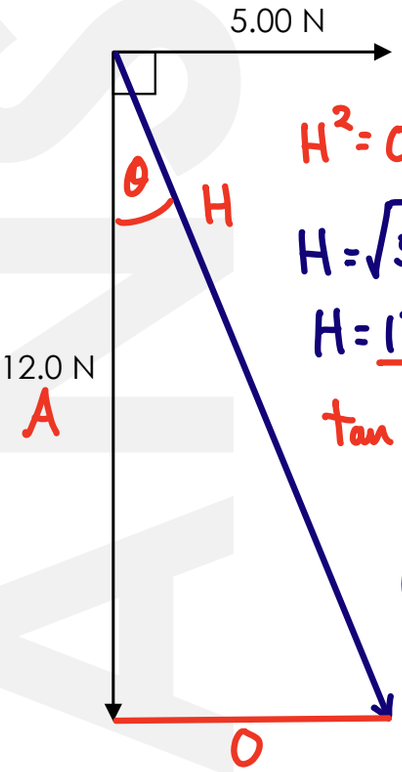
$v = \sqrt{2 \times 9.81 \times 310}$

$v = 77.988 \approx \underline{78.0\ ms^{-1}}$

Drag will increase until it reaches a terminal velocity lower than $78.0\ ms^{-1}$.

3. Calculate, using a **mathematical** method, the size and angle to the vertical of the resultant force produced by these two perpendicular forces.

a.



$H^2 = O^2 + A^2$

$H = \sqrt{5.00^2 + 12.0^2}$

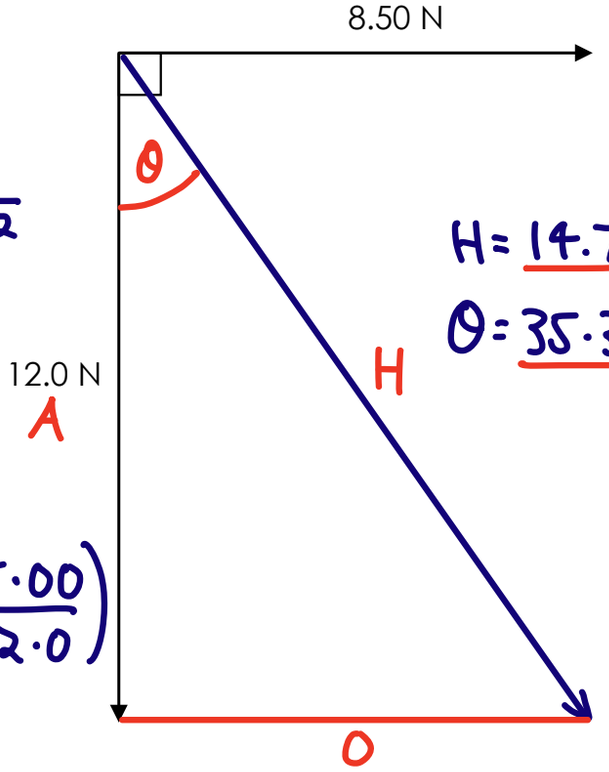
$H = \underline{13.0\,N}$

$\tan\theta = \frac{O}{A}$

$\theta = \tan^{-1}\left(\frac{5.00}{12.0}\right)$

$\theta = \underline{22.6°}$

b.



$H = \underline{14.7\,N}$

$\theta = \underline{35.3°}$

18th September

1. Write down the **units** for:
   a. Momentum — kg ms^{-1}
   b. Pressure — Pa
   c. Activity — Bq
   d. Magnetic flux density — T

2. An object of mass 2.0 kg is launched vertically upwards by a catapult to a height of 57 m. The catapult has a spring constant of 1 800 N m^{-1}.

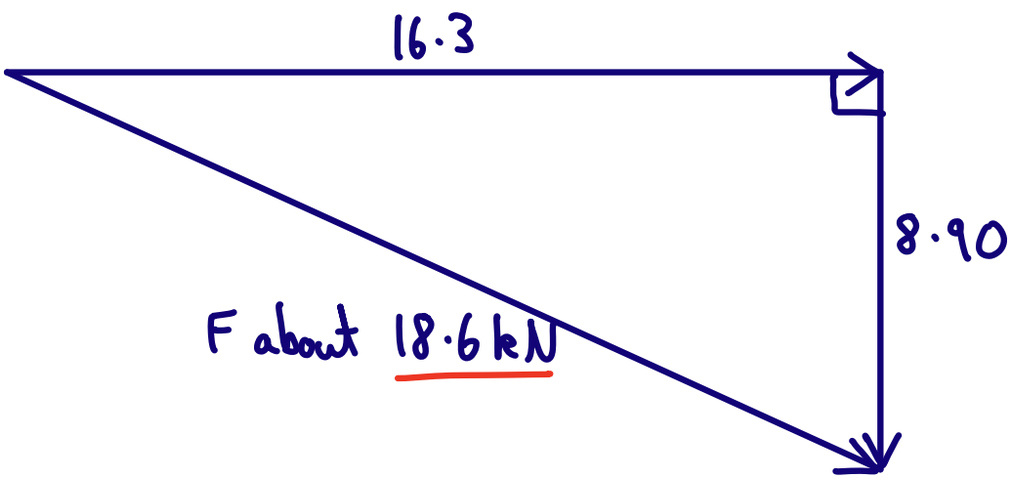
   Calculate the **extension** of the catapult to achieve this.

$E_e = E_p \quad \frac{1}{2}ke^2 = mg\Delta h$

$e = \sqrt{\frac{2mg\Delta h}{k}} = \sqrt{\frac{2 \times 2.0 \times 9.81 \times 57}{1800}}$

$e = 1.1\ m$

3. Calculate the size of the resultant force to the nearest 100 N, using **scale drawing**, produced by a vertical force of 8.90 kN and a horizontal force of 16.3 kN.



19th September

1. List ten **types** of force.

There are loads to choose from!

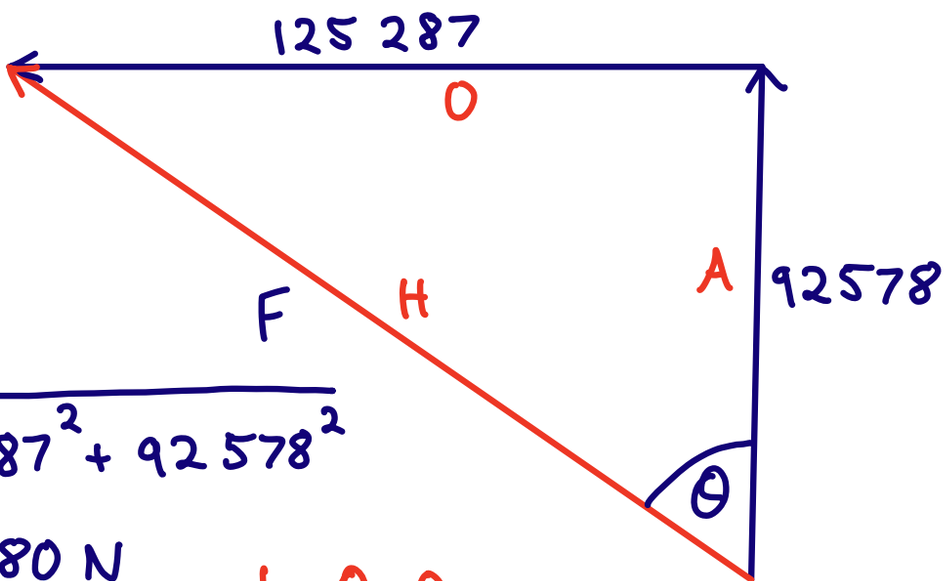
2. Explain why it is better to use a **monochromatic** light source when studying refraction.

often a LASER is used

Mono chromatic

Single Colour ∴ One wavelength

3. Calculate the size and direction of the resultant force, using a **mathematical** method, produced by an upwards vertical force of 92 578 N and a horizontal force of 125 287 N to the left.



$F = \sqrt{125287^2 + 92578^2}$

$F = 155\,780$ N

$\tan\theta = \frac{O}{A}$

$\theta = \tan^{-1}\left(\frac{125\,287}{92\,578}\right) = 53.538°$

5sf!

20th September

1. Rearrange the following to make $\mathbf{V_p}$ the subject:

   a. $V_p / V_s = n_p / n_s$

   $V_p = V_s \frac{n_p}{n_s}$

   b. $V_p I_p = V_s I_s$

   $V_p = V_s \frac{I_s}{I_p}$

2. The number of turns of a transformer is 300 on the primary coil and 100 on the secondary coil. The potential difference across the primary coil is 6.0 V.

   Calculate the **potential difference** across the secondary coil and state the type of transformer used.

   $V_s = V_p \frac{n_s}{n_p} = 6.0 \times \frac{100}{300} = 2.0\,V$

   Step-down as the potential difference decreases.

3. A 2.50 tonne Landrover is initially moving at 18 m s^{-1}. It takes 24.0 m to come to a complete stop.

   Calculate the average **braking force** required and describe what happens to the kinetic energy of the car as it slows down.

   $W = F_s$

   $W = E_K$

   $F_s = \frac{1}{2}mv^2$

   $F = \frac{mv^2}{2s} = \frac{2.50 \times 10^3 \times 18^2}{2 \times 24.0}$

   $F = 16\,875 \approx 1.7 \times 10^4\,N$

21st September

1. Calculate the **area**, in m^2, of a circle with:
   a. Radius 2.42 mm
   b. Diameter 1.12 mm
   c. Diameter 181 μm
   d. Diameter 3.14 m

$A = \pi r^2 = 1.84 \times 10^{-5}\ m^2$

$A = \frac{\pi d^2}{4}$ $= 9.85 \times 10^{-7}\ m^2$

$= 2.57 \times 10^{-8}\ m^2$

$= 7.74\ m^2$

2. Calculate the **current** if:
   a. 300 mC of charge moves past a point every 0.50 s

$I = \frac{Q}{t} = \frac{0.300}{0.5} = 0.60\ A$

   b. A 20 W heater has a potential difference of 24 V across it

$P = VI \quad I = \frac{P}{V} = \frac{20}{24} = 0.83\ A$

   c. A 20 W heater has a resistance of 47 Ω

$P = I^2R \quad I = \sqrt{\frac{P}{R}} = \sqrt{\frac{20}{47}} = 0.65\ A$

3. Explain the **difference** between:
   a. Distance and displacement

Scalar Vector

   b. Speed and velocity

Scalar Vector

   c. Gravity and weight

Weight is the force experienced by an object with mass in a gravitational field.

Gravity is one of the four fundamental forces.

22nd September

1. Combine into one fraction and rearrange $1/R_T = 1/R_1 + 1/R_2$ to make $\mathbf{R_T}$ the subject.

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$$

$\times R_1$ $\quad \frac{R_1}{R_T} = 1 + \frac{R_1}{R_2}$

$\times R_2$ $\quad \frac{R_1 R_2}{R_T} = R_2 + R_1$

$$R_1 R_2 = R_T (R_1 + R_2)$$

$$R_T = \frac{R_1 R_2}{R_1 + R_2}$$

$$R_T = \frac{\text{Product}}{\text{Sum}}$$

2. Calculate the **total resistance** of a 13 Ω and 18 Ω resistor if connected in:

a. Series

$R_T = R_1 + R_2 = 13 + 18 = 31\ \Omega$ R increases

a. Parallel

$R_T = \frac{R_1 R_2}{R_1 + R_2} = \frac{13 \times 18}{13 + 18} = 7.5\ \Omega$ R decreases

3. Two cars have masses m_1 = 1500 kg and m_2 = 2000 kg. They travel in opposite directions at 1.0 m s^{-1} and 6.0 m s^{-1} respectively. They collide and move off together.

Calculate the **final velocity** of the two cars after they crash.

Before

$u_1 = -1.0$ → $\quad$ ← $u_2 = 6.0$

[1] $m_1 = 1500$ $\quad$ [2] $m_2 = 2000$

← +ve

$P_{before} = P_{after}$

$m_1 u_1 + m_2 u_2 = (m_1 + m_2) v$

$(1500 \times -1) + (2000 \times 6) = 3500 v$

$v = 3.0\ \text{m s}^{-1}$ (left)

After

$v = ?$ ←

[1][2] $m = 3500$

23rd September

1. Calculate the **gradient** and **y-intercept** of the line with equation:

   a. $3y = 9x - 3$ $\quad y = 3x - 1 \quad m = 3 \quad c = -1$

   b. $3y + 9x = -3$ $\quad y = -3x - 1 \quad m = -3 \quad c = -1$

   c. $3y^2 - 3y = 9yx$ $\quad y = 3x + 1 \quad m = 3 \quad c = 1$

   d. $y = 3(x + 3)$ $\quad y = 3x + 9 \quad m = 3 \quad c = 9$

2. Calculate the **total resistance** of a 13 Ω, 20 Ω and 18 Ω resistor if connected in:

   a. Series

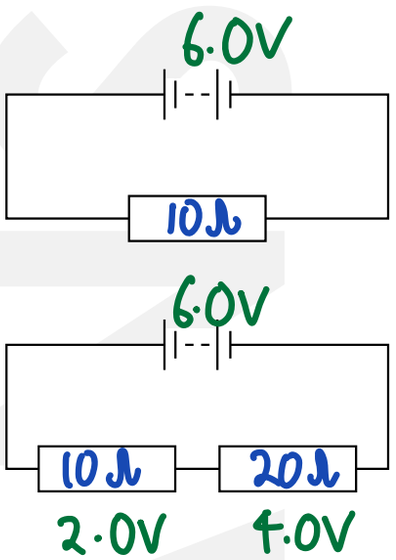
   $R_T = R_1 + R_2 + R_3 = 13 + 20 + 18 = 51\ \Omega$

   a. Parallel

   $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{13} + \frac{1}{20} + \frac{1}{18}$ $\quad R_T = 5.5\ \Omega$

3. A 10 Ω resistor is connected to a 6.0 V battery.

   Describe the **effect** (including **values**) that adding another 20 Ω resistor in **series** has on:



   a. The total resistance

   $R_T = R = 10 = 10\ \Omega$

   $R_T = R_1 + R_2 = 10 + 20 = 30\ \Omega$ $\quad \times 3$

   b. The current $I = \frac{V}{R_T} = \frac{6.0}{10} = 0.60\ A$

   $I = \frac{V}{R_T} = \frac{6.0}{30} = 0.20\ A$ $\quad \div 3$

   c. The potential difference across each component

   Reduces from 6.0 V to 2.0V and 4.0V

24th September

1. Write down the **units** for:
   a. Acceleration ms^{-2}
   b. Density $kg\,m^{-3}$
   c. Spring constant Nm^{-1}
   d. Moment Nm

2. By taking the minimum radio wave frequency as 1.0 Hz and the maximum gamma ray frequency as 1.0×10^{20} Hz, calculate the **ratio** between the range of visible light frequencies and the whole EM spectrum.

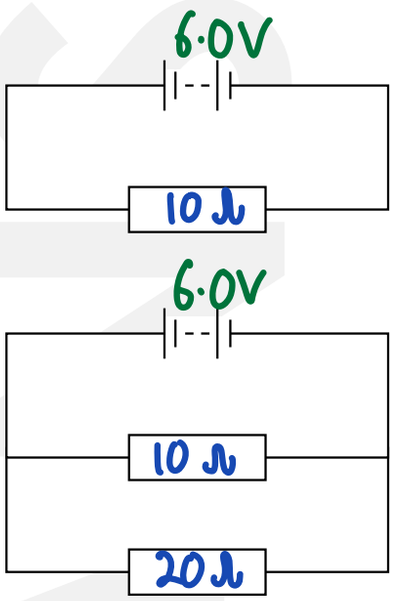
Visible 400×10^{-9} to 700×10^{-9} (data from 12th August)

$$\frac{7.5\times10^{14} - 4.3\times10^{14}}{1.0\times10^{20} - 1.0\times10^{1}} = 3.2\times10^{-6}$$

A very small part of the EM spectrum is visible light!

3. A 10 Ω resistor is connected to a 6.0 V battery.

   Describe the **effect** (including **values**) that adding another 20 Ω resistor in **parallel** has on:



   a. The total resistance

$$R_T = \frac{R_1 R_2}{R_1 + R_2} = \frac{10\times20}{30} = 6.7\,\Omega$$ Compared to 10 Ω before

   b. The total current $I = \frac{V}{R_T} = \frac{6.0}{10} = 0.60\,A$

$$I = \frac{V}{R_T} = \frac{6.0}{6.7} = 0.90\,A$$

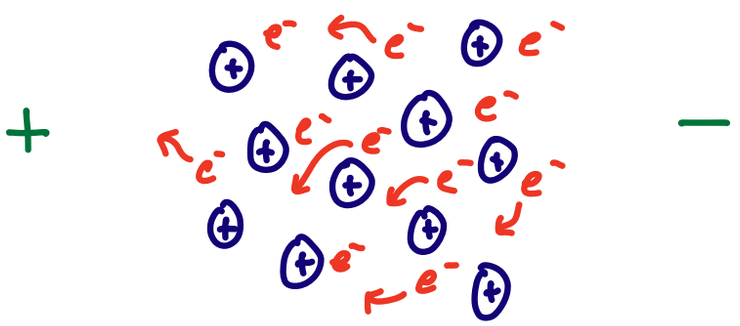
   c. The potential difference across each component

6.0 V across every component

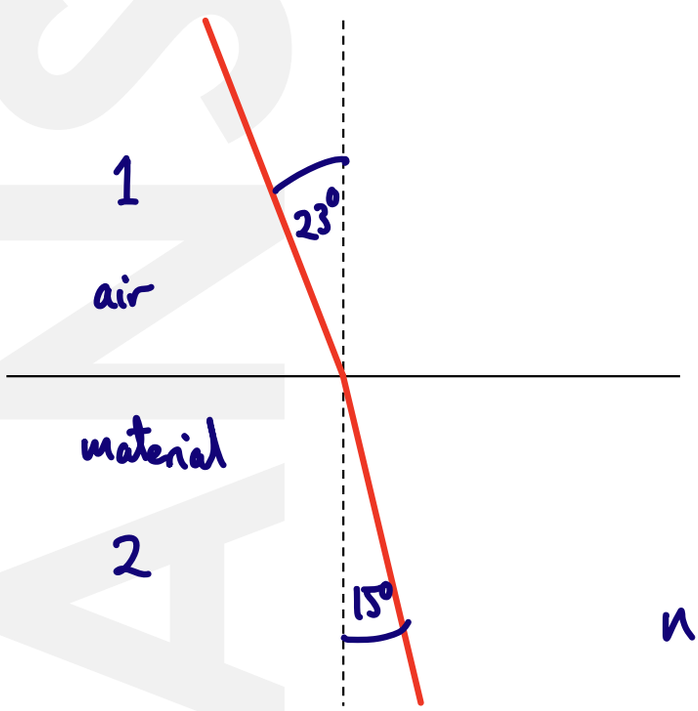
25th September

1. Write down the **units** for:
   a. Acceleration due to gravity — ms^{-2}
   b. Specific heat capacity — $J\,kg^{-1}\,K^{-1}$
   c. Specific latent heat — $J\,kg^{-1}$
   d. Gravitational field strength — $N\,kg^{-1}$

2. Describe how metals **conduct** electricity.



3. A ray of light is shone into a block of unknown material from air at an angle of 23˚ to the normal and refracts at an angle of 15˚. Calculate the **refractive index** of the material and hence the **speed of light** in the material.



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

$$n_2 = n_1 \frac{\sin\theta_1}{\sin\theta_2}$$

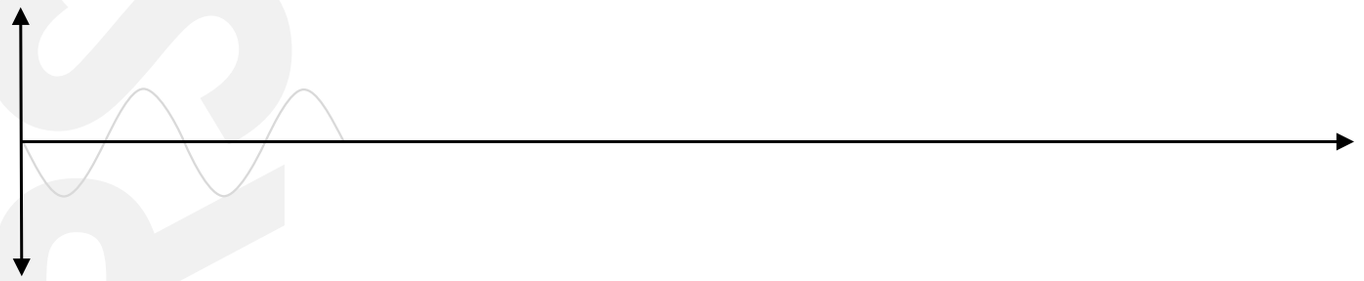
$$n_2 = \frac{\sin 23}{\sin 15}$$

$$n_2 = 1.5 \quad \text{(no units)}$$

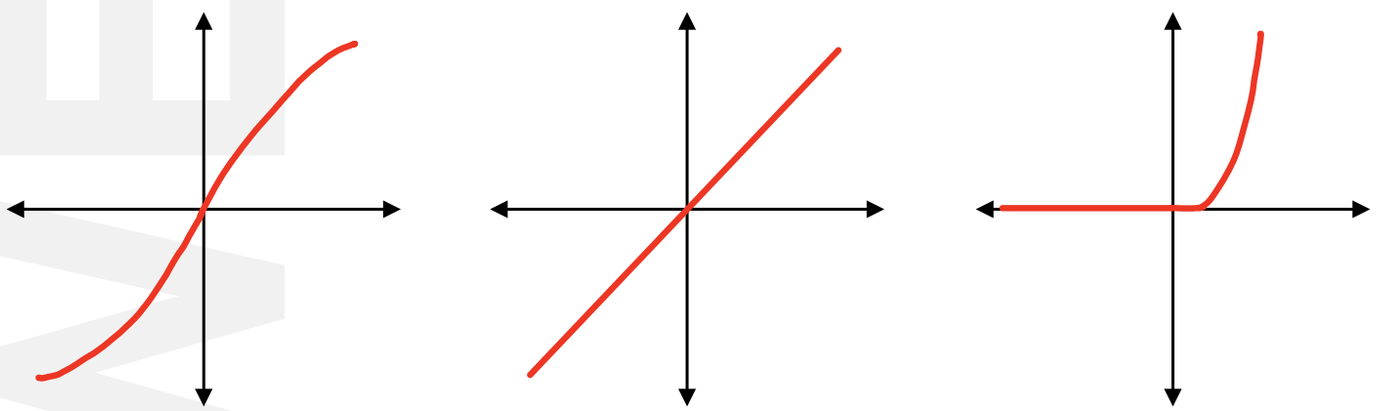
$$n = \frac{c}{v} \qquad v = \frac{c}{1.51} = 2.0\times10^{8}\ ms^{-1}$$

26th September

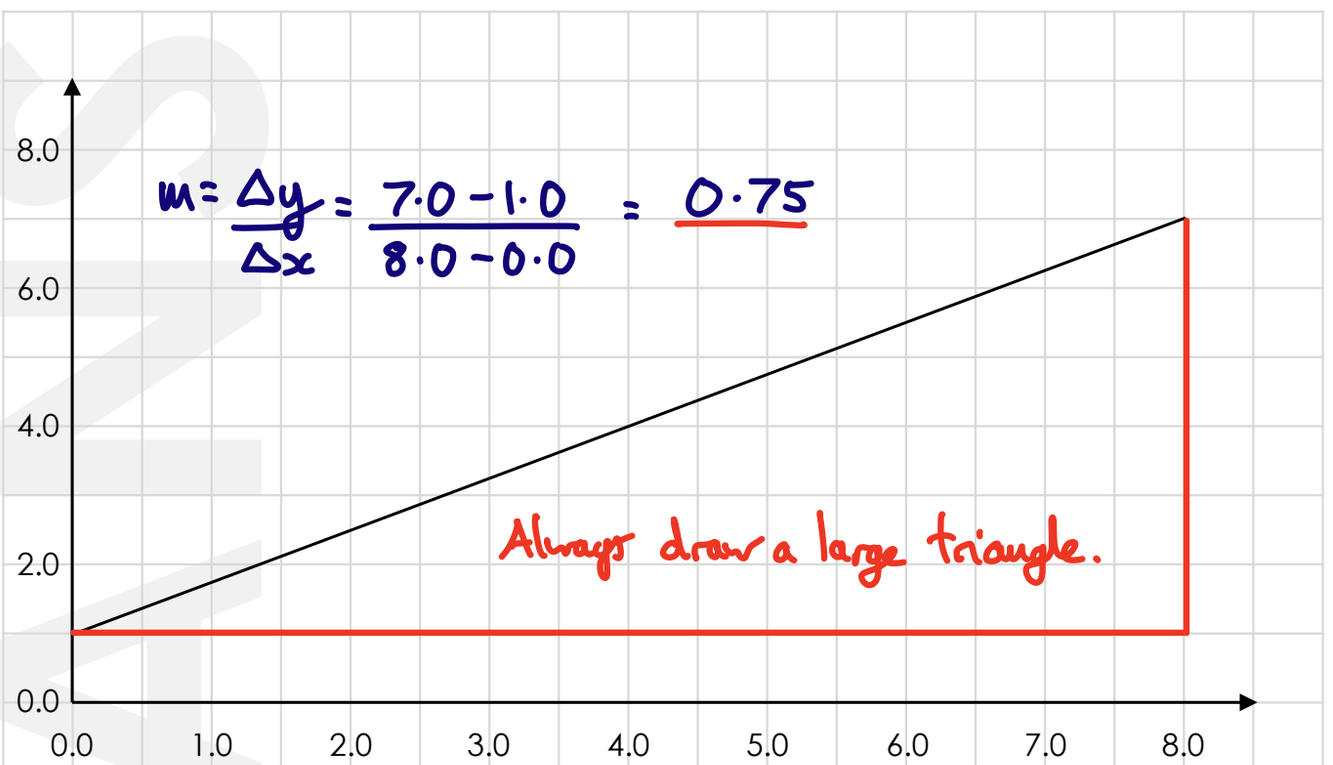
1. Sketch a **sinusoidal** curve on the axis below.



2. Sketch the **IV graph** for a filament lamp, ohmic resistor and diode.



3. Calculate the **gradient** of the following line.



27th September

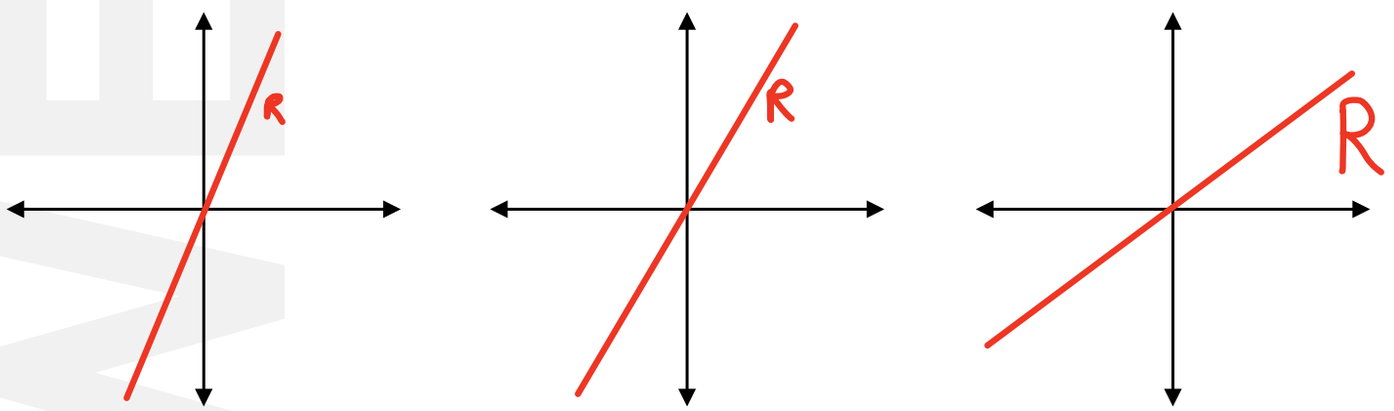
1. Calculate the gradient and hence the **equation** of the straight-line graph that goes through the points (5, 2) and (9, 1).

$$m = \frac{\Delta y}{\Delta x} = \frac{1-2}{9-5} = \frac{-1}{4} = -0.25$$

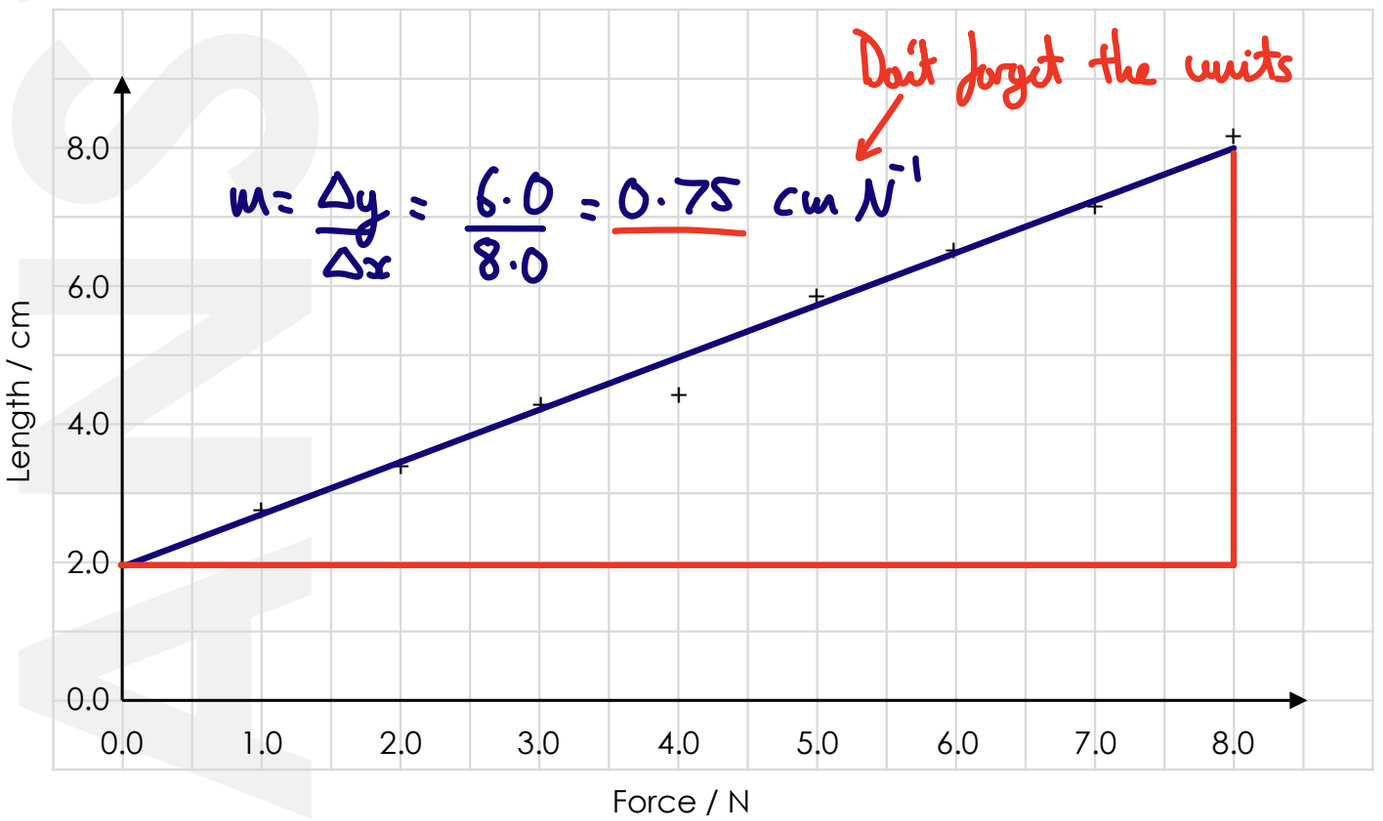
$$y - 2 = -0.25(x-5)$$

$$y = -0.25x + 3.25$$

2. Sketch the **IV graph** for three different resistors of increasing resistance.



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



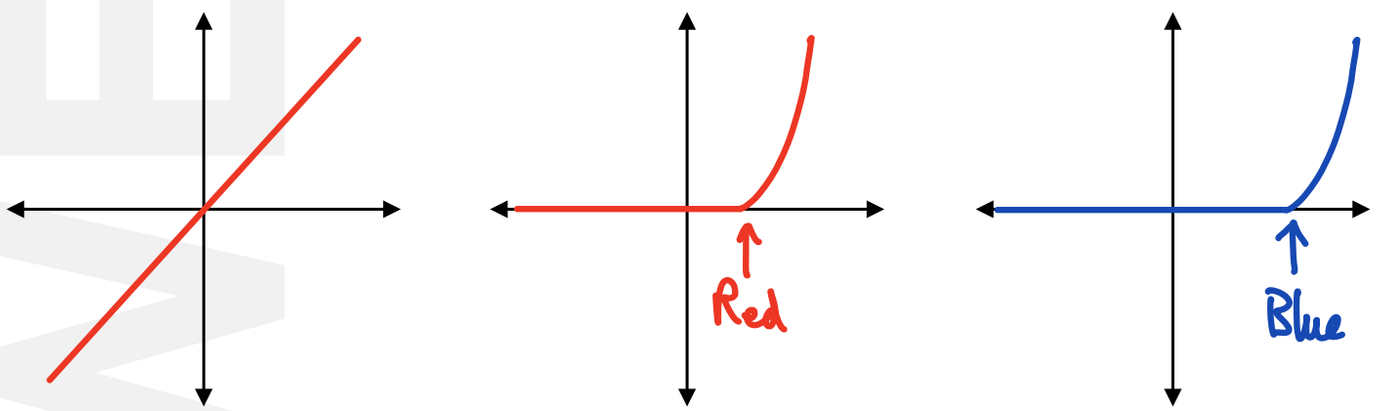
28th September

1. Calculate the **equation** of the straight-line graph that goes through the point (0, 4) and has a gradient of -0.1.

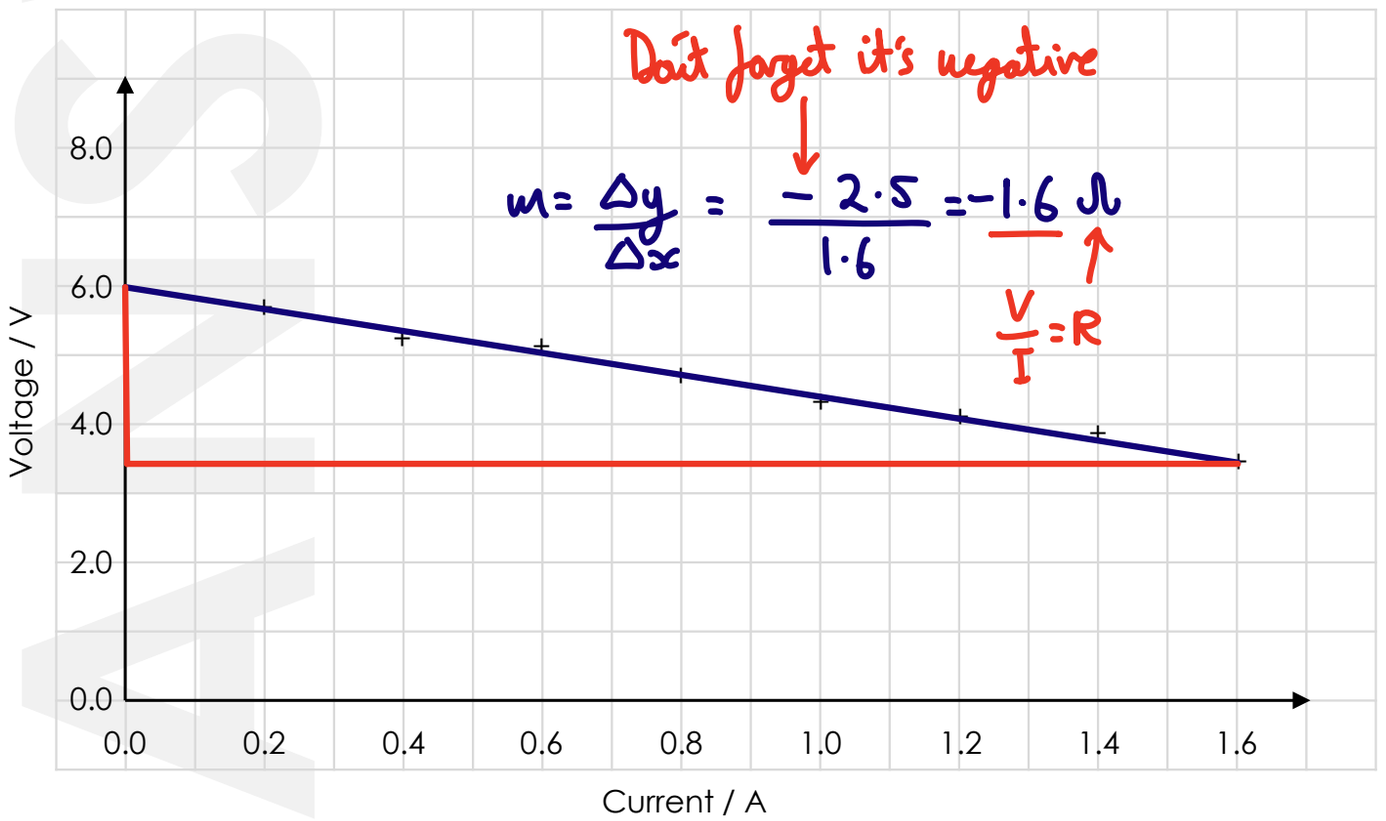
$y - 4 = -0.1(x - 0)$

$y = -0.1x + 4$

2. Sketch the **IV graph** of a metal wire at a constant temperature, a red LED and a blue LED.



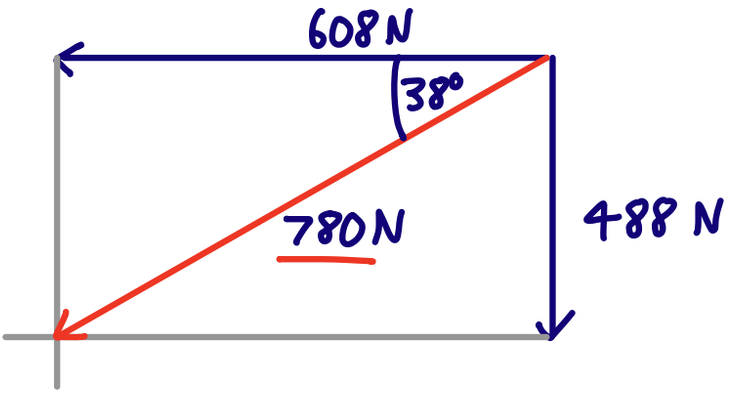
3. Calculate the **gradient** of the following data, giving an appropriate unit.



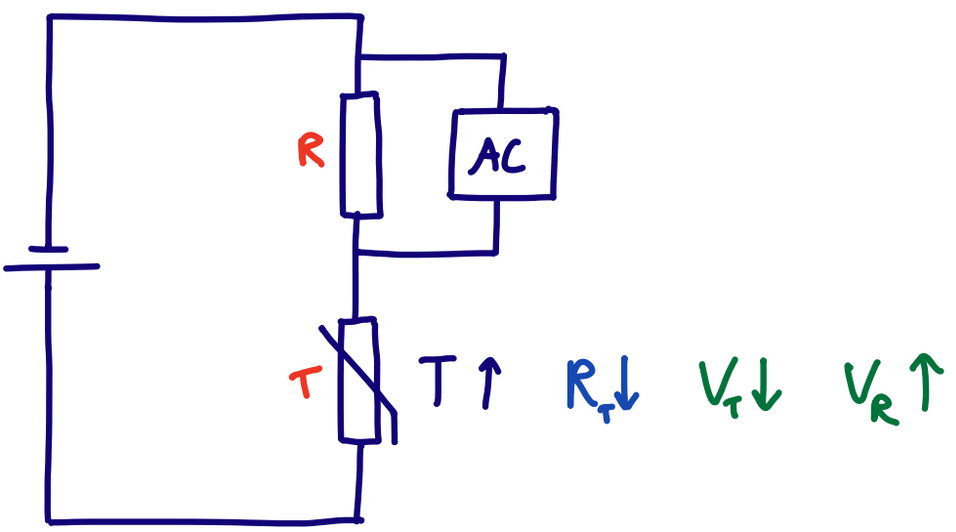
29th September

1. Write down the **units** for:
   a. Upthrust — N
   b. Elementary charge — C
   c. Internal resistance — Ω
   d. Frequency — Hz

2. Calculate the size and direction of the resultant force, using **scale drawing**, produced by vertical forces of 809 N down and 321 N up, and horizontal forces of 1.04 kN left and 432 N to the right.



3. Design and describe a **sensing circuit** used to operate an air conditioning unit. Your circuit should include an NTC thermistor and a fixed resistor.



30th September

1. Calculate the **area** of a circle, in m^2, with a:
   a. Diameter of 520 mm — $0.212\ m^2$
   b. Radius of 0.67 mm — $1.4 \times 10^{-6}\ m^2$
   c. Diameter of 2.3×10^9 nm — $4.2\ m^2$
   d. Radius of 3.14 μm — $3.10 \times 10^{-11}\ m^2$

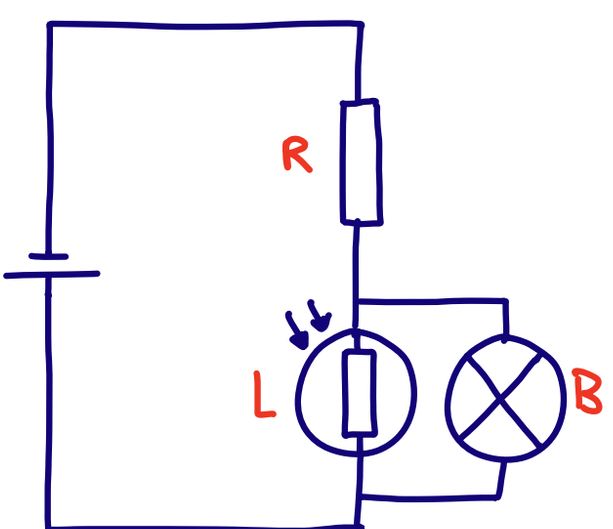
2. Write the following derived unit in terms of SI Base Units: **watts**

$$P = \frac{E}{t}$$

From 2nd September

$$W = \frac{kg\ m^2\ s^{-2}}{s} = kg\ m^2\ s^{-3}$$

3. Design and describe a **sensing circuit** used to operate a garden light. Your circuit should include an LDR and a fixed resistor.



Light ↓ R_L↑ V_L↑ V_B↑