

Physics Exam Scope

November 15, 2025

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1 Info

Notes according to exam scope given for a specific exam.

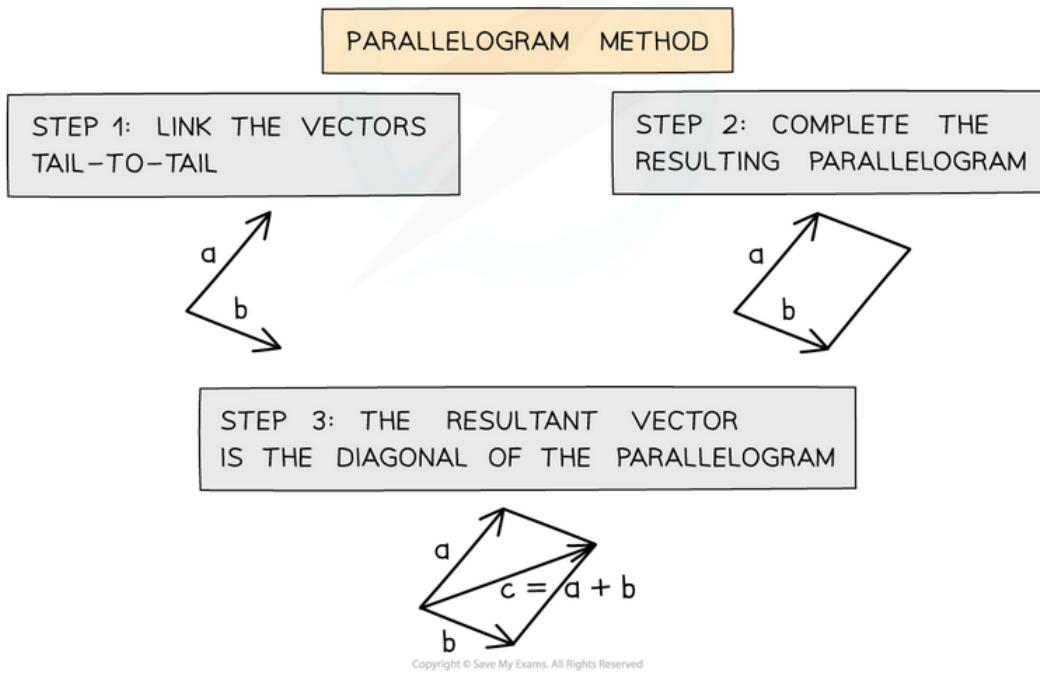
Idk if it's going to be useful

Return home -> https://joevim.github.io/IGCSE_Notes/

2 Paper 4

2.1 Forces

- Parallelogram method for resultant forces



- Magnitude scale
Scale drawings
- Kinetic and gravitational potential energy
 - $\text{Kinetic Energy} = \frac{1}{2} \times m \times v^2$
 - $GPE = mgh = \text{Kinetic Energy Lost}$
- Energy resources
 - List
 1. Fossil fuels
 2. Biofuels
 3. Water
 - * Ocean waves
 - * Hydroelectric dams
 4. Geothermal
 5. Nuclear fuel
 6. Light from the Sun
 - * Solar cells
 7. Infrared and other EM waves
 - * Heat water

- * Solar panels
- * Wind energy
- Radiation is the main source of energy for all resources except
 1. Geothermal
 2. Nuclear
 3. Tidal
- Advantages of different energy sources
 - * Is it renewable?
 - * What fuel does it need?
 - * What pollutants does it produce?
- Energy-power relationship(calculation)

- Equations:

$$WorkDone = Force \times Distance$$

$$Power(Watt) = \frac{WorkDone}{Time}$$

$$Energy = Power \times Time$$

- Moment

$$Moment(Nm^{-1}) = Force(N) \times DistanceFromPivot(m) \quad F_1d_1 = F_2d_2$$

- Use force to find cross-sectional area

$$Pressure(Pa) = \frac{Force(N)}{Area(m^2)}$$

2.2 Thermal Physics

- Radiation

How surfaces affect radiation

	Matt black	Shiny white
Emmision	Good	Bad
Absorbtion	Good	Bad

- Convection

- How a radiator works

It uses convection and radiation. Explain radiation specifically

- * Convection

The main method used by the radiator

- Steps

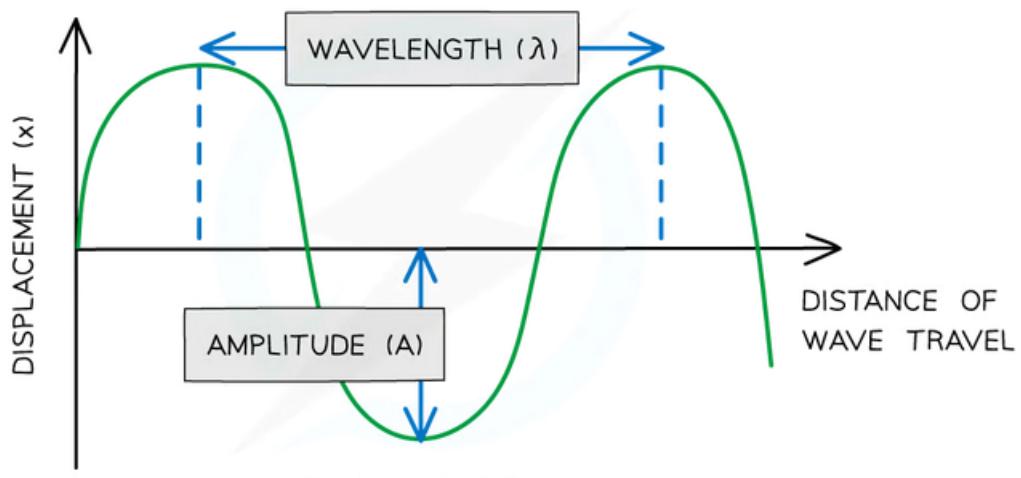
1. The air is heated by the radiator
2. The hot air rises
3. It cools down
4. The cool air falls
5. It flows back to the radiator
6. This repeats

- * Radiation
 - Secondary method used by the radiator
 - The infrared radiation given off by the radiator is absorbed by Walls and people near the radiator
- Kinetic theory
 - How temperature affects particles
 - Temp ↑, Kinetic energy of particles ↑
 - Arrangement and motion of particles

	Solid	Liquid	Gas
Density	High	Medium	Low
Arrangement	Regular	Random	Random
Movement	Vibrate in place	Move past each other	Move quickly in all directions
Energy	Low	Greater	Greatest

- Intermolecular forces
 1. Solids
 - * They have strong intermolecular forces
 - * The particles are held in place
 2. Liquids
 - * They have enough energy to overcome their intermolecular forces
 - * Their particles are held close together
 3. Gases
 - * They have even more energy
 - * Their particles move randomly, quickly
 - * There are large spaces in between gas particles

2.3 Waves



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- Diagrams

Make sure to draw the

- The normal line
- The displacement line

- Terminology

- Parts of a wave diagram

1. Normal line(time)
2. Displacement(vertical line)

It is the distance the wave particles move

3. Transverse wave

Oscillates perpendicular to the normal(direction of energy transfer)

- (a) Crest/peak

The highest point of the wave

- (b) Trough

The lowest point of the wave

4. Longitudinal wave

Oscillates parallel to normal

- (a) Rarefaction

A point of low pressure

- (b) Compression

Point of high pressure

- (c) Wavefront

A line used to represent a single wave

- Parts of a wave

1. Frequency(f)

The number of complete waves per second $Frequency = \frac{1}{Period} = \frac{N.O.Cycles}{Time}$

2. Period(t)

The time taken to complete a wave $Period = \frac{1}{Frequency} = \frac{Time}{N.O.Cycles}$

3. Amplitude(A)

The maximum distance of a wave from the normal

4. Wavelength: Lambda Λ

The length of a wave(distance between 2 points on a wave)

5. Wave speed

Speed of wave $Speed = f\Lambda$

- Definition

When energy is transferred without transferring matter

2.4 Light

- Refraction calculation

- Snell's law

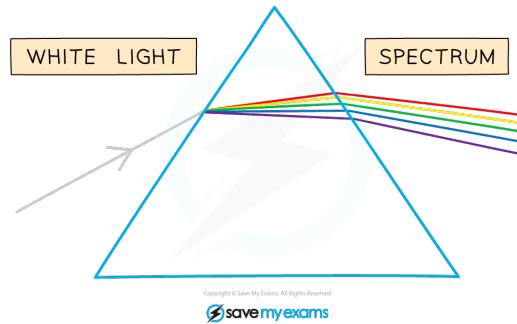
$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

- Refractive index
- $$n = \frac{\sin\theta_i}{\sin\theta_r} = \frac{SpeedOfLightInAir}{SpeedOfLightInMaterial} = \frac{1}{\sin\theta_c}$$

$$\theta_c = CriticalAngle$$

- Misc
 - * Optical density ↑, refractive index ↑

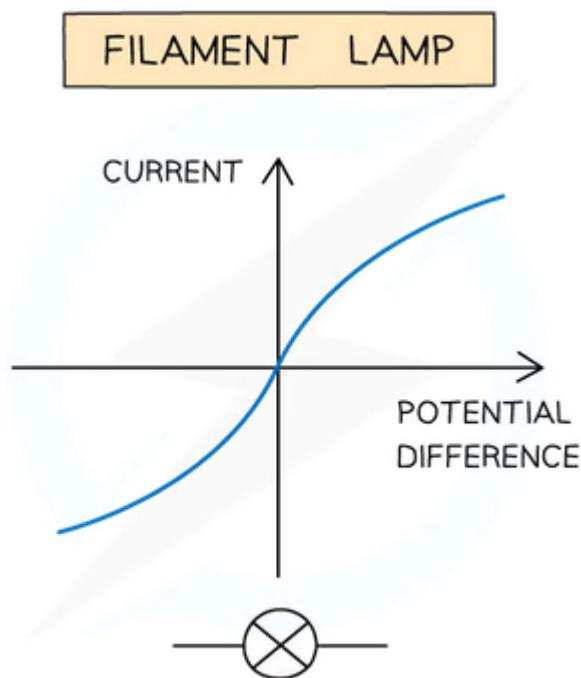
- White light dispersion



- Dispersion
 - * Definition
Separation of white light into a spectrum through refraction
 - * Explanation
 - Red: Longest wavelength
So it is refracted the least
 - Violet: Shortest wavelength
So it is refracted the most
- Misc
 - More optically dense to less
Light refracted away from normal
 - Less optically dense to more
Light refracted towards normal

2.5 Electricity

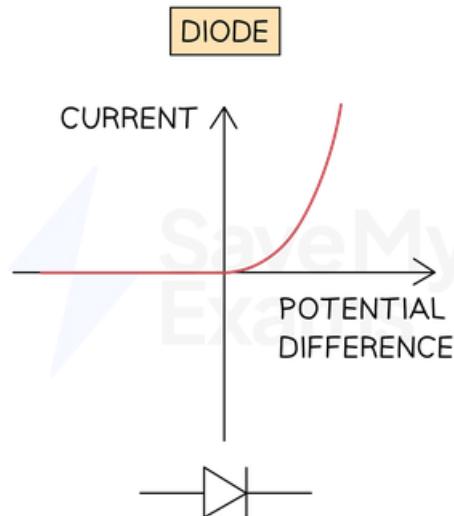
- Filament lamps
 - As heat \uparrow , resistance \uparrow
- Resistance, voltage and current calculation $I = \frac{V}{R} = \frac{Q}{t}$ E.M.F. $= \frac{W}{Q}$ $P = IV$ $E(\text{transferred}) = ItV$
 - Ohm's Law $R = \frac{V}{I}$
- Current-voltage graphs
 - Filament lamp
 - * Kind of looks like a sine wave
 - * As voltage gets further from 0
The current rises less and less



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- Diode

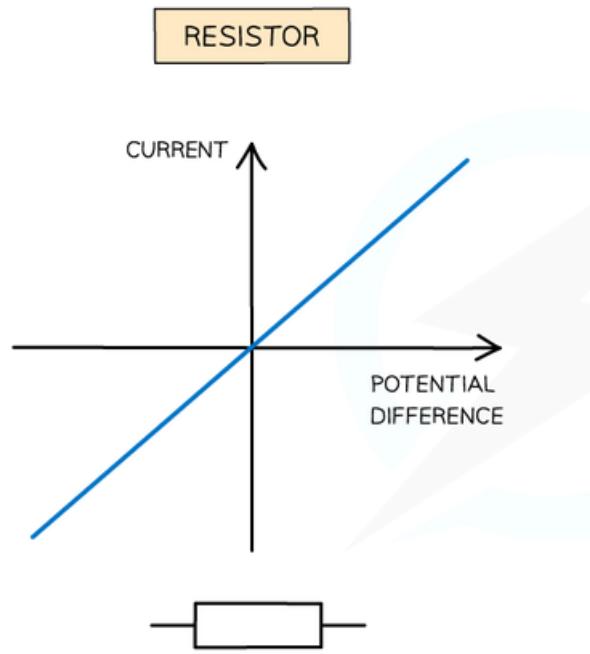
- * Like an exponential graph with an asymptote at $y = 0$
- * The y can only change at one side of the y -axis



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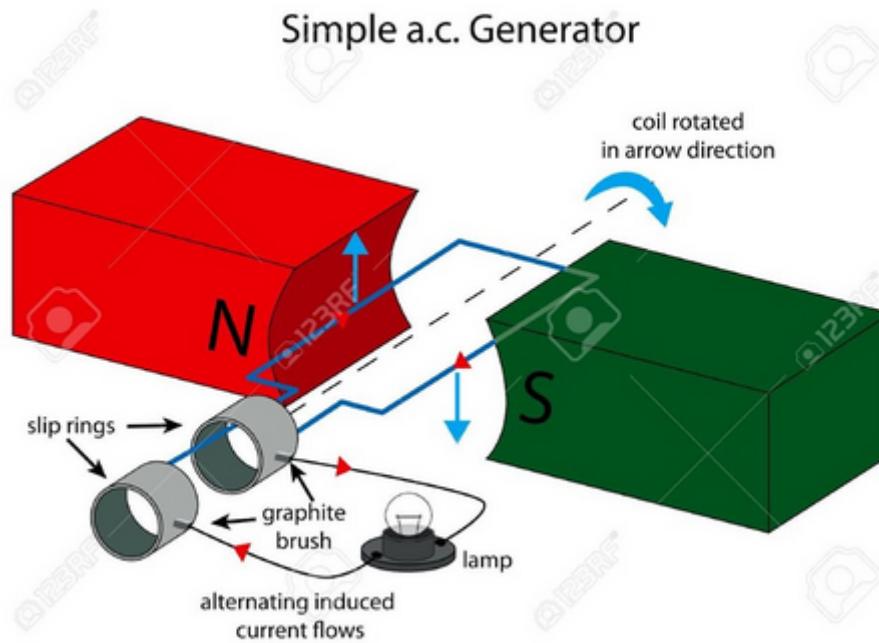
- Constant resistor

- * Looks like $y = mx$



2.6 Electro-magnetism

- Simple A. C. generator



- Fleming's right hand rule
- Components
 1. Coil
Spun so it cuts the magnetic field lines
 2. 2 slip rings & brushes
So the contacts are always connected
 3. Magnets
Generates the magnetic field lines
- Investigating electro-magnetic induction
How does a magnet induce an electric current?
 - When a conductor cuts the magnetic fields

2.7 Radioactivity

- Applications of alpha, beta and gamma radiation
 1. Household smoke detectors
 2. Irradiating food to kill bacteria
 3. Sterilisation of equipment using gamma rays
 4. Measuring and controlling thicknesses of materials
e.g. In paper making
 5. Diagnosis and treatment of cancer using gamma rays

- Define ionisation and how does each particle(alpha, beta, gamma) ionise?

	Alpha	Beta	Gamma
Penetration(stopped by)	Low(paper)	Medium(aluminium)	High(lead)
Ionising power	High	Medium	Low

- Ionising power

The higher the ionising power the more likely the emission is to remove electrons from the atoms it collides with.

How strong the ionising power is based on the energy and charge of the emission

1. Alpha has the highest mass(2) and charge(+2), so it has the highest ionising power
2. Beta has no mass but a -1 charge, so it has moderate ionising power
3. Gamma has both no mass and no charge, so it has very weak ionising power

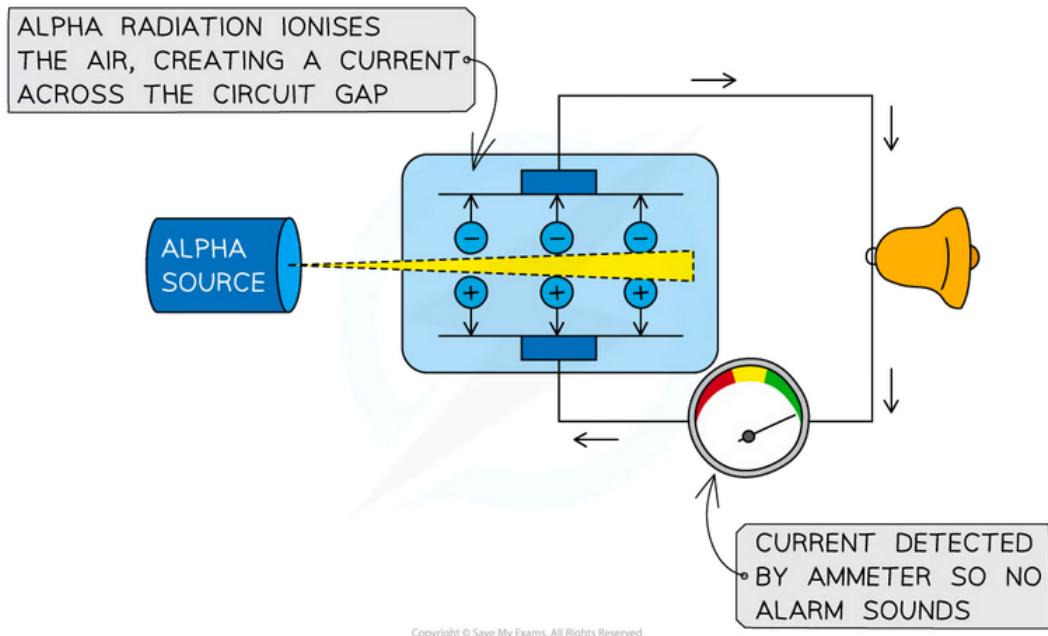
- Penetration power is the ability of an emission to go through a substance

It depends on the size and mass of the emission

* Lead can absorb all emissions

- Smoke detectors

How they work?



1. There is an alpha emitter in the smoke detector
2. The emitted alpha particles ionise the air and generate a current
If the current is detected, the alarm doesn't sound
3. When smoke enters the detector, it attaches to the air ions and makes them uncharged
4. The current drop prompts the alarm to start ringing

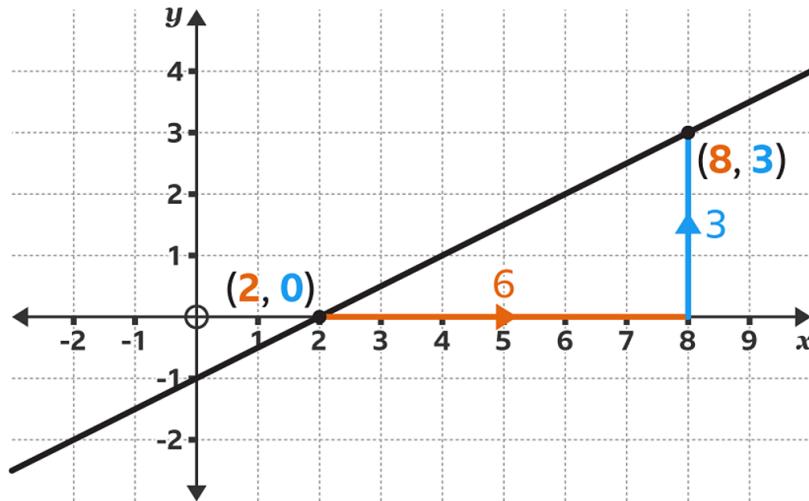
2.8 Space Physics

- Orbital speed calculation $Speed = \frac{2\pi \times AverageRadiusOfOrbit}{OrbitalPeriod}$
- Life cycle of a star
 1. Nebula
Clouds of gas and dust with hydrogen
 2. Protostar
When the gravity pulls the gas and dust together
The GPE is turned into thermal E
 3. Main sequence star
When forces of attraction and expansion(from nuclear fusion) equal out and the star becomes stable
The fusion creates heavier elements from hydrogen and helium
 4. Red Giant
When the helium and hydrogen runs out it becomes cold and red and starts to swell
If it is large enough it becomes a red supergiant
 5. Death
 - For red giants
Red giant → White dwarf → Black dwarf
 - For red supergiants
 - * Shrinks then explodes(supernova)
 - * Outside dust and gas leave
 - * The rest collapses into a neutron star
If it is large enough it becomes a black hole
 6. Second generation stars
Stars made from the dust and gas from the supernova of dead stars
- Misc
 - Constants
 - * 1 light year = $9.5 \times 10^{15} m$
 - * Diameter of milky way = 100, 000 light years
 - * Hubble constant $H_0 = 2.2 \times 10^{-18}$
 - Its equation $H_0 = \frac{v}{d}$
v is velocity the galaxy is moving away from Earth
d is the distance from Earth
 - Age of the universe $\frac{d}{v} = \frac{1}{H_0}$

3 Paper 6

3.1 Misc

- Calculating gradient
 - Use the triangle method

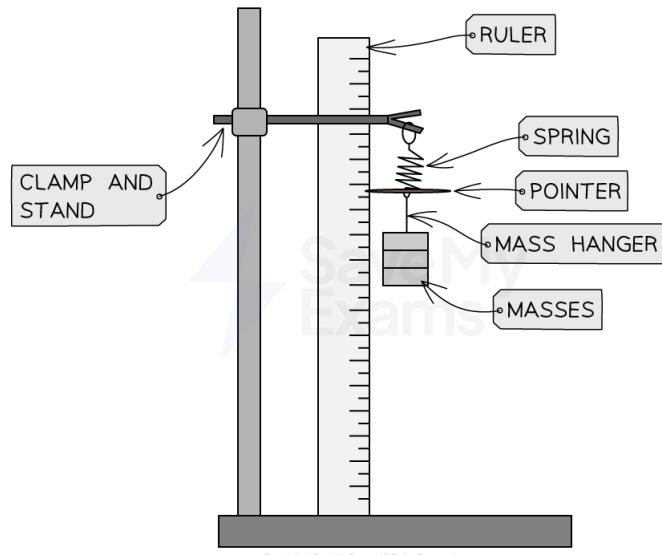


1. Form a triangle with the 2 furthest points on the graph
 2. Measure the change in x and y
 3. Calculate the gradient
- Read measuring cylinders from the bottom of the meniscus

3.2 Forces

- Hooke's Law
 - Definition
The extension of an elastic object is directly proportional to the force applied, up to the limit of proportionality
 - Calculation $F(N) = k(\frac{N}{cm})x(cm)$
 k = Spring's constant ($\frac{N}{cm}$), x = extension
 - Limit of proportionality
As you increase the force on a spring, there is a point at which the extension is no longer proportional (doesn't follow Hooke's Law)

- Experiment



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* Materials

1. Clamp and stand
2. Ruler
3. Spring
4. Masses
5. Pointer

* Process

1. Set up the apparatus according to the diagram
2. Measure the natural length(no load) of the spring with the ruler
3. Add mass to the spring and measure the new length
Get the extension length by subtracting the natural length with the new length
4. Repeat with all masses

* Possible errors

1. Parallax error

If your eye is not perpendicular to the spring and ruler, it will give a false reading

3.3 Electricity

- Resistance of a diode

How is it different to a filament lamp?

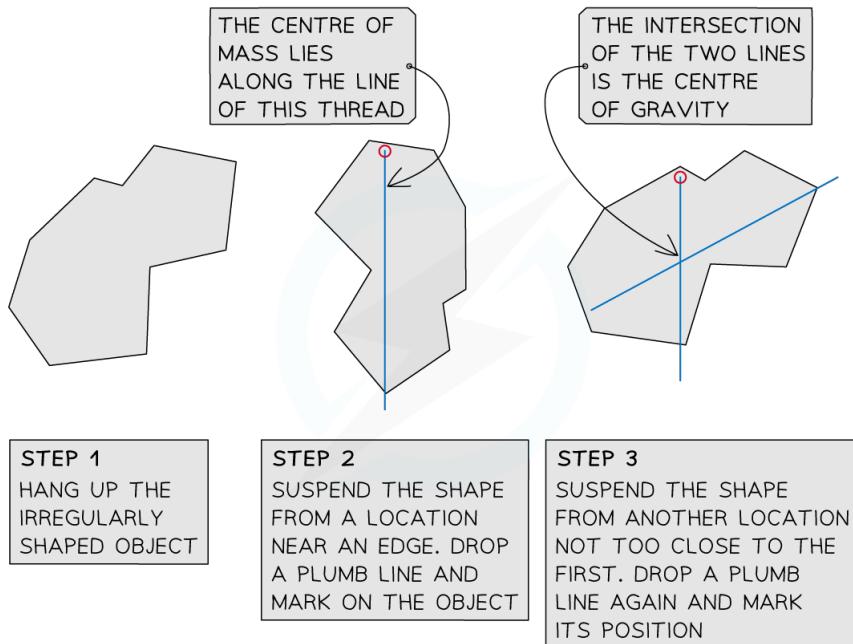
- A diode has very high resistance in only one direction
- A filament's resistance increases as the temperature increases
 - * High current causes the lamp to heat up

- Draw circuit

Remember the symbols

3.4 Planned experiment

- Moment & centre of gravity
 - Investigating the centre of gravity of objects



* Materials

1. Plane lamina
To be investigated
2. Plumb line
3. Pencil

* Process

1. Suspend the plane lamina and the plumb line from the same pivot
2. Draw a line along the line on the lamina
3. Suspend again from another point
4. Draw a second line along the line
5. The intersection between the lines as the centre of gravity