General Physics

Formula in Symbols	Formula in Words
$v = d / t$	**speed = total distance / total time**
$w = m \times g$	**weight = mass x acceleration of gravity**
$a = v / t$	acceleration = change in speed / change in time
$d = m / v$	**density = mass / volume**
$F = m \times a$	force = mass x acceleration
$x = k \times F$	extension = a constant x load
$W = F \times d$	work = force x distance
$p.e. = m \times g \times h$	potential energy = mass x acceleration of gravity x height
$k.e. = \frac{1}{2} \times m \times v^2$	kinetic energy = ½ x mass x velocity squared
$e = Eout / Ein \times 100\%$	energy efficiency = energy output / energy input x 100%
$E = W$	**energy used = work done**
$E = m \times c^2$	energy of a nuclear reaction = mass x speed of light squared
$P = E / t$	power = energy / time

Physics of Waves

Formula in Symbols	Formula in Words
$c = f \times \lambda$	speed of a wave = frequency x wavelength
$i = r$	**angle of incidence = angle of reflection**
$n = \sin i / \sin r$	index of refraction = sine of incident angle / sine of refracted angle

Electricity and Magnetism

Formula in Symbols	Formula in Words
$I = Q / t$	current = charge / time
$R = V / I$	**resistance = potential difference / current**
$R = k \times l / A$	resistance = a constant x length / cross sectional area
$R = R_1 + R_2$	**resistances in series add together**
$1 / R = 1 / R_1 + 1 / R_2$	reciprocals of resistances in parallel add together
$I = I_1 + I_2$	currents in parallel add together
$I_{in} = I_{out}$	total current into a point = total current out of a point
$V = V_1 + V_2$	voltage of source = sum of all voltage drops in a circuit
$P = I \times V$	power used in an electric circuit = current x voltage
$E = I \times V \times t$	energy used in an electric circuit = current x voltage x time
$\frac{V_p}{V_s} = \frac{N_p}{N_s}$	**voltage in primary coil / voltage in secondary coil = number of turns in primary coil / number of turns in secondary coil**
$V_p \times I_p = V_s \times I_s$	power in primary coil = power in secondary coil (for a perfect transformer)
$V = w/Q$	
$Q = I t$	
$W = V \times I \times t$	
$P = V \times I$	
$P = I^2 \times R$	
$P = V^2 / R$	

Sp Heat Capacity

$Q = m \times c \times \Delta t$

$P t = m \times c \times \Delta t$

$V I t = m \times c \times \Delta t$

Thermal Capacity = $m \times C$ Or $= Q / \Delta t$

Sp Latent Heat of Fusion

$Q = m \times Lf$ or $P t = m \times Lf$

$VIt = m \times Lf$

Sp Latent Heat of Vaporisation

$Q = m \times Lv$ or $Pt = m \times Lv$

$V I t = m \times Lv$

PHYSICS NOTES REVISION.

1.General Physics

1.1 Length and time

The Use of rules to measure length

Submultiples of m

1cm=10^{-2} m

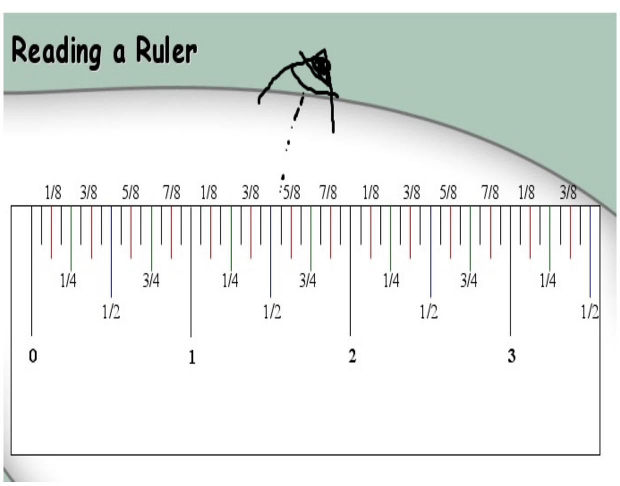
1mm=10^{-3}m

1um=10^{-6} m

1nm= 10^{-9} m

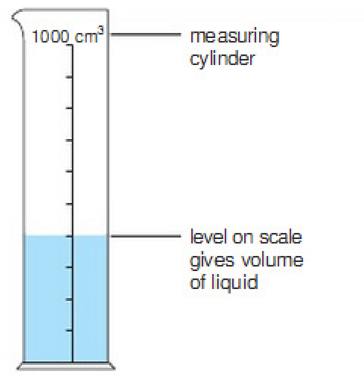
1km=1000 m

How measurements are done:

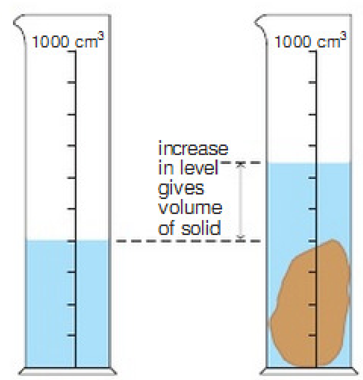


Stare directly above a ruler

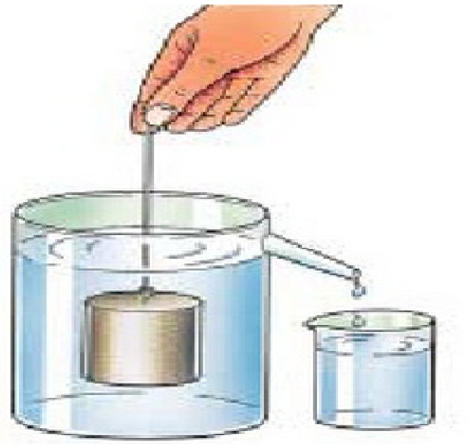
The use of measuring cylinder for volume



Measuring the volume of a liquid



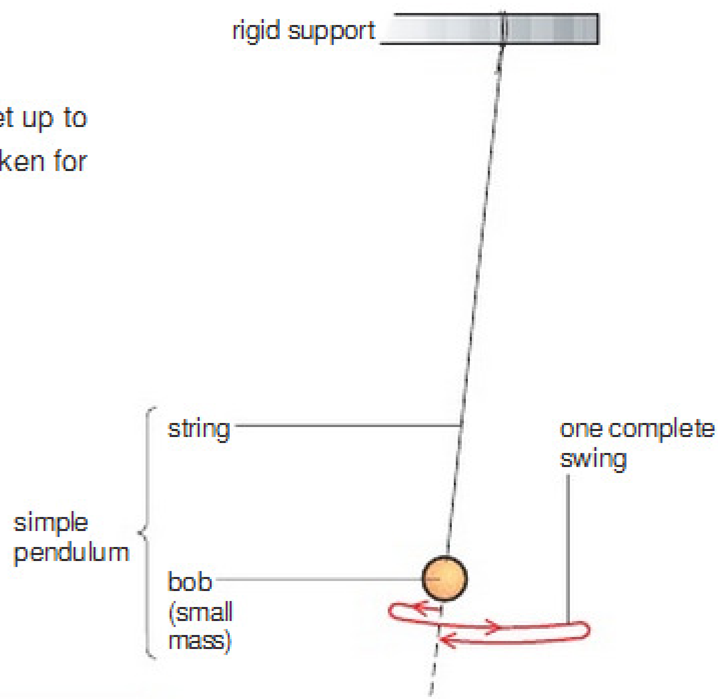
Measuring the volume of a small solid



Using a displacement can. Provided the can is filled to the spout at the start, the volume of water collected in the beaker is equal to the volume of the object lowered into the can.

Measuring Time: Instruments are the stop clock or stopwatch

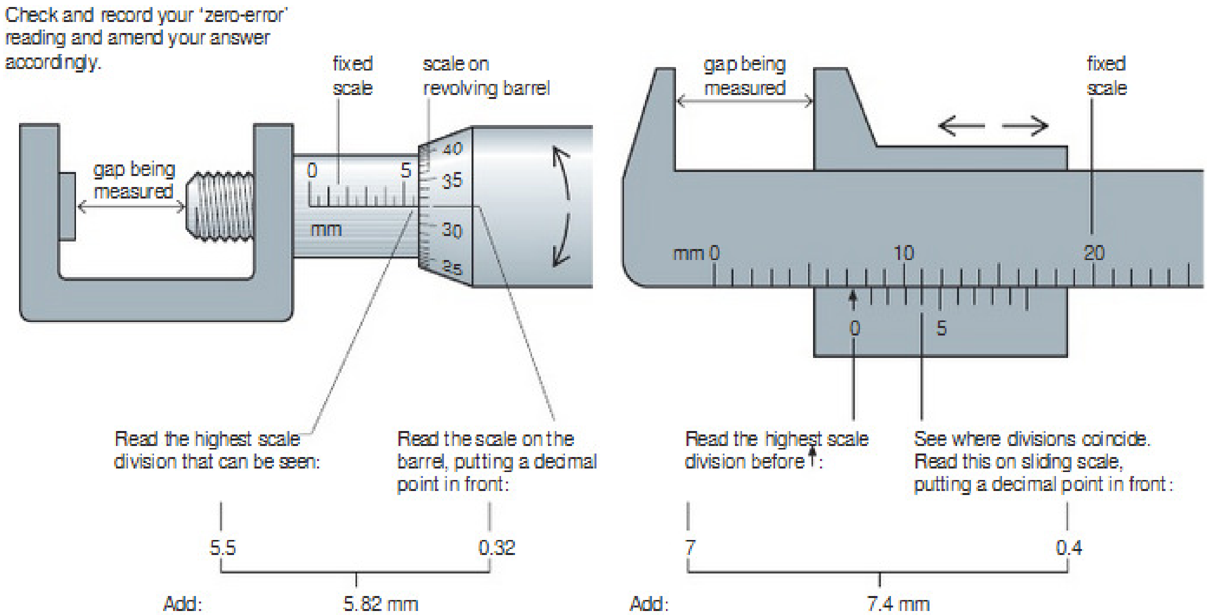
A pendulum can be set up to investigate the time taken for a single swing.



The pendulum above takes about two seconds to make one complete swing. Provided the swings are small, every swing takes the same time. This time is called its **period**. You can find it accurately by measuring the time for 25 swings, and then dividing the result by 25. For example:

Time for 25 swings = 55 seconds

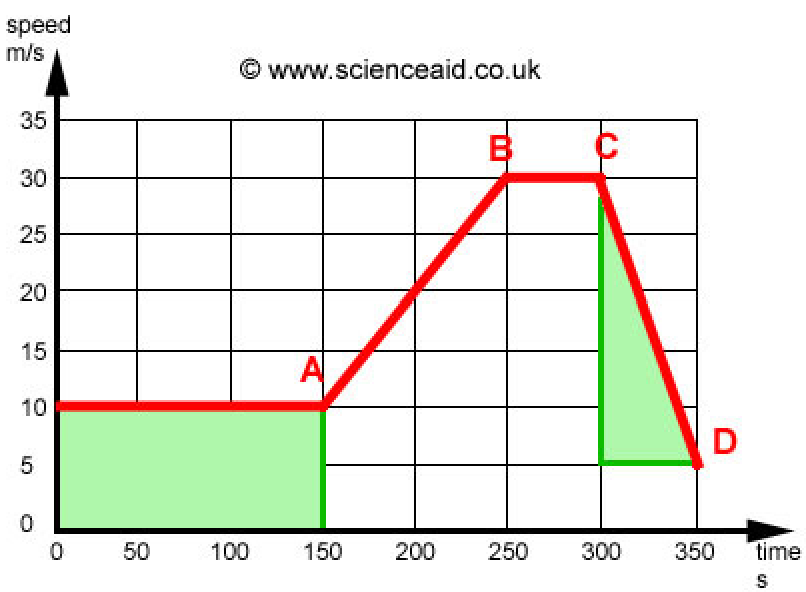
So: time for 1 swing = 55/25 seconds = 2.2 seconds



1.2 Speed, velocity and acceleration

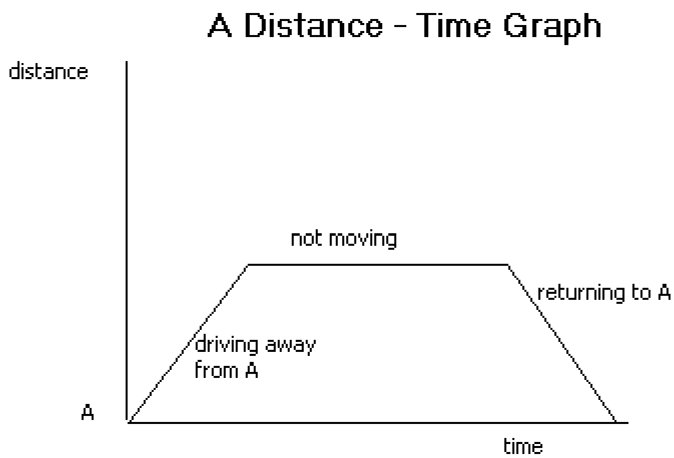
Speed is the distance travelled in unit time.

Speed-time graphs



Start to Point A- Constant speed To find distance- find area under graph

A to B- Uniform Acceleration- To find acceleration find its slope or gradient



Driving away from A is Constant speed

Then the body is at rest or not moving

EQUATIONS OF MOTION

When a (acceleration) is a constant:

V=u+at

S=(u+v)t/2

V2=u2+2as

S=ut+1/2at^2

Acceleration of free fall= Any body falling under the effect of gravity alone will fall down at a constant and uniform acceleration is called acceleration of free fall. Value- $10m/s^2$

What is Terminal Velocity?

As a body falls from a particular height the air resistance opposing it increases as its speed increases, thus its accelerations falls. Gradually, the air resistance increases and eventually its value will match the value of the object's weight or gravitational force. **(Air resistance=Weight)** The resultant force is zero so the body will travel at a constant velocity called terminal velocity.

Value of Terminal Velocity differs.

Depends on: weight, size and shape.

Example 1: A small dense object.

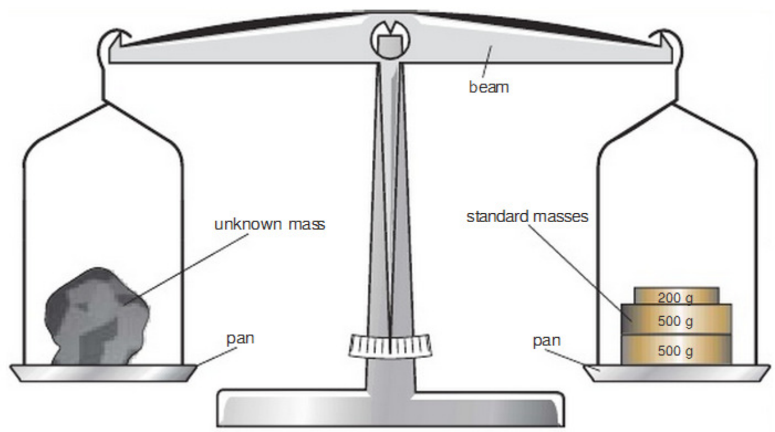
It will have a high terminal velocity as it will travel a longer distance before air resistance equals its weight.

Example 2: A light object with larger area

It has a low terminal velocity as it will travel a shorter distance before air resistance equals its weight.

1.3 Mass and weight

Comparing masses



The above **beam balance** balances when we add an object to one pan and more objects of known mass to the other pan. The balance actually compares the weights i.e. gravitational force on both the pans. Since the pans balance when both weights are equal, the masses should also be equal. So both mass and weight can be compared at the same time using the beam balance.

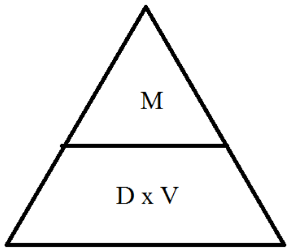
What is mass?

1. It is the amount of matter in a substance.
2. Mass can be related to inertia, which is the resistance of the body or its inability to a change in velocity and motion.

What is weight?

1. Weight is the gravitational force of the earth acting on a body.
2. "g" can be of two meanings. Firstly it is the gravitational field strength that is the force of gravity acting on unit mass of a body that is at rest (g=10 kg/N). Secondly it is called acceleration of free fall that is the uniform acceleration of a body falling under effect of gravity alone (g=10 m/s^2). Both are denoted by the letter "g".

1.4 Density



Density is defined as the mass per unit volume.

1 g/cm^3=1000 kg/m^3

Determining density

1. **Liquid**
   a. **Use a measuring cylinder to find the volume.**
   b. **Use a balance to get the mass.**
   c. **Use the formula to get the density. D=m/v**

2. **Regular solid**
   a. **Use a ruler to measure the necessary dimensions. Then use correct formula to get the volume.**
   b. **Use a balance to get mass.**
   c. **Use d=m/v to get the density**
3. **Irregular solid**
   a. **Use a balance to get the mass.**
   b. **Pour water to the measuring cylinder. Note initial volume, then add the solid inside and measure final volume. Find the difference between both, which is the volume of the solid.**
   c. **Or just use the displacement method.**

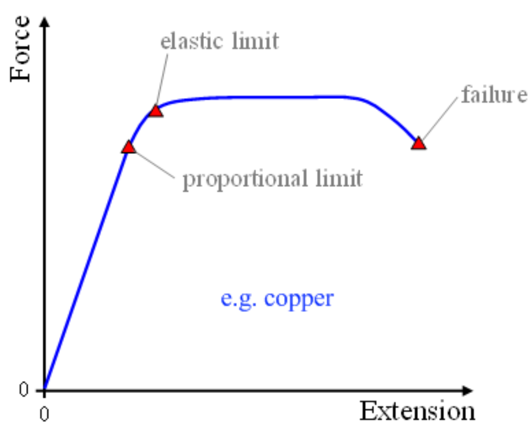
d. **Use d=m/v to get the density.**

1.5 Forces

a)Effects of forces.

- Forces acting on an object may cause a change in its size and shape.
- A force can change the speed and direction of a moving object.
- On force-extension graphs the stretching force is plotted in the y-axis while the total extension on the x-axis.
- F=ma

To interpret Force-extension graphs:

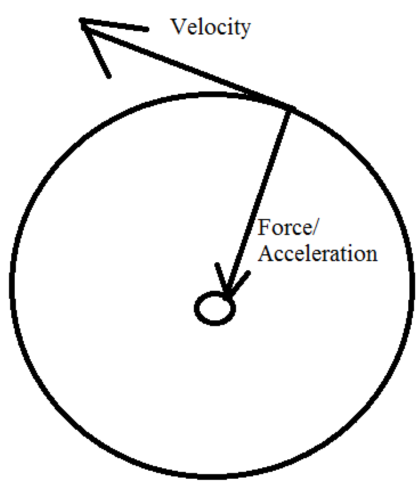


- This shows a spring stretched beyond its elastic limit
- Extension means difference between stretched and unstretched lengths
- Hooke's Law applies here. It states that stretching force and extension are both proportional only if the elastic limit is not exceeded.
- In the proportional limit, removing the load, returns the spring to its origin length.
- Beyond the elastic limit, at any point where we remove the load the spring will not return to its original length.

Important points about Hooke's Law

- Extension and stretching force are both proportional to each other as long as the elastic limit is not exceeded.
- For force-extension questions use the formula: F=kx
- Where "k" is the force constant which can be found from two other readings F and x. X is the extension.

Circular motion



- Motion along a circular path is Circular Motion.
- It is an accelerated motion because velocity keeps changing i.e. direction of speed changes.
- This acceleration is called Centripetal acceleration.
- The force needed to move an object in a circular path is called centripetal force.
- Both centripetal acceleration and force act inwards and towards the centre of the circular path.
- The force depends on mass of the mass and speed of the object, and the radius of the circular path.
- Different type of forces causes centripetal force on the object:

a. Frictional force gives the force between road and tire of the car.
b. Tension of the string gives the centripetal force to move a stone in a circle

If an object is released from the circular path it will move through the tangent.

b) Turning Effect

Moment of a force is a measure of its turning effect. It is measured by multiplying the force into the distance from a pivot or fulcrum.

Examples include **balancing pans in a beam balance.**

A beam is normally balanced when:

1. The weights on both pans are same.
2. Same mass.
3. Equal distance from the pivot.
4. So in the end the clockwise moment is equal to the clockwise moment.

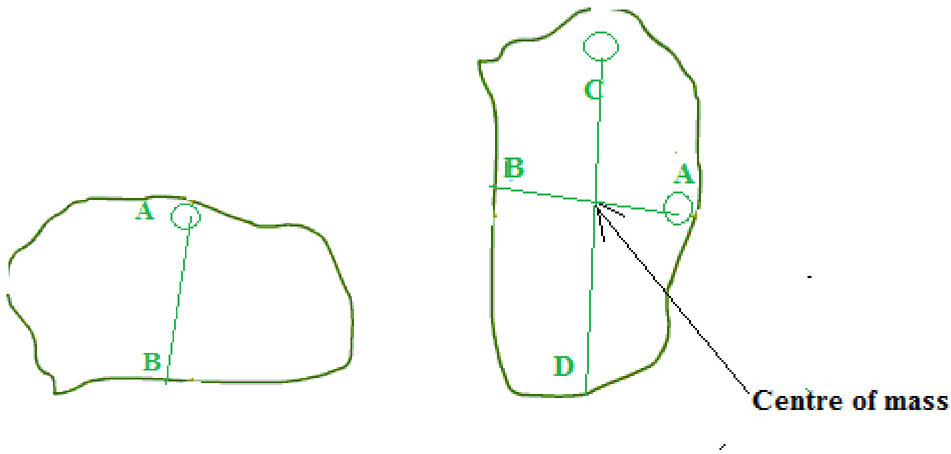
All equilibrium systems follow the Law of moments which says:
When a system is in equilibrium the sum of clockwise moment equals the sum of anticlockwise moment about the same pivot.

C)Conditions for equilibrium to occur:

1. Sum of the forces in one direction equals the sum of forces in the opposite direction.
2. Law of moments should apply.

d) Centre of Mass

Centre of mass of a plane lamina (Very important for Paper 6)



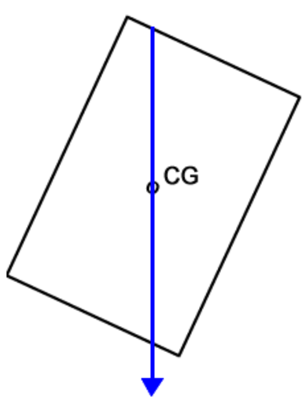
1. Make a hole in the lamina.
2. Hang it so it can swing freely.
3. Hang a plumb line in the hole and mark the line it passes through.
4. Repeat the procedure again to get another line
5. Their intersection point is the centre of mass.

Stability of simple objects

The position of the centre of mass affects its stability. If the centre of mass of an object is low, it is less likely that will tip over if we tilt it. To increase stability we should:

1. Increase surface area
2. Making the object shorter.

How to know if an object will not tip over after tilting them?



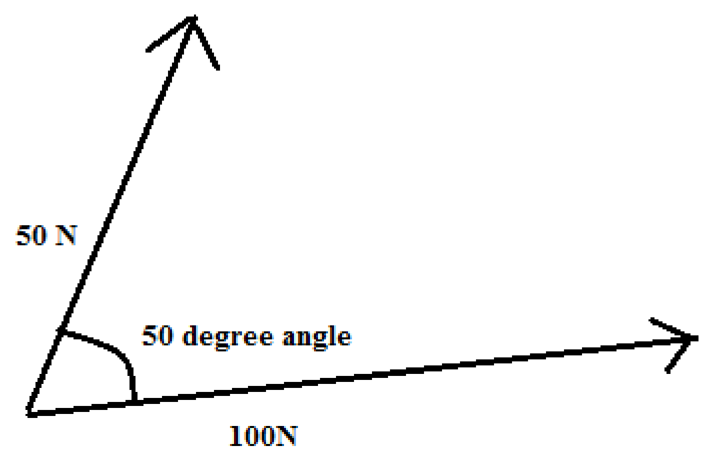
The vertical line through the centre of mashould be within the base.

e) Scalars and vectors

Difference

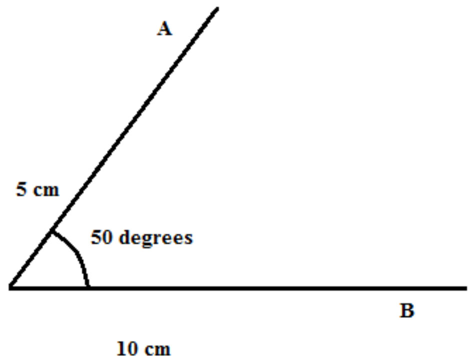
Scalar	Vector
Has a magnitude.	Has a magnitude.
No direction.	Direction present.
Eg: distance, speed	Eg: Force,weight,velocity

Resultant of two vectors

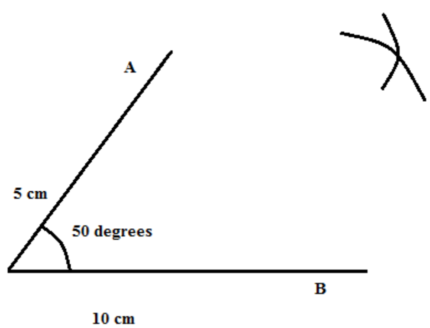


We should use the Parrallogram law:

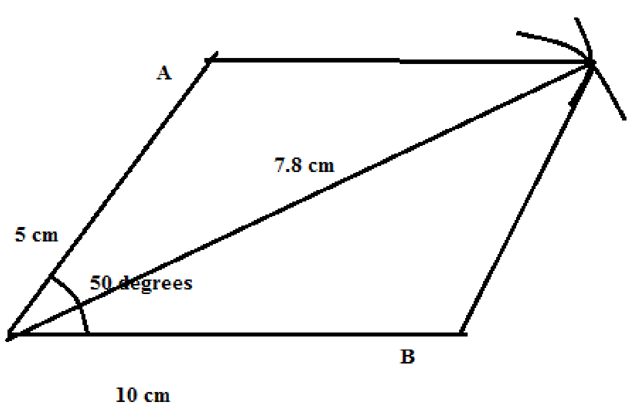
1. Give a suitable scale to the forces such as 10 N= 1cm. So 50 N will be 5 cm and 100 N will be 10 cm.



2. Draw the two lines using the suitable scale given with the correct angle in between in graphical form (on paper).
3. Using a compass with 10 cm wide length, place the needle on the point A, and draw an arc.
4. Change the compass to 5 cm and make a 5cm wide length and place it on point B. Draw another arc.



5. Draw a line through point A to the intersection point of the arc. And draw another line through point B to the arc. So now we got a complete parellogram.
6. Draw the diagonal from the intersection point of the two arcs to the centre of the angle 50 degrees.
7. Measure the diagonal. Convert the length to Newton. That is the resultant force.
8. The direction will be stated as **"making an angle X^0 with the force 100 N"**



1.6 Energy, work and power

a)Energy

Kinetic Energy: An energy possessed by a body by the virtue of its motion.

K.E= $\frac{1}{2} mv^2$

Potential energy: An energy possessed by a body by the virtue of its position.

P.E=mgh

Different forms of energy

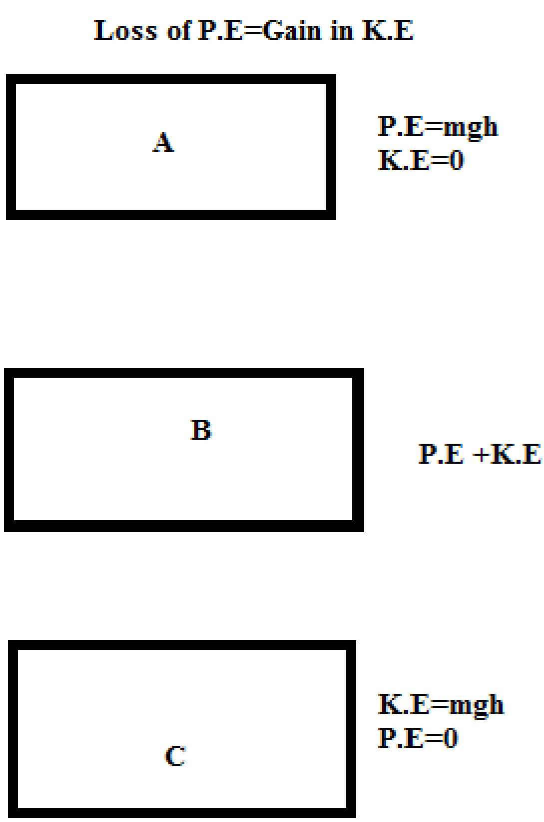
a) Kinetic energy
b) Gravitational potential energy (a form of potential energy)
c) Chemical energy
d) Elastic potential energy (a strained condition of potential energy)
e) Nuclear energy
f) Internal energy
g) Electrical energy
h) Light/ heat energy
i) Sound energy

Conversion of energy

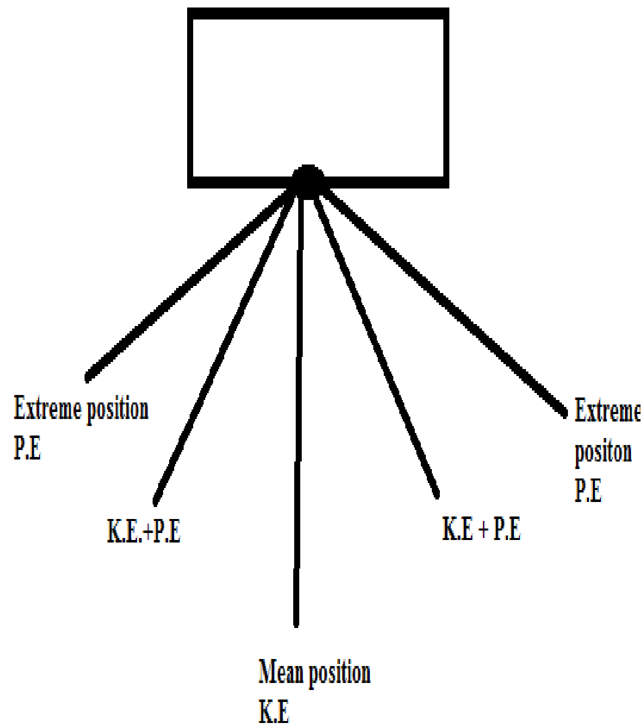
Energy is not lost, but is converted from one form to another.

Law of Conservation of energy

Energy cannot be created nor destroyed. If it disappears, it converts to another form in which the total energy is still the same.
Examples include:



A falling body



Swinging
pendelum

b) Energy Resources

Renewable and Non renewable resources

Renewable sources of energy are natural sources of energy which can be replaced and be used over and over again. Non-renewable sources of energy are natural sources which cannot be replaced and so once using it, there is no more use of it in the future.

Obtaining useful forms of energy

Fossil fuels- The fuels are burned in a thermal power station which in turns heat up the water in a boiler and turns it to steam. The steam drives the turbines which in turn drives the generator that generates electricity.

Chemical energy→Heat energy→Kinetic energy→Electrical energy

Water-They are used in Hydroelectric power stations. The water is stored behind dams, found in a large water reservoir. When the dam is opened so water moves which rotates a turbine which in turn drives a generator to create electricity.

Potential energy→Kinetic energy→Electrical energy

Geothermal energy: If water is pumped into the hot rocks down the earth they can be heated to steam. This steam can drive a turbine and in turn allows a generator to generate electricity.

Nuclear energy: The radioactive materials are decomposed by nuclear fission and so they release heat that boils water in a boiler. The steam drives the turbine and so electricity is generated by the generator.

Nuclear energy→Heat energy→Kinetic energy→Electrical energy

Solar energy: Solar cells convert light energy directly to electrical energy.

Light energy→Electrical energy

Advantages and disadvantages

A. **Fossil fuels**

Advantages:

1. High energy density
2. Ready availability
3. Small size of energy transfer device

Disadvantages:

1. Non Renewable
2. Causes air pollution by waste gases CO_2 and SO_2

B. **Nuclear fuels**

Advantages:

1.Ready availability

2.High energy density

3.Does not cause air pollution with CO_2 and SO_2.

Disadvantages:

1. Expensive to build and to decommission
2. Wastes from fuels are very dangerous and will stay reactive for many years.
3. High safety standards are needed.

Renewable Resources advantages: They are renewable so it can be replaced. And they do not pollute the atmosphere.

Disadvantages:

Solar energy:

1. It is not always renewable

2. Low energy density

3. Expensive.

Wind energy:

1. Wind is variable.
2. Spoils landscape and is very noisy.
3. It needs a large site to build turbine towers

Wave energy: Difficult to build.

Hydroelectric energy:

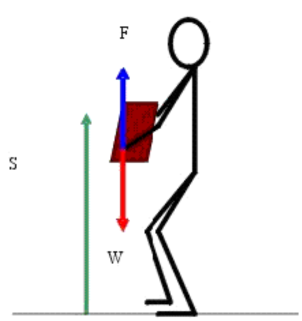
1. Expensive to build.
2. Not all sites are suitable
3. Can damage the environment

Geothermal Energy: Difficult and expensive to dig deep inside the earth.

Biofuel: Large sites are needed to grow enough plants.

c)Work

Work is done when a force moves an object through a particular distance. When a work is done energy is being converted to another form.



Work= Force x Distance

Unit=Joules.

e) Power

Power is defined as the rate at which work is done.

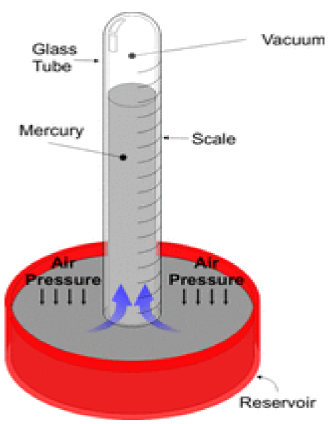
P = E/t

1.7 Pressure

Pressure is defined as the force acting on unit area. **Lower the surface area, the higher is the pressure. The higher is the surface area, the lower is the pressure.**

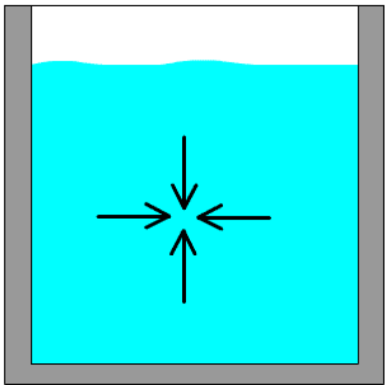
P=F/A

Mercury Barometer



The mercury barometer is used to measure the atmospheric pressure. It consists of a glass tube placed upside down on a reservoir. The entire device is filled with mercury. It works on the principle that the weight of the mercury should balance the atmospheric pressure. If its weight is less than the air, then it will rise so that it can balance itself with the air pressure. If it is more than the air, its level will reduce.

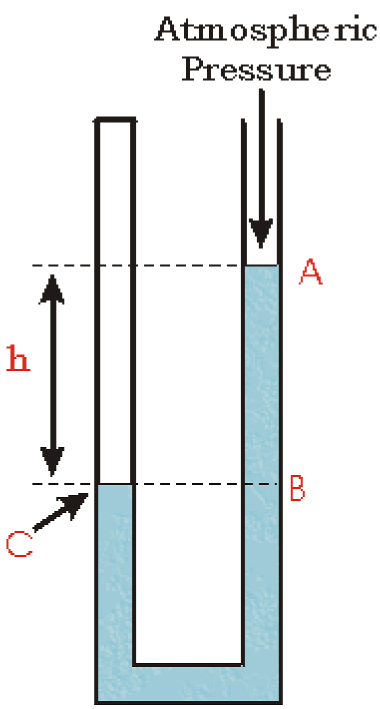
Liquid Pressure



Liquid pressure depends on both density and depth inside the liquid. Denser the liquid like oil, has higher pressure than a water. Deep sea divers face more pressure inside the water than when at near the surface.

So **p=hpg**

Manometer



A manometer is used to measure gas pressure. At first, the liquid levels will be the same, as atmospheric pressure is same. But when we add an extra supply of gas, the pressure will be different. Thus, the liquid will increase by a certain height. So the gas pressure will be=

Atmospheric pressure + pressure due to the liquid column AB

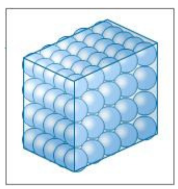
The pressure on the liquid column AB can be found by the formula hpg.

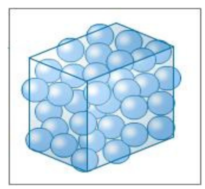
2.Thermal Physics

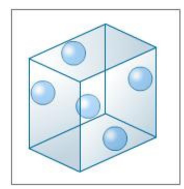
2.1 Simple kinetic molecular model of matter

(a) States of matter

Distinguishing features of solids, liquids, and gases.







Property	Solid	Liquid	Gas
Packing	Molecules are closely packed, arranged in regular pattern.	Loosely packed, so they are slightly further apart than in solids.	Molecules are much farther apart than in solids and liquids.
Shape	Definite shape	No definite shape. Takes shape of container.	No definite shape.
Volume	Definite volume	Definite volume	No definite volume
Movement	Vibrate in its place	Moves rapidly past each other in short distances	Moves quickly in all directions
Compress	Difficult.	Possible but only at a limit.	Easy to compress.
Forces	Attraction and repulsion both balance.	Weak force of attraction and repulsion.	No forces seen only when molecules are close.

Temperature of a gas

As a gas is heated, its molecules will gain energy and they will move faster in all directions. This means that their average speed and kinetic energy increases. So temperature can be said to be the measure of the average kinetic energy of molecules.

Pressure of a gas

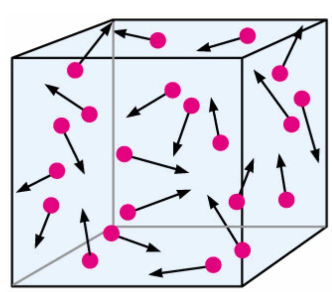
Molecules are in constant and rapid motion in gas, and so they collide with the walls of the container many times a second. So they will exert a pressure by giving an average force on a unit area.

Relations of temperature and pressure at constant volume

When the volume of a gas is kept constant, and there is a temperature increase in the gas molecules; the gas particles will move around at a greater speed with a great average kinetic energy, so there will be more number of collisions on the wall of the container per second. And so the pressure increases.

Formula= p/t= constant

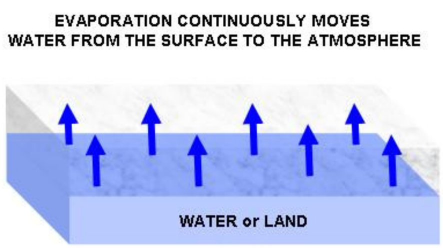
Brownian motion



Random motion of smoke particles when viewed under a microscope in a zig-zag manner. This is because of random collisions between smoke particles and molecules of air.

NOTE: Large and heavy particles can be moved by collisions with light and smaller particles like air.

c) Evaporation



Evaporation occurs when fast moving water molecules from the liquid surface escape to the atmosphere. The average kinetic energy of the liquid left behind falls. So the temperature of the liquid falls.

Factors:

Temperature: The rate of evaporation increases as the temperature increases.

Surface area: The greater the surface area, the more the molecules evaporate.

Humidity: The lower the humidity more is the rate of evaporation.

d) Pressure changes

Eg: Temperature of a gas in a container is kept constant, and then we half the volume of the gas by halving the volume of the container. The pressure will increase as there will be more molecules of gas per cm^3 so the number of collisions per second is more on the walls of the container.

Formula- pV=constant

2.2 Thermal properties

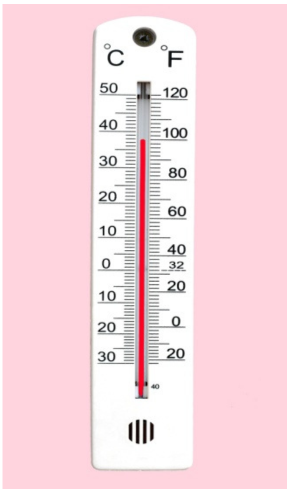
(a) Thermal expansion of solids, liquids and gases

Thermal Expansion: Most substances increase in size when heated. This is called thermal expansion. Remember= V/T=constant

Effect of temperature on volume: When the pressure of a gas is kept constant and temperature increases. The gas molecules will gain more kinetic energy so they move around at a much greater average speed at longer distances. So the gas will increase in volume

And so the volume of a gas is directly proportional to its temperature if the pressure is constant.

(b) Measurement of temperature



Properties of a thermometer:

The liquid must expand

Liquid must be easily seen

Liquid must not stick on wall of glass

Liquid must expand or contract rapidly and by large range of temperatures.

Fixed points of a thermometer

Fixed points on a thermometer are very important for finding the scale and unit of temperature. The two fixed points are:

Lower fixed point: The temperature of melting ice which is taken as 0^{o}C.

Upper fixed point: The temperature of pure boiling water which is taken at 100^{o}C.

Then the ranges between these points are divided into equal divisions called **degrees**. This means that the thermometer has now been **calibrated.**

Typical terms needed

Sensitivity: How easily the liquids expand from small changes in temperature.

Linear scale: Equal distance between each degree on the scale.

Range: The set of degrees between two points on the scale of a thermometer.

Thermocouple thermometers

This mainly consists of a digital thermometer that has two wires joint together. The wire are of two different metals kept at different junctions: hot and cold. Electrons start to flow through it and so give a reading on the meter.

This is used to measure large temperatures and rapidly changing ones.

(c) Thermal capacity

When the temperature of a body rises, this occurs when the internal energy increases. Internal energy means heat energy that is as the increase in both the kinetic and potential energy of molecules.

Specific heat capacity/ Thermal capacity: It is the heat energy needed to increase the temperature of 1 kg of an object by 1^oC.

$$Q=mc\Delta\theta$$

d) Melting and boiling

Melting is defined as the process in which a solid changes to a liquid by supplying it with heat energy. There is no temperature change during this process.

Melting point is the fixed temperature in which the solid changes to a liquid.

Boiling is the process in which liquid changes to a gas by supplying it with heat energy. There is no temperature change.

Boiling point is the temperature in which a liquid changes itself to a gas.

Latent heat of fusion and vaporization

Specific Latent heat of fusion: Is defined as the amount of heat needed to change a unit mass of a solid to liquid without a temperature change.

In terms of Kinetic theory: Latent heat of fusion is the energy needed by solid molecules to overcome the force of attraction between them and become a liquid. Their potential energy increases but not their kinetic energy so the temperature remains constant.

$Q-m \times l_f$

Specific latent heat of vaporization: Is defined as the amount of heat needed to change a unit mass of a liquid to gas without temperature change.

In terms of Kinetic theory: The latent heat of vaporization is defined the energy needed by liquid molecules to overcome their force of attraction and become a gas. An extra energy is needed to push back air molecules from atmosphere as it becomes a gas. Their potential energy remains the same but not their kinetic energy. So temperature is constant.

$Q=m \times l_v$

Differences between boiling and evaporation

Boiling-

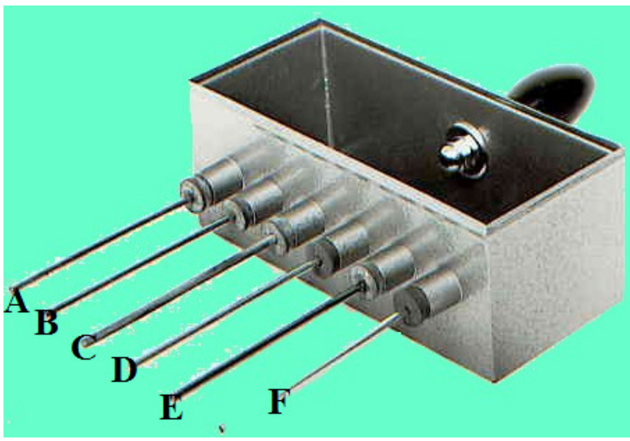
- Occurs only at a particular temperature called the boiling point
- Occurs throughout the liquid
- Bubbles are formed

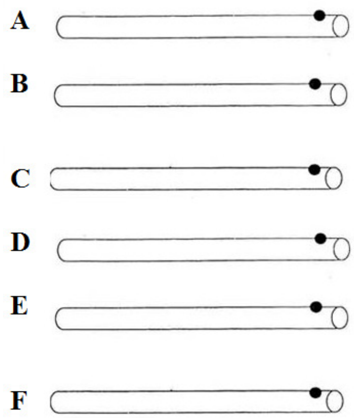
Evaporation-

- Occurs at any temperature
- Occurs only at the liquid surface
- No bubbles formed.

Conductors

Experiments demonstrating good and bad conductors





The Rod and Wax experiment

Suppose each of the rods A,B,C, D,E,F are made of different metals. A match if fixed to each end of the rods using a little piece of wax. The other ends are heated.

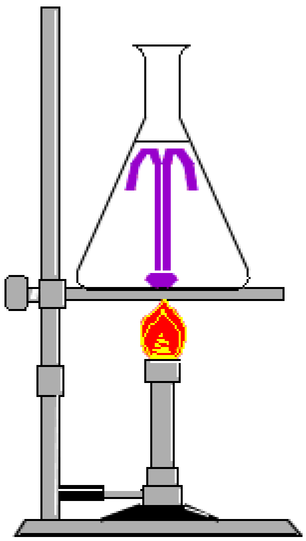
The result: The rod falls down from metal B. Because the end of B reaches the melting point of wax the match immediately falls off. So B is the best conductor of heat.

What causes conduction?

1. In metals: The free electrons of the warmer end move faster and so "jostle" atoms in colder areas. So the energy is passed, the kinetic energy of the atoms in the colder region have their temperature increased.
2. In non metals: The atoms in the region being heated move faster and collide with the atoms in the colder region. So they vibrate much faster and so the temperature in increases.

Remember: Heat always flows from hotter to colder regions.

Convection



Convection is a way of carrying heat in liquids and gases. Suppose we place potassium permanganate crystals in a beaker. And then we heat the beaker. The crystals will move upwards and downwards.

The streams of warm moving fluid are called **convection currents**. The convection currents rise when the fluid expands and becomes less dense. And falls down when the colder fluid is more dense.

The concept is same for all kinds of convection.

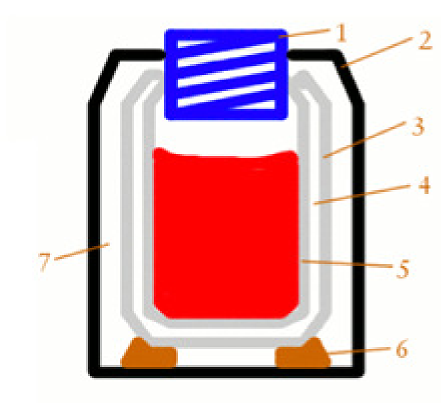
Radiation:

Flow of heat from one place to another by electromagnetic waves.

Good and bad absorbers/ Good and bad emitters:

Dull black surfaces are good absorbers and good emitters.

Shiny surfaces are bad absorbers and bad emitters. They are good reflectors.



Vacuum flask:

1→Stopper

2→Case

3→ Double walled glass vessel: Reduces conduction

4→Vacuum: Reduces conduction and convection

5→ Silvered surface: Reduces radiation

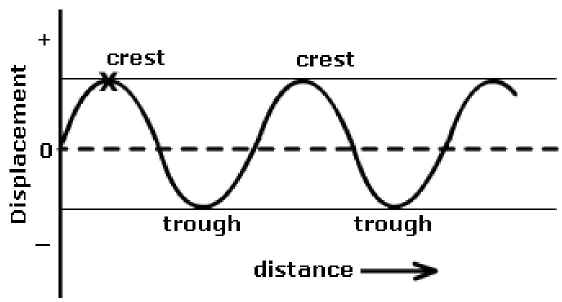
6→Felt pad

7→ Additional insulation

3.Properties of waves, including light and sound

Wave motion

Wave is a way of carrying energy from one place to another.



Components of a wave:

Crest- Upper tip

Trough-Lower tip

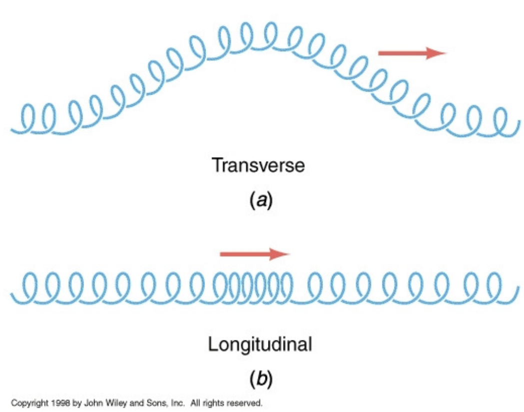
Wavelength- Distance between two crests or troughs

Frequency- Number of waves produced in a second

Speed- Distance moved by a crest or any point in one second.

Amplitude- Distance between undisturbed position with the crest or trough.

Type of waves



(a)Transverse wave: Moves perpendicular to the direction of wave

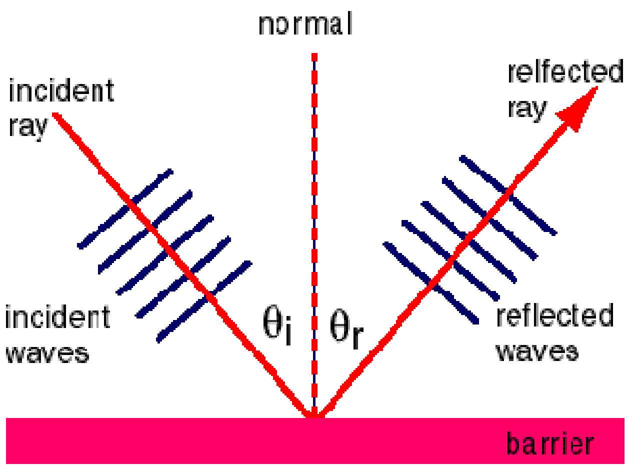
Example: Light waves

(b)Longitudinal wave: Moves parallel the direction of wave.

Example: Sound wave

Applying wave properties in a ripple tank

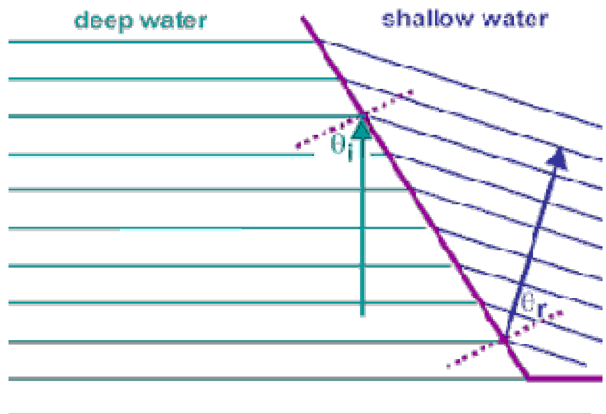
Reflection



Angle of incidence= Angle of reflection

The angle is measured by measuring the angle between the direction of the wave and the normal. Or the wavefront with the barrier.

Refraction

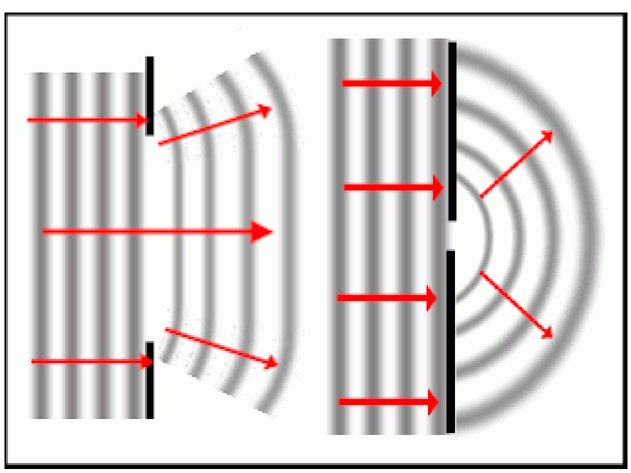


Deep water → Shallow water

(Longer wavelength) (Shorter wavelength)

(Higher speed) (Low speed)

So the direction of the wave is bent towards the normal.



Diffraction- The spreading of waves

(Left)- Waves are passing through a wide gap. There will be less spreading of waves.

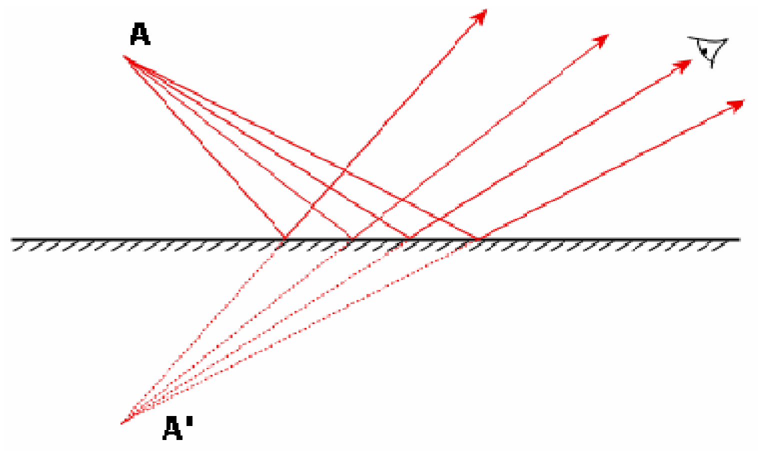
(Right) Waves are passing through a narrow gap. There will be more spreading of waves.

Remember for all waves : speed= frequenecy x wavelength

3.2 Light

Reflection of light

Optical images



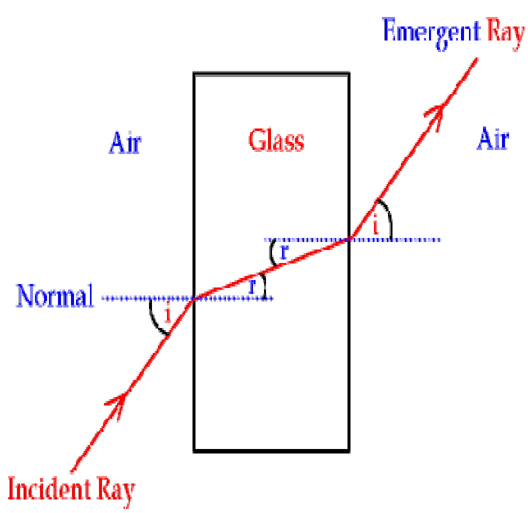
Virtual iamge: Image that cannot be formed on a screen.

Properties:

a.The distance of the image from the mirror is same as the object in front.
b. Same size as object
c. Laterally inverted

Angle of incidence= Angle of reflection

Refraction:



Refraction= Bending of light rays

From rarer (eg;air) to denser medium (eg: glass) the light rays bend towards the normal.

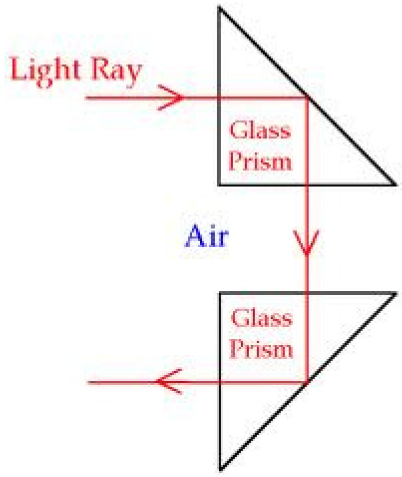
Reason: Speed is changing i.e the speed is less in the denser medium.

From denser (eg: glass) to rarer mediums (air) the light rays bend away from the normal.

Reason: Speed is changing i.e. the speed is more in the rarer medium.

The angle of incidence is equal to the angle of emergence!

Critical angle: The angle of incidence in a denser medium where the angle of refraction is 90°C.

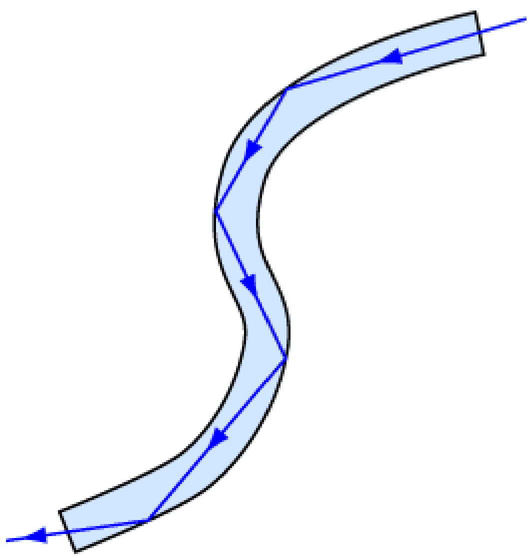


Total internal reflection: When the angle of incidence in the denser medium is greater than the critical angle and the incident ray is in the denser medium, the light ray reflects back in the denser medium.

Important points:

Refractive index=speed of light in air/speed of light in medium

Refractive index=sin i/sin r



Total internal Reflection in fibre optics (Important for Paper 3)

1. They are denser mediums surrounded by rarer mediums.

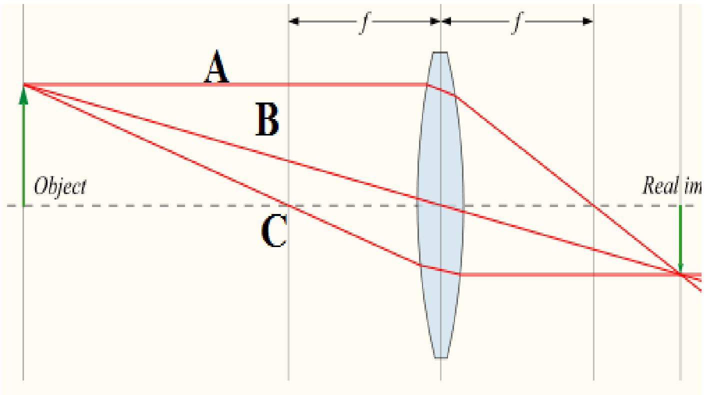
2. The light rays striking each boundary of the fiber is more than the critical angle so total internal reflection occurs. All the light rays are reflected back in the denser medium.

3. There will be multiple reflections till it reaches the other end of the fiber.

4. There are many fibers together to increase flexibility. This "flexibility" gives a more detailed image of the object.

5. When the light rays reach the other end, they get reflected back again to the fiber when they strike the object!

Thin Converging Lens



Three rays are needed to find the image:

A) A ray parallel to the principal axis (a horizontal access drawn through a lens) which is refracted through the principal focus.
B)A ray pass immediately through the centre of the lens without bending at all!
C) A ray passing through the principal focus and then bends. The ray will be parallel to the principal axis.

Two or more of these two rays will meet each other. A line is drawn from the intersection point straight/perpendicular to the horizontal axis.

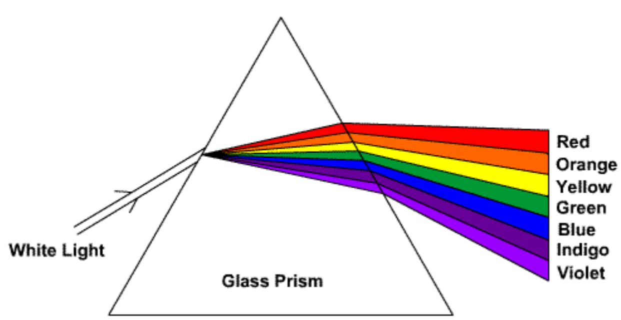
Principal focus: When a light ray parallel to the principal axis passes through a lens and bends. It touches a point of the principal axis called the Principal focus.

Focal length: The line between the focus and centre of a lens.

Images formed by a convex lens

Object position	Image position	Size	Upright or inverted	Real or virtual
Beyond 2F	Between F and 2F	Small	Inverted	Real
At 2F	At 2F	Same size	Inverted	Real
Between F and 2F	Beyond 2F	Larger	Inverted	Real
Between F and lens	Behind the object	Larger	Upright	Virtual
At F	At infinity	Larger	Inverted	Real

Light dispersion:



Dispersion is the splitting of white light into different colors of the rainbow. Remember them as VIBGYOR going backwards!

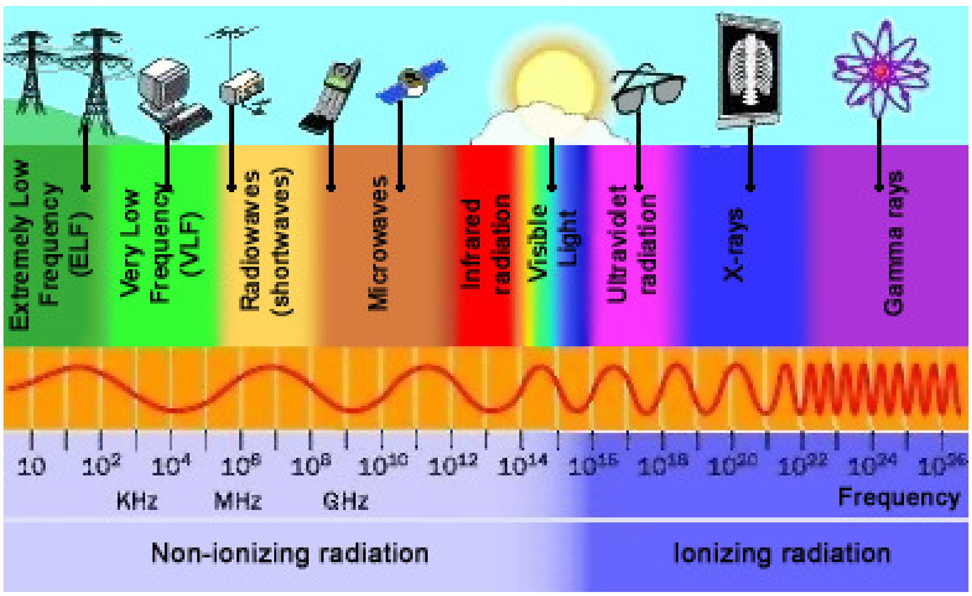
Violet bends the most because it has the highest refractive index.

Red deviates least!

Electromagnetic waves

Features:

1. Travels at 3×10^8 m/s
2. Uses the wave equation speed= frequenecy x wavelength
3. Are tranverse waves (moves perpendicular to the direction of wave)
4. Able to travel in a vacuum



What is needed to know:

1. As we go forwards the wavelength decreases
2. The frequency increases as we go forwards

Nothing else is needed to know but the names of the rays and their typical uses and basics:

Radiowaves -> Radio and television communication

Microwaves -> Satellite and telephones (Living cells are endangered from such rays)

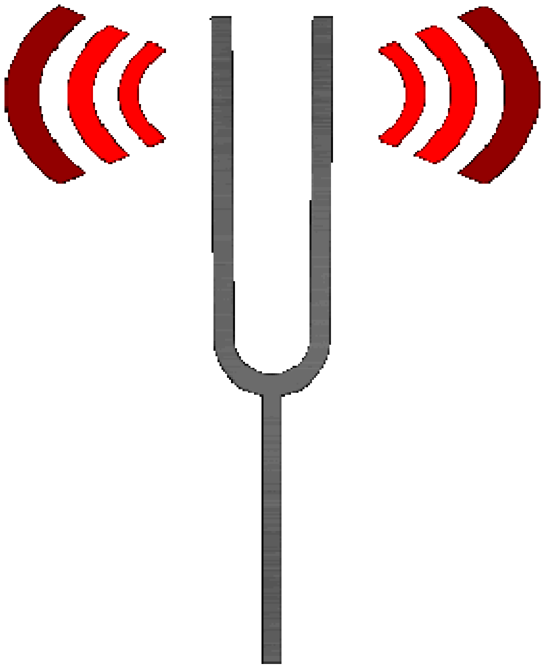
Infrared -> Remote controllers

X-rays -> Medicines for x-ray detection of bones (Dangerous so safety precautions are needed)

Gamma rays ->Kills cancer cells

And remember ultra-violet rays are the powerful rays causing skin cancer.

Sound



Sound is produced by objects such as a tuning fork by vibrating the air molecules. There will be a series of compressions (regions of high pressure when air molecules are close) and rarefactions (regions of low pressure when molecules are far apart.

Important points

a.Sound waves are longitudinal waves

b.Humans are able to hear within the range of 10Hz to 10KHz.

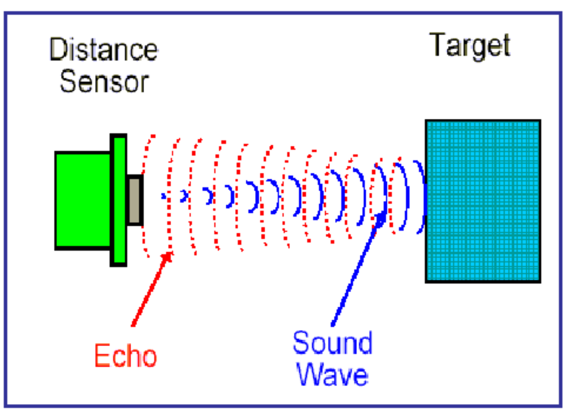
c.A medium is needed for sound to travel through

d.Frequency means pitch and amplitude relates to the loudness!

e. Sound travels fastest in solids then liquids, and finally gases.

To find the speed of sound: speed=distance/time

Echo:



Echo is the reflection of sound waves.

A sonar is used to transmit sound waves which detect an object and then gets reflected. This way the distance of a target can be found. Using this formula:

Distance= $\frac{\text{speed x time}}{2}$

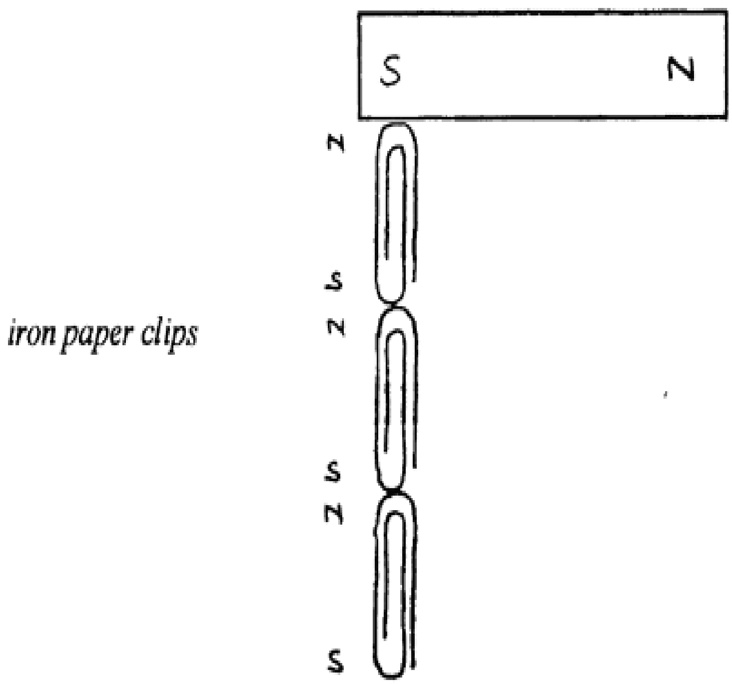
4.Electricity and magnetism

Properties of a magnet:

1.It has a magnetic field around it

2.They run from the north pole to the south pole of the magnet

3.They attract magnetic materials to it by induced magnetism. (induced can be said as introduced or "created" magnetism". It works by this:



The magnet attracts the iron paper clips because it creates poles on each iron clip!

Each iron clip will have a pole that attracts each other and the magnet.

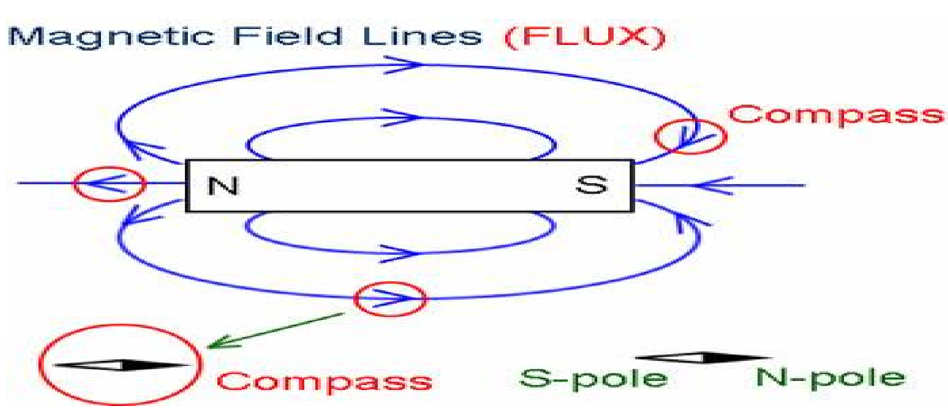
For example North and south to attract each other.

To magnetise and demagnetize:

Magnetising can be done by placing a steel bar in a solenoid (a coil with many turns)

Demagnetising can be done by moving the bar magnet from a solenoid carrying an alternating current.

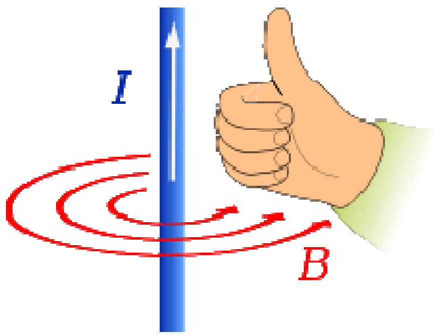
Experiment:



Iron is a temporary magnet. While steel is permanent.

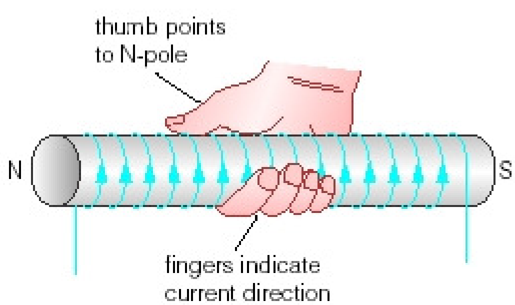
Ferrous meterials are magnetic materials such as iron and other metal alloys (cobalt, nickel). Non-ferrous materials are non magnetic materials such as aluminum and copper.

Magnetic field around a wire



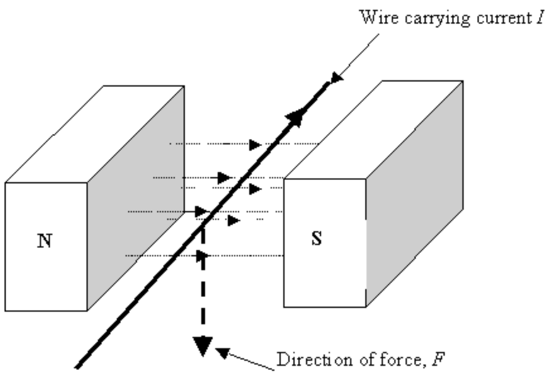
A current carrying wire has a magnetic field around in the form of circles. To know the direction of the magnetic field use the **right hand grip rule**. Imagine you are holding the wire, the direction of your thumb is the direction of the current and the direction of your fingers are the same as the magnetic field. This is shown on the given diagram.

Magnetic field around a solenoid

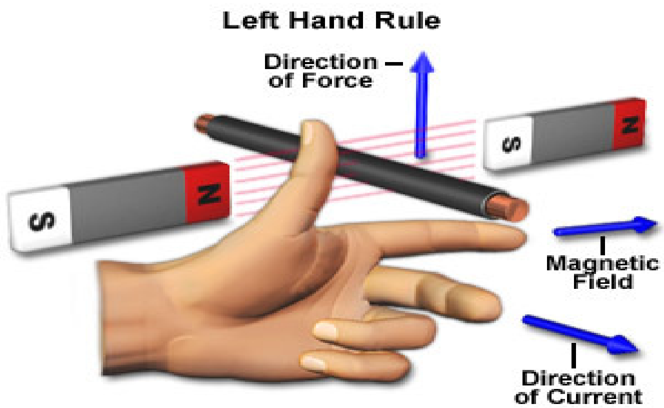


A solenoid is a coil with many turns. The magnetic field lines are like those of a bar magnet. Hold your hands as shown. Your finger tips should be like the direction of the solenoid. Your fingers point to the north. So the left side is the North Pole and right is the south pole. The magnetic field runs now from north to south!

Magnetic force on a current



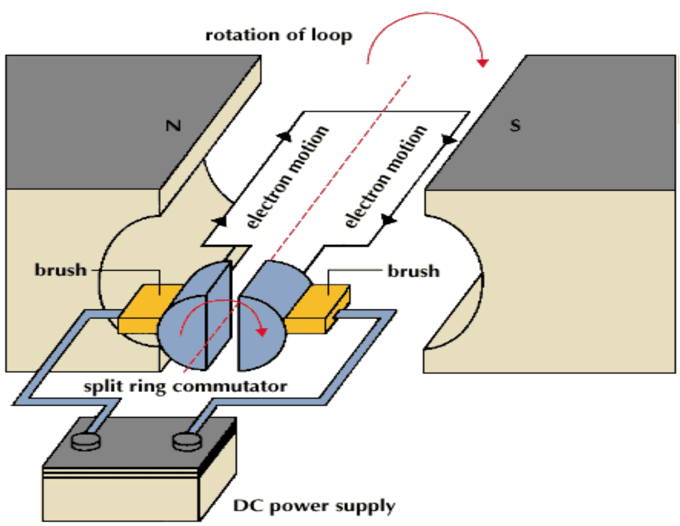
If you know the direction of the field lines and the current you can find the direction of force acting on the wire if placed between two magnets. You have to use Flemming's left hand rule. First old your left hand this way:



Remember it as FFC: Force, field current.

Your fingers point to the direction of the force!

DC Motor

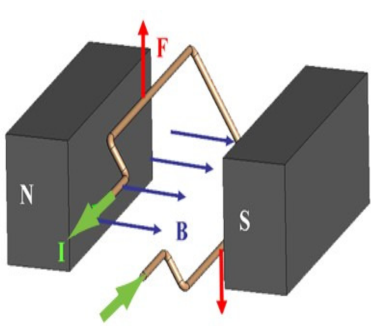


Main idea: Changes electrical energy to kinetic energy.

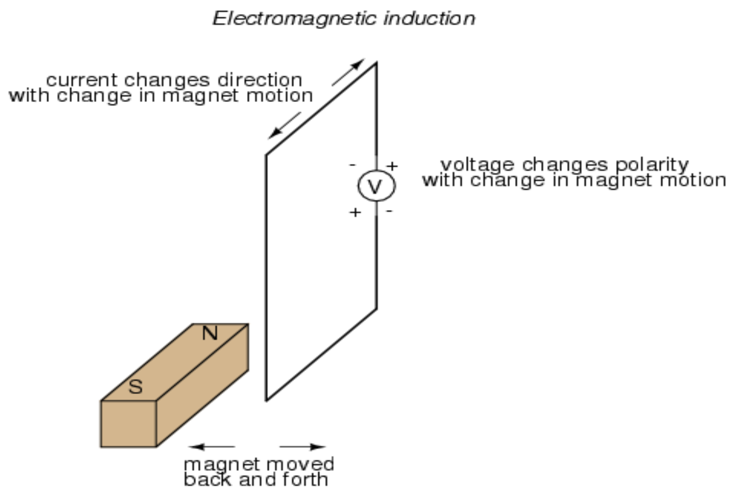
How it works?

When the coil is horizontal a force acts on the coil that makes it turn. The commutator rotates with it. The brushes are needed to keep contact with the coil.

Then the coil is vertical, and no current passes through. It relies on its own momentum to turn, and so it makes contact again with the commutator. The current direction of the coil changes, so the direction of the forces change. This principle keeps turning the motor on and on….



Electromagnetic induction

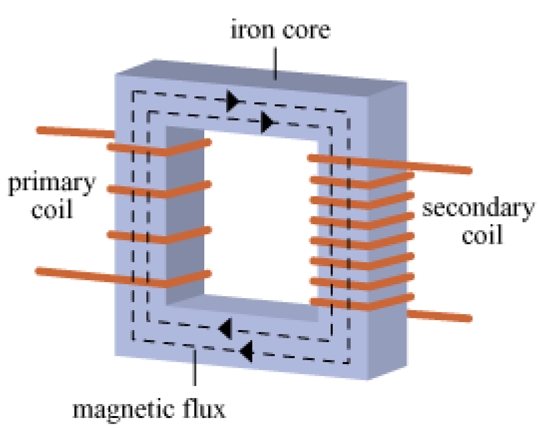


When a magnet is moved through a wire an e.m.f./ voltage is generated in the wire because the field lines are cut.

The current changes direction based on the movement of the magnet.

Len'z law states that:

The direction of the current flows in a direction that opposes the changing that produced it.



Transformer

It works by the principle of Mutual induction: where an AC current in the primary coil produces a changing magnetic field. The magnetic field gets cut and an e.m.f. is induced in the secondary coil.

The more the number of turns in the secondary coil, the higher is the voltage. The less the number of turns, lower is the voltage.

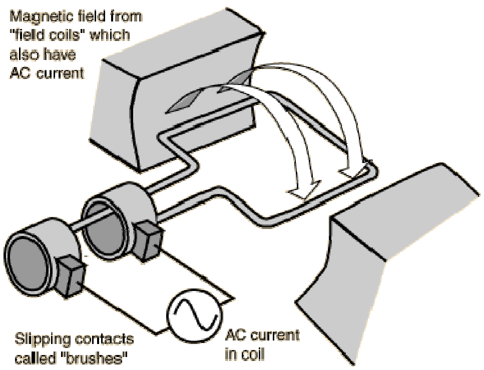
Three important points to know:

Step up transformer; Secondary coil has more number of turns

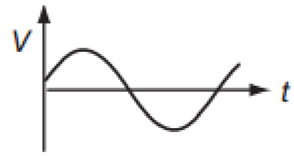
Step down transformer: Secondary coil has less number of turns.

High voltage transmission is very important because less current is used, cheaper and thinner cables can be used. There will be less risk of the cables being heated from the high current. So less power is lost.

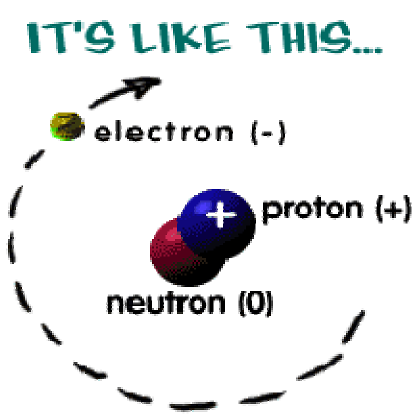
AC Generator and the oscilloscope



The coil is rotated many times in between two magnets. An AC current is produced as a result. It will look like this on the oscilloscope:



5.Atomic Physics

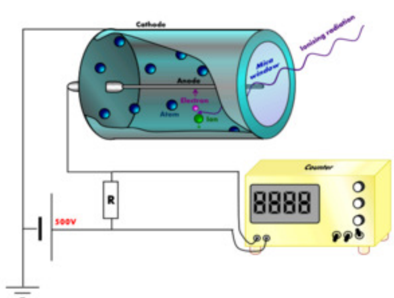


The atom:

<>At the center is the nucleus, containing the protons and neturons.
<> Electrons revolve around it

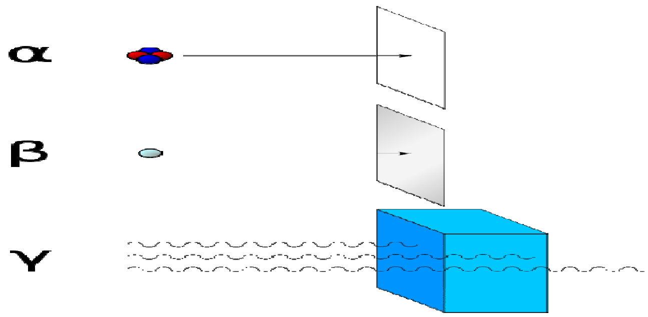
Detection of radioactivity

1. The radiation coming from the various objects around us are called background radiation.
2. A radioactive substances releases: gamma particles *y*, beta particles β and alpha particles.



3.A GM tube is used to measure the radiation from the radioactive source. It is a high priority to subtract the measured value with the value of background radiation

Characteristics of the three kinds of emission



Alpha	Gamma **y**	Beta
Made up of 2 protons and 2 neutrons	Electromagnetic wave	An electron
Strong ionizing effect	Very low ionizing effect	Weak
Weak penetration	Able to penetrate but stops when a metal is placed	Strong penetration

Radioactive decay

Alpha decay:

Radium-226 (atomic number 88) decays by alpha emission. The loss of the alpha particles leaves the nucleus with 2 protons and 2 neutrons less than before. It changes to element radon.

$_{88}Ra^{226} \rightarrow {}_{86}Rn^{22} + {}_{2}a^{4}$

Beta decay:

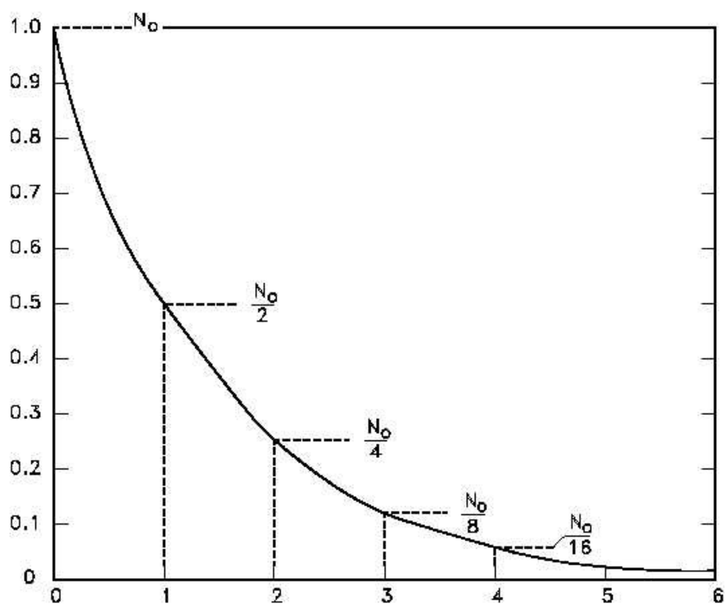
Idionine-131 decays by beta emission. When this happens the neutron is that it changes to a proton, an electron and a antineutrino. Idione-131 changes to Xenon-131

$_{53}I^{131} \rightarrow {}_{54}Xe^{131} + {}_{-1}\beta^{0} + {}_{0}v^{0}$ v=antineutrino

Half life and activity

Half life is the time taken for half of nuclei of a radioactive sample to decay. **Activity** is the number of disintegrations per second.

There is an important relation between these two ideas. Activity is proportional to half-life. So as the radioactive material decays, the activity halves at the same time. This can be shown by this graph:



Suppose the half life is every 1 day. We can say that half life is the time taken for the activity of a radioactive sample to be halved.