Force

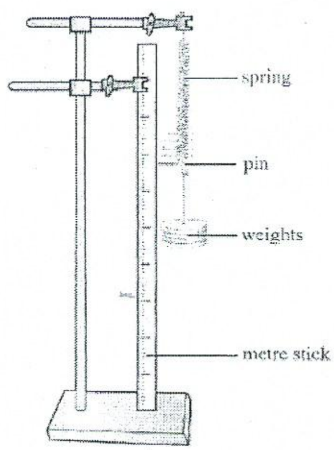
	Measured in:
• A **force** is anything which causes an object to **move** or **change** its **velocity**.	**newtons** (N)
• **Push, pull, weight** and **friction** are all examples of **forces**.	
• **Forces** are measured using a **spring balance.**	
• **Friction** is a force which **prevents easy movement** between two objects in contact.	**newtons** (N)
• The **weight** of an object is the **force of gravity** acting on it.	**newtons** (N)
• **Hooke's Law** states that the **extension** of a spring depends on the size of the **weight** (force) attached to it.	
• A **graph** of **spring extension** against the **weight** (force) attached to it, gives a **straight line** through the **origin** (0,0)	

EXPERIMENTS:

40.1 To Investigate the Law of the Spiral Spring (Hooke's Law)

The **spring** and **metre stick** are held in the retort stand as shown.
The position of the **pin** is **noted** as each **weight** is added to the spring.
The **extension** of the spring for each **total weight** is noted.

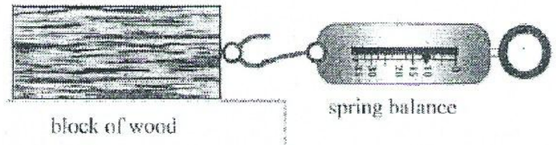
The **bigger** the **weight**, the **greater** the **extension** of the spring. They are in **direct proportion**, and so would give a **straight line graph** through (0,0).



40.2 To Investigate the Force of Friction

The **force of friction** is measured on the spring balance as the block just **begins to move.**

Sandpaper or **oil** could be placed under the block to **increase/decrease friction.**

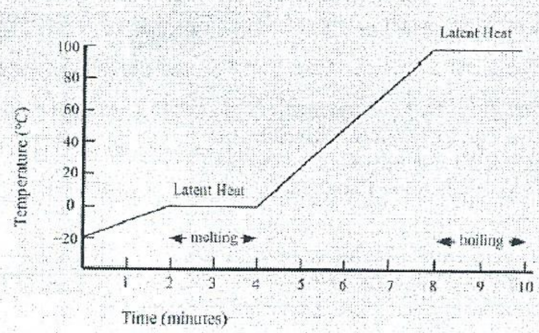


Heat and Heat Transfer

- **Heat** is a form of **energy**; it is measured in **joules** (J).
- **Heat** always moves from a **hot area** to a **cold area.**
- **Conduction** is the transfer of heat through a substance **without** the particles in the substance **moving out of position**.
- **Metals** are very **good conductors** of heat.
- An **insulator** is a substance that does **not allow heat** to pass through it easily. Insulators are very poor conductors.
- **Convection** is the transfer of heat through a **liquid** or **gas** when **molecules** of the liquid or gas **move upwards** and carry the heat.
- **Radiation** is the transfer of heat, in **rays**, from a hot object, **without** needing a **medium** to pass through.
- A **dull, black surface radiates** heat out better than a **bright shiny surface**.
- A **dull, black surface absorbs** heat better than a **bright, shiny surface.**
- **Solids, liquids and gases** all **expand** when **heated** and **contract** on **cooling**.
- When water is cooled **below 4°C**, it begins to **expand.**
- **Ice is less dense than liquid water** and so **floats** on water - this is important for fish to survive.
- **Temperature** is a measure of **how hot** an object is.
- A **mercury** or **alcohol thermometer** is used to **measure** temperature accurately.
- **Thermometers** work because **liquids expand** when **heated** and **contract** when **cooled**.
- **Temperature** is measured in **degrees Celsius** (°C).
- **Water freezes** at **0°C**, and **boils** at **100°C** at normal atmospheric pressure.

HL The **amount of heat** in a substance **depends** on its **temperature**, its **mass**, and **what the substance is.**

- **200 ml of water** at **60°C** contains **twice** as much heat as **100 ml of water** at **60°C.**
- **200 ml of water** at **60°C** contains **more heat** than **200 ml of oil** at **60°C**.
- **Latent heat** is the heat used by a substance to **change its state** - it does **not** raise the temperature.
- Latent heat:

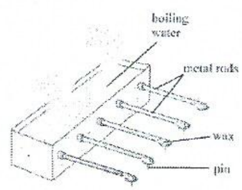


Heat Experiments (Expansion/contraction/conduction/convection/radiation/latent heat/cooling curves)

EXPERIMENTS:

44.1 To Compare the Conductivity of Various Metals

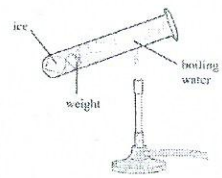
Heat travels by **conduction** through the **metal rods**. The **wax melts** and the **pin drops** off the metal that is the **best conductor** of heat first.



44.2 To Show that Water is a Poor Conductor of Heat

The **ice** at the bottom of the test tube **does not melt**, even though the **water** at the **top** is **boiling**.

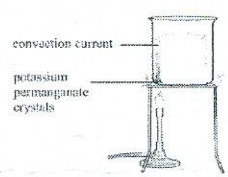
As heat cannot reach the ice by convection (where molecules move upwards to carry heat), the **water** above the ice must be a **very bad conductor** of heat.



44.3 To Show Convection Currents in Water

Some potassium permanganate **crystals** are placed at the bottom of the beaker, to **colour the water**.

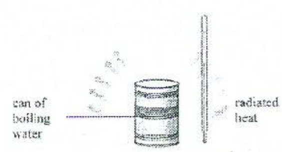
The **movement** of the **coloured water**, shows a **convection current** in the water, as **heated water** moves **upwards** and is **replaced** by **colder water** moving **downwards**.



44.4 To Show Heat Transfer by Radiation

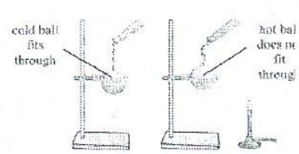
The **tin can** is filled with **boiling water** and the **thermometer bulb** is placed **beside it** as shown.

Heat transfer from the hot can, by **radiation**, raises the **temperature** on the thermometer.



44.5 To Show that Solids Expand when Heated and Contract when Cooled

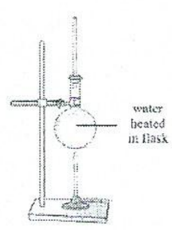
The **metal ball can fit** through the **ring** when the ball is **cold**.
When the ball is **heated**, it **expands** and can **no longer fit** through the ring.
On **cooling**, the ball **contracts** and can fit through the ring again.



44.6 To Show that Liquids Expand when Heated and Contract when Cooled

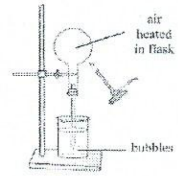
When the **water** in the flask is **heated** it **expands** and **rises up** the glass tube.
On **cooling**, the water **contracts** and moves back **down** the tube.

The **expansion** of a **liquid** on **heating** and its **contraction** on **cooling** explains how a **thermometer** works.



44.7 To Show that Gases Expand when Heated and Contract when Cooled

When **heated**, the **air in the flask expands** and some escapes causing **bubbles** in the water in the beaker.
On **cooling**, the **air contracts** and water from the beaker gets **sucked up** the tube.

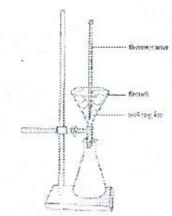


EXPERIMENTS:

45.1 To Determine the Melting Point of Ice

A **thermometer** is placed in a **funnel** of **melting ice**, as shown.

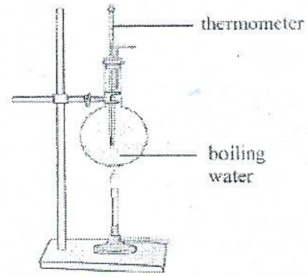
The temperature remains **steady** at 0°C as the ice melts - this is the **melting point** of ice.



45.2 To Determine the Boiling Point of Water

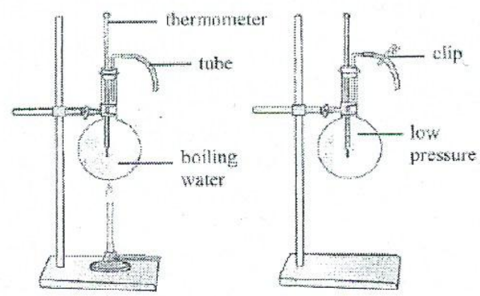
A **thermometer** is placed just **above** the **surface** of **boiling water** in a flask, as shown.

Note the **steady temperature** of **100 °C** in the steam - this is the **boiling point** of water.



45.3 To Show the Effect of Pressure on the Boiling Point of Water

With the **tube open**, the **water** in the flask is **boiled** for **three minutes**.
The **steam** drives all the **air out** of the flask.
The **Bunsen burner** is then **removed** and the **tube clamped**.
The **steam** then **condenses** leaving a **partial vacuum** (with very **low pressure**) above the water in the flask.
At this **low pressure**, the water is seen to boil again at temperatures of as **low as 60°C**.

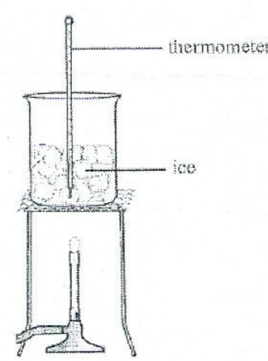


45.4 To Demonstrate Latent Heat

A **thermometer** is placed in ice taken **directly** from the **freezer**. This ice should show a temperature of **less than** 0°C, and, as it **heats**, the temperature **rises** to **0°C**.

The **ice** and **water** will **remain at 0°C** until **all** the ice has **melted**. The heat being supplied is **latent heat** - it is being used to **change the state**, and does **not raise** the **temperature**.

The **temperature** will then **increase** steadily to **100°C** when the water begins to **boil**. The **temperature** will **not rise above 100°C**, as, once again, the heat supplied is being used to **change the state (latent heat)**.



45.5 To Plot a Cooling Curve for Naphthalene

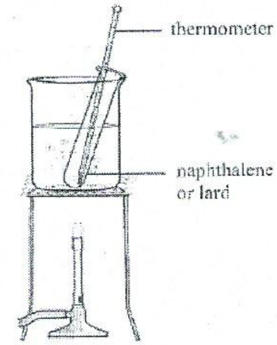
A **thermometer** is placed in a **test tube** containing **naphthalene** (freezing point 80°C) or **lard** (F.P. 30°C).
The **naphthalene** is heated to **100°C**, or **lard** to **60°C**.

The liquid is then allowed to **cool**, and the temperature is **noted** every **minute** for 10 minutes.

A **graph** is drawn with **time** (minutes) on the X-axis and **temperature** (°C) on the Y-axis.

As the **liquid freezes** to a **solid** (80° for naphthalene and 30°C for lard), the **temperature** does **not fall** for several minutes, until **all** the liquid has turned to solid.

The heat **(latent heat)** is being given off as the liquid changes state to a solid.



FORMULAE

Quantity	Formula	Measured in:
• **Speed:**	The **speed** of an object is the **distance** it travels per **unit time**. $\text{Speed} = \frac{\text{Distance (m)}}{\text{Time taken (s)}}$	m/s or ms^{-1}
HL **Velocity:**	The **velocity** of an object is the distance it travels per unit time, in a **given direction.**	m/s or ms^{-1}
• **Acceleration:**	**Acceleration** is the **change in velocity** per second. $\text{Acceleration} = \frac{\text{Change in velocity (m/s)}}{\text{Time taken (s)}}$	m/s/s, or ms^{-2}, or m/s^2
• **Density:**	The **density** of a substance is the **mass of 1 cm^3** of it. $\text{Density} = \frac{\text{Mass (g)}}{\text{Volume (cm}^3\text{)}}$	g/cm^3, or kg/m^3
• **Work** =	Force (N) x Distance (m)	J (joules)
• **Power:**	**Power** is the **work** done in **one second.** $\text{Power} = \frac{\text{Work done (J)}}{\text{Time taken (s)}}$	W (Watts)
• **Weight:**	**Weight** is the **force of gravity** acting on an object. Weight = Mass (kg) x 10	N (newtons)
• **Moment** = **(of a force)**	Force (N) x Perpendicular distance (m)	Nm (newton metres)
• **Pressure:**	**Pressure** is the **force** per unit **area**. $\text{Pressure} = \frac{\text{Force (N)}}{\text{Area (m}^2\text{)}}$	Pa (pascals), N/m^2
• **Voltage** =	Current (A) x Resistance (Ω)	V (volts)
• **Current** =	$\frac{\text{Voltage (V)}}{\text{Resistance (}\Omega\text{)}}$	A (amps)
• **Resistance** =	$\frac{\text{Voltage (V)}}{\text{Current (A)}}$	Ω (ohms)
• **Unit of Electricity** =	kilowatts x hours	kWh (kilowatt hours)

Light

- **Light** is a form of **energy** - it can make things move.
- The **Crooke's radiometer** and the **solar-powered calculator** show that light is a form of **energy**.
- **Luminous objects** give out light, e.g. the **Sun**, a **light bulb**, a **candle**.
- **Light travels** in **straight lines** - this gives rise to **shadows**.
- A **solar eclipse** occurs when the **Moon** passes between **Sun** and **Earth**.
- **Reflection** occurs when light **bounces** back off a surface.
- Light is **reflected** in a **regular manner** off a **shiny surface** e.g. a mirror. .

HL **Refraction** is the **bending of light** as it goes from one medium to another.

- Light **rays** are always **refracted towards** the **denser medium**.
- A **convex** or **converging lens** brings light **rays together**.
- A **concave** or **diverging lens** spreads light **rays apart**.
- **White light** is a mixture of the **7 colours** of the **spectrum**.

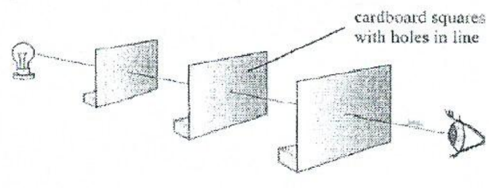
HL **Dispersion** is the **breaking up of white light** into its 7 colours. (*Only the word 'dispersion' is HL*)

- Be able to complete ray diagram for magnifying glass convex and concave lens and Perspex/glass blocks

EXPERIMENTS:

46.1 To Show that Light Travels in Straight Lines

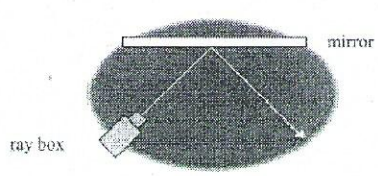
The bulb can only be seen when the three holes in the cardboard squares are in a straight line.



46.2 To Show the Reflection of Light

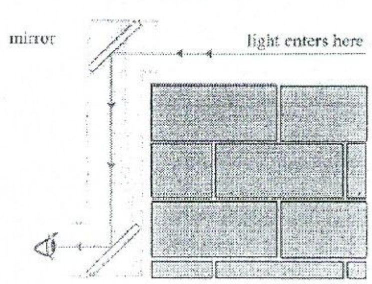
The **light ray** from the **ray box** strikes the **mirror** and gets **reflected** back.

The ray gets **reflected** back at the **same angle** as it strikes the mirror with.



Light from an **object** enters the **periscope** and strikes the **top mirror**.
It is then **reflected down** to the **bottom mirror** which reflects it **into the eye**.

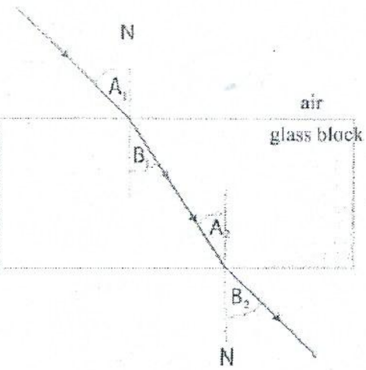
Both mirrors must be at an angle of 45° for the periscope to work.



46.3 To Show the Refraction of Light

A **light ray** from a **ray box** is seen to **change direction** (bend) as it goes from **air** into the **glass block.**

The **angle B_1 is less** than the **angle A_1** as the light ray gets pulled in **towards** the **denser medium** (the glass).



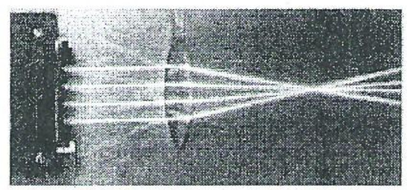
46.4 To Show the Effect of Convex and Concave Lenses

Light rays from a **ray box** are passed through a **convex** and a **concave** lens.

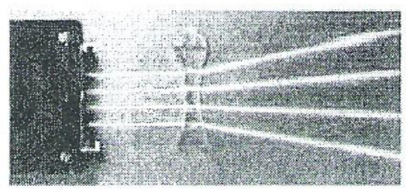
Light rays striking a glass with a **curved surface get refracted** at different angles.

A **convex (converging)** lens refracts the light rays entering it so that they all **meet at a point**.

A **concave (diverging)** lens refracts the light rays entering it so that they **spread out** as they leave the lens.



convex lens



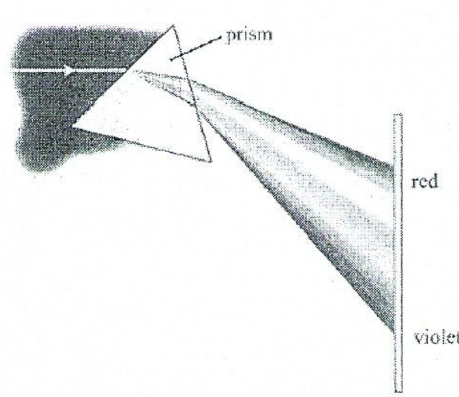
concave lens

46.5 To Show the Dispersion of White Light

A **ray** of **white light** is passed through a glass **prism**.
The prism **disperses** (breaks up) the light into its **7 different colours**.

Each colour is **refracted differently** through the prism - **red light** is **refracted** the **least**, and **violet**, the **most**.
This causes the colours to **spread out** as seen on a **screen**.

The **colours** are: Red, Orange, Yellow, Green, Blue, Indigo and Violet.
(Richard Of York Gave Battle In Vain).



Magnetism (be able to plot the field lines of a bar magnet from N->S)

- **Iron**, **nickel**, **cobalt** or their **alloys** can be **magnetised**.
- The **magnetic effect** of a magnet is strongest at the **two ends** - called the **north pole** and the **south pole**.
- The north pole of a freely suspended magnet always points North.
- **Like poles repel** each other, **unlike poles attract**.
- A **magnetic compass** contains a small **magnet balanced** on a **thin spindle** which is free to move. Its **north pole** points **North**.
- A **magnetic field** is the **space** around a magnet where a **magnetic force** can be seen.
- **Magnetic fields** can be shown using **iron filings** or **plotting compasses**.
- **Magnetic field lines** go from the **north pole** to the **south pole** of a magnet.
- The **Earth** has a **magnetic field** as if it had a huge **bar magnet** at its **centre**, with the **magnet's south pole** in the **northern hemisphere**.
- Magnets are used in **electric motors**, **telephones**, **loudspeakers**, **compasses**, press and **fridge doors**, **dynamos** etc.

EXPERIMENTS:

48.1 To Test a Variety of Materials for Magnetism

Bring a **bar magnet** close to a variety of materials to see if they are **attracted** to the **magnet**. Materials that contain the elements **iron**, **nickel** or **cobalt** will have magnetic properties.

48.2 To Find the North Pole of a Magnet

One end of a **suspended magnet** points **North**.

A **compass** is used to determine which end of the suspended magnet is pointing **North**.

48.4 To Make a Floating Compass and Demonstrate the Earth's Magnetic Field

A **bar magnet**, **floating** on a piece of **polystyrene** in a **bowl of water**, will have its **north pole** pointing **North**.

The magnet is free to move so it behaves just like the **magnetised pointer** of a **compass**.
Its **north pole** is **attracted** to the **Earth's magnetic south pole** (which is in the **northern hemisphere** of the Earth).

48.3 To Demonstrate the Attraction and Repulsion of Magnets

When the **south pole** of a bar magnet is brought **towards** the **north pole** of a suspended magnet, the **magnets attract** each other.

Unlike poles attract.

When the **north pole** of a bar magnet is brought **towards** the **north pole** of a suspended magnet, the **magnets repel** each other.

Like poles repel.

48.5 To Plot the Magnetic Field Around a Bar Magnet Using Plotting Compasses

Plotting compasses are placed around a **bar magnet** as shown.

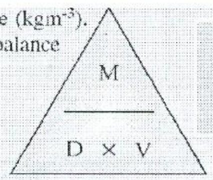
The pointers of the **compasses point** from the **north pole** of the magnet to the **south pole** of the magnet.

This shows that the **magnetic field lines** of a magnet point from **north pole** to **south pole**.

Measurement, Density and Floatation

- **Know units of length, time, temp, mass, area and volume.**
- **Know instruments used to measure these.**
- **Know how to find volume of small stone using graduated cylinder.**
- **Know how to find the volume of a large stone using overflow can and grad cylinder.**
- **Know how to fin the mass of a solid or liquid**
- **Know that Density=mass/volume**
- **Know that to find the density of an object you need to find the mass, the volume and then DIVIDE mass by volume to find the DENSITY**

- **Density** is mass per unit volume (kgm^{-3}).
  - Density is measured using a balance and graduated cylinder.
  - **Density** = $\frac{\textbf{Mass}}{\textbf{Volume}}$



Mass = Density x Volume
Density = Mass / Volume
Volume = Mass / Density

- The **mass** of an object is the **amount of matter** in it.
  Mass is measured in **kilograms** (kg) or **grams** (g).

- The **density** of a substance is the **mass of 1 cm^3** of it.
  Density is measured in **grams per cubic centimetre**. (g/cm^3).

- **Density** = $\frac{\text{Mass (g)}}{\text{Volume (cm}^3\text{)}}$

- To find the density of any substance, first find its **mass** on an **electronic balance**, and then find its **volume**, using an **overflow can** and **graduated cylinder**.
  Then **divide** the **mass** by the **volume** to find the density. (answer in g/cm^3).

- The **density** of **water** is 1 g/cm^3.

- An object **sinks** if its **density** is **greater** than the density of the liquid it is in.

- An object **floats** if its **density** is **less** than the density of the liquid it is in.

- **Ice floats** in **water** because its **density** (0.9 g/cm^3) is less than the density of water.

Explain why Ice floats on water (as water freezes it expands so its volume increases so its density decreases so it floats in denser water!)

Motion

			Measured in:
•	Speed:	The **speed** of an object is the **distance** it travels per **unit time**. **Speed** = $\frac{\text{Distance (m)}}{\text{Time taken (s)}}$	m/s or ms^{-1}
HL	Velocity:	The **velocity** of an object is the distance it travels per unit time, in a **given direction**.	m/s or ms^{-1}
•	Acceleration:	**Acceleration** is the **change** in **velocity** per second. **Acceleration** = $\frac{\text{Change in velocity (m/s)}}{\text{Time taken (s)}}$	m/s/s, or ms^{-2}, or m/s^2

Sample Question and Answer 2011 9a

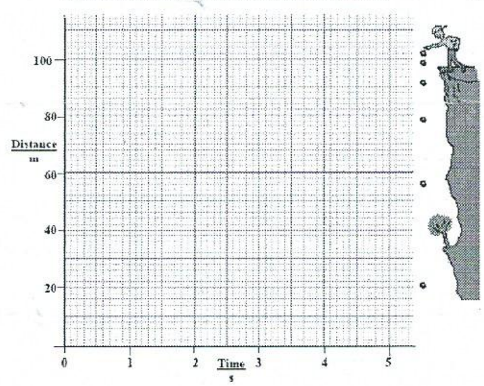
Question 9 (39)

(*a*) A stone was dropped from the top of a cliff and the distance that it fell was measured at the intervals of time as given in the table below.

Distance (m)	0	5	20	45	80	100
Time (s)	0	1	2	3	4	4.5

(also … know that a graph with a straight line thro the origin means speed/acc is constant)

(*i*) Draw a graph of distance against time in the grid below. A smooth curve through the plotted points is required. (9)



(*ii*) Use the graph to find how far the stone had fallen in 3.5 s. (3)

____

(*iii*) Calculate the average speed of the falling stone between the second and the fourth second. Give the unit with your answer. (6)

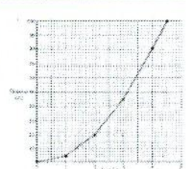
____

(*iv*) In this experiment is distance fallen directly proportional to time? Justify your answer. (6)

____

____

(*a*) (*i*) Draw — six points plotted correctly; allow (3) for 3 – 5 points plotted correctly (6)
curved line through the six points (3) [9]

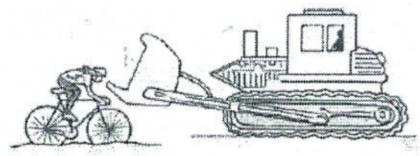


(*ii*) Use — 60 m + or –4 m (3) [3]

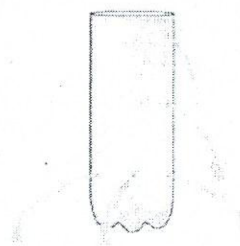
(*iii*) Calculate — $\frac{80 - 20}{2} = 30$ (3)
m/s (3) [6]

(*iv*) Is? — no (3)
curved graph/ graph not straight line/ stone accelerating … (3) [6]

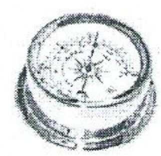
Pressure



- **Pressure** is the **force** per **unit area**.
- **Pressure** $= \frac{\text{Force (N)}}{\text{Area (m}^2\text{)}}$
- **Pressure** is measured in **newtons per square metre** (N/m^2), or **pascals** (Pa). $1\ N/m^2 = 1$ Pa.
- The **smaller the area**, the **greater the pressure**.



- **Pressure** in a **liquid increases** with **depth.**
- The **pressure** in a **liquid** acts **equally** in all directions.
- **Atmospheric pressure** is caused by the **weight** of the **atmosphere.**
- **Atmospheric pressure decreases** the **higher** you go above sea-level.
- A **barometer** is used to measure atmospheric pressure.
- **Normal atmospheric pressure** can hold up **76 cm of mercury** in a mercury barometer.
- Normal atmospheric pressure is **76 cm of mercury** or **1013 hectopascals.**
- An **altimeter** is a **barometer** used to measure **height**.



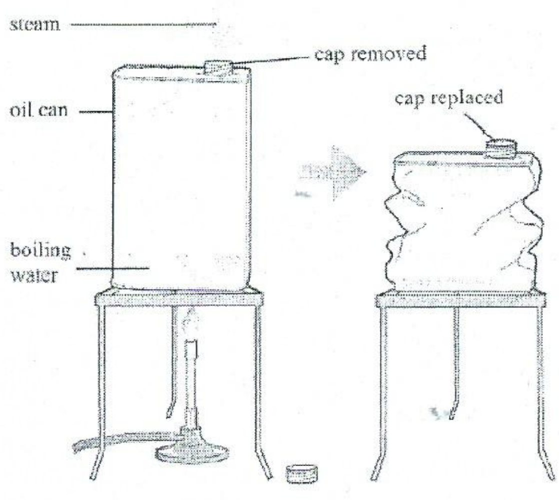
- **High atmospheric pressure** gives **good**, settled **weather.**
- **Low atmospheric pressure** gives **bad**, unsettled **weather**.

43.4 To Demonstrate Atmospheric Pressure

A small amount of **water** is **boiled** for five minutes in the can, with the **cap removed.** The **steam** drives all the air out of the can. The Bunsen burner is then removed and the cap replaced so **no more air** can get in.

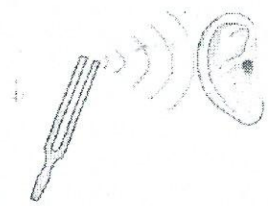
As the steam cools, it **condenses** back into **water**, leaving **no air in the can** above the water.

With no air inside the can, **atmospheric pressure** outside the can crushes it.



Sound

- **Sound** is a form of **energy** caused by **vibrating objects**.
- **Sound**, unlike light, **needs a medium** to pass through.
- **Sound** is **reflected** off hard surfaces, resulting in echoes.
- **Ultrasound** has **frequencies** too **high** for humans to **hear**.
- **Sound travels** at **340 m/s** - much **slower** than **light** (300,000,000 m/s).
- **Thunder** and **lightning** show that **light travels faster** than sound.
- The **loudness** of sound is measured in units called **decibels**.

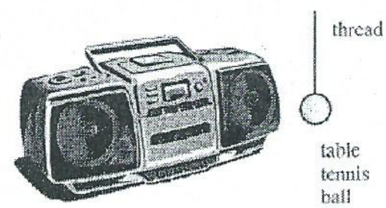


EXPERIMENTS:

47.1 To Show that Sound is a Form of Energy

Sound from the **speaker** travels through the air and causes the **table tennis ball** to **move**.

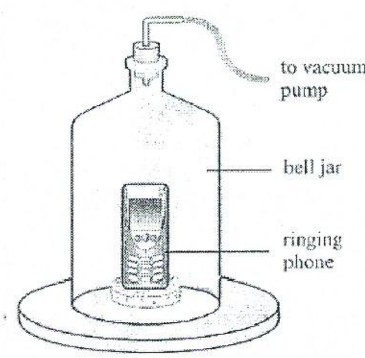
This shows that **sound** is a form of **energy** and can be **converted** into other forms.



47.2 To Show that Sound Cannot Travel in a Vacuum

A **vacuum pump** is used to **remove** the **air** from inside the bell jar.
The **phone** can be heard **ringing** when there **is air** in the bell jar - the **sound can travel** through **air**.

When the **air** is **removed**, even though the phone is still ringing, **no sound** is **heard**.
Sound cannot travel through a **vacuum**.

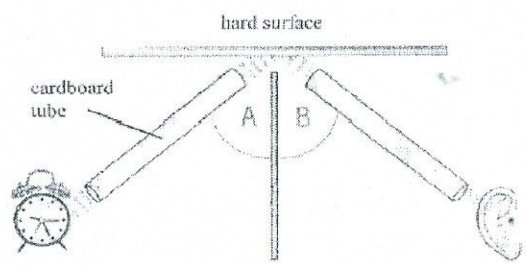


47.3 To Demonstrate the Reflection of Sound

Sound from the ticking clock is directed through the **cardboard tube**, to a **hard surface**.

The **reflected sound** is then heard through the **second tube**.
The reflected sound is heard the **loudest** when the **angle A equals** the **angle B**.

This shows that sound, like light, reflects off a surface at the **same angle** it enters.

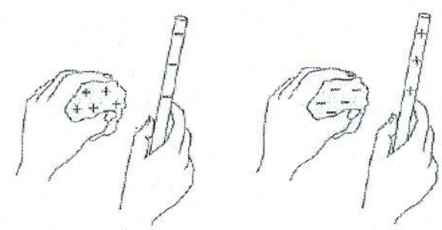


- Speed of sound is 340 m/s s=d/t calculations for echos problems
- Sound used in ultrasound etc…

Static and Current Electricity

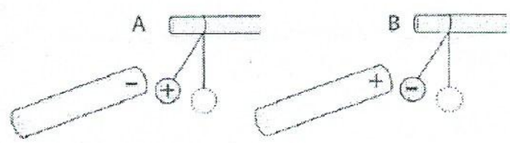
- **STATIC: Rubbing leaves objects charged. Unlike Charges attract etc**
- **Dry weather stops charge from going into moist air so it builds up on us until we touch a conducting material (metal) which lets charge conduct to ground .. trolley**
- **Uses- electroplating / soot removal**

- When two objects are **rubbed together**, **electrons** get **transfered** from one to the other.
- Some substances such as **polythene** and **perspex** (good **insulators**) do not allow these electrons to flow out so they build up an **electric charge** called **static electricity**.
- A **polythene rod gains electrons** from a woollen cloth when it is rubbed with the cloth - the rod **gains** a **negative charge**.
- A **perspex rod loses electrons** to a woollen cloth when it is rubbed with the cloth - the rod **gains** a **positive charge**.
- An object becomes **negatively charged** if it **gains electrons**; an object becomes **positively charged** if it **loses electrons**.
- **Unlike charges attract** each other; **like charges repel** each other.
- **Earthing** occurs when a charged object **loses** its **charge** to the **earth**.

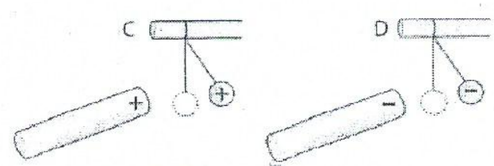


Polythene rod gains electrons

Perspex rod loses electrons



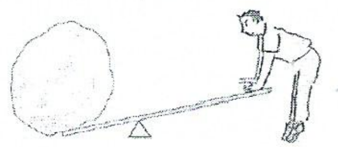
Unlike charges attract



Like charges repel

As well as experiments with charged rods…like the magnetism ones…

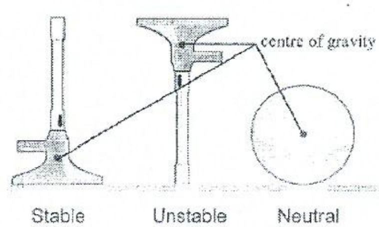
Turning Forces and Centre of Gravity



- The **moment** of a force is the **turning effect** of a force.
  Moment = (Force) x (Distance from the fulcrum).
- A **lever** is any **rigid body** which is free to turn about a a fixed point called the **fulcrum**.
- **Examples** of **levers** are: door, door handle, pliers, scissors, metre stick, screwdriver (used to open paint tin), etc.

H/L The **Law of the Lever** states that when a lever (e.g. a metre stick) is **balanced**, the total **clockwise moments equal** the total **anticlockwise moments**.

- The **centre of gravity** of an object is the point through which all the weight of the object appears to act. (i.e. the centre of its weight).
- **Stable equilibrium** is present if when an object is **slightly tilted**, its **centre of gravity** is **raised**, and it goes back to the original position on release.
- Objects in **stable equilibrium** will have a **wide base** and a **low** centre of gravity.
- **Unstable equilibrium** is present if when an object is **slightly tilted**, its **centre of gravity** is **lowered**, and it takes a new position when released (i.e. it falls over on its side).
- **Neutral equilibrium** is present if when an object is moved, its **centre of gravity** is **neither raised** nor **lowered**. The object never becomes unstable - it does not fall over and just takes up a new position where it is still in neutral equilibrium.



H/L **The three states of Equilibrium**

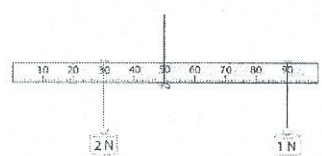
EXPERIMENTS:

H/L *42.1 To Prove the Law of the Lever*

The metre stick is hung from the **50 cm mark** and **weights** are hung from each side, **balancing the metre stick** each time.

The **moments** are calculated on each side by **multiplying** the **weight** by the **distance to the fulcrum**,
When the **clockwise moments** equal the **anticlockwise moments**, the metre stick is balanced.

This proves the **Law of the Lever**.



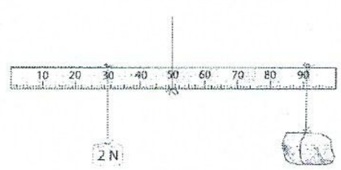
H/L *42.2 To Find the Weight of an Object Using the Law of the Lever*

A **known weight** is hung on one side of the metre stick and a **stone** on the other side, so that they **balance**.

The **moments** caused by the **weight** is calculated and this must **equal** the **moments** caused by the **stone**.

Therefore, moments caused by the weight = (weight of stone) x (distance of stone from the fulcrum).

The **weight** of the **stone** can then be found by **dividing**.



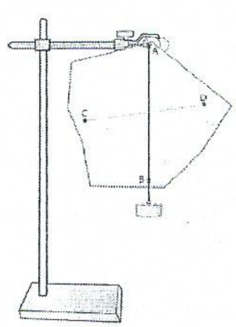
H/L *42.3 To Find the Centre of Gravity of an Irregularly Shaped Cardboard*

The **cardboard** and a **plumbline** are hung from a **pin**, stuck in a **cork** and held as shown in a **retort stand**.

Using the plumbline as a guide, the line AB is drawn on the **cardboard**.
The cardboard is then hung from a different point (e.g. C), and, again, the plumbline is used to draw the line CD.

This is repeated twice more from **other points** at the edge of the cardboard, and vertical lines drawn, as before.

Where all the lines **meet** is the **centre of gravity** of the cardboard.



Weight

- The **weight** of an object is the **force of gravity** acting on it.
- **Weight** is a **force** and is measured in **newtons** (N).
- The **force of gravity on Earth** is 10 N on every 1 kg of mass.
- **Weight** (N) = **Mass** (kg) x **10** N/kg (earth's gravity).
- To **find the weight** on Earth, **multiply** the **mass** (in kg's) by **10**.
- The weight of something in **outer space** is the mass multiplied by **0**. It is **weightless**.

DIFFERENCES BETWEEN MASS AND WEIGHT

MASS	WEIGHT
1. Measured in **kilograms** (kg)	1. Measured in **newtons** (N)
2. Is **fixed**, never changes.	2. **Varies**, depends on where you are.
3. Is a **fixed feature** of all things - like length or volume.	3. Is a **force** or pull on something.

Work, Energy and Power

- **Energy** is the **ability** to do **work**. — **joules** (J)
- **Work** is done when a **force** moves an **object**. — **joules** (J)
  Work (J) = **Force** (N) x **Distance** (m)
- **Power** is the **rate** at which **work** is done. — **watts** (W)
  Power is the amount of **work** done in **1 second**.
- **Power** = $\frac{\text{Work done (J)}}{\text{Time taken (s)}}$

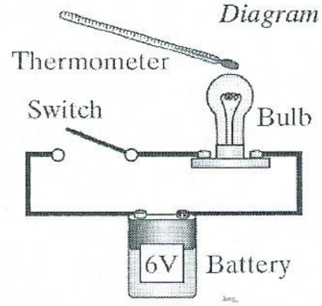
- Sun is primary source of energy-warms planet / plants photosynthesise / energy conversion
- Know renewable and non renewable energy … give examples
- Adv and disadvantage of renewable energy sources…. Cheap to run / no co2 emissions / high start up costs etc…
- Know principle of conservation of energy

3 Main Experiments

MI To convert chemical energy to electrical energy to heat energy

1. Set up the apparatus as shown.
2. Note the temperature of the bulb.
3. Close the switch and let the current flow for a few minutes.
4. Note the temperature of the bulb.
5. **Result:** the battery drives a current through the circuit causing the bulb to heat up.

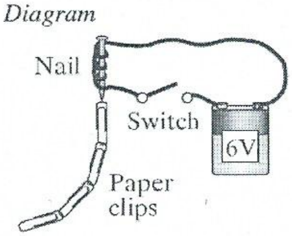
Diagram



MI To convert electrical energy to magnetic energy to kinetic energy

1. Set up the apparatus as shown.
2. Bring the nail close to the paper clips.
3. Close the switch.
4. **Result:** the electrical current makes an electromagnet that causes the clips to jump to the nail.

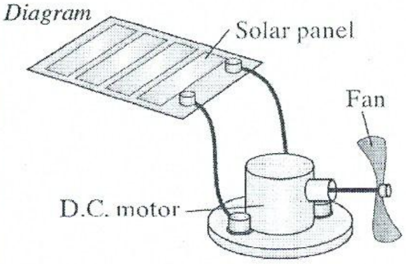
Diagram



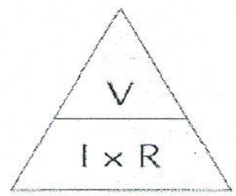
MI To convert light energy to electrical and kinetic energy

1. Set up the apparatus as shown.
2. Turn a lamp on and bring it close to the solar panel.
3. **Result:** the solar panel makes electrical energy that makes the motor turn.

Diagram

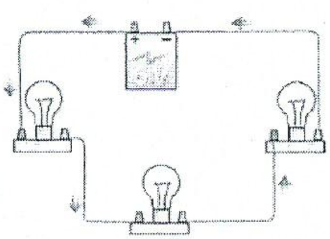


- An **electric current** is a **flow** of **electric charge**.
- **Conductors** are substances which **allow** electric **current** to **flow** through them freely (e.g. all metals).
- **Insulators** are substances which do **not allow current** to pass through them (e.g. wood, plastic).
- A **battery** or **power pack** is an '**electrical pump**' that **pumps electrons** around a circuit.
- **Electrons** are pumped from a region of **high electrical pressure** (the **negative terminal**) to a region of **low electrical pressure** (the **positive terminal**).
- The **difference in** electrical pressure between the **negative** and **positive terminals** is called the **potential difference** or **voltage**. It is measured in **volts** (V) using a **voltmeter**.
- **Current** is the **flow** of **electrical charge**. It is measured in **amps** (A) using an **ammeter**. The symbol for **current** in amps is (**I**).
- **Resistance** is the ability a substance has to **resist the flow** of **current** in a circuit. It is measured in **ohms** (Ω).
- The **larger** the **voltage**, the **larger** the **current** that can flow. The **larger** the **resistance**, the **smaller** the **current** in the circuit. The **relationship** between voltage (V), current (I) and resistance (**R**) can be shown using the **VIR triangle**.

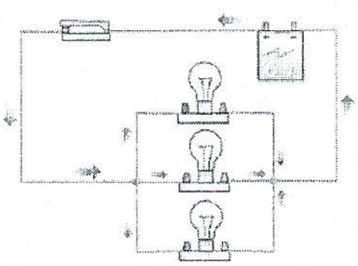


- **Ohm's Law** states that at **constant temperature**, the **voltage** (V) is always **proportional** to the **current** (I) in a circuit.
- **Resistors** (e.g. bulbs) in a circuit can be **wired** either in **series** or **parallel**.

Resistors wired in series



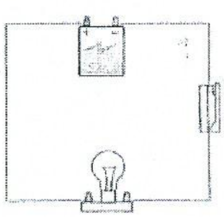
Resistors wired in parallel



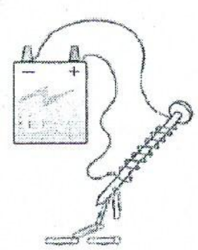
- For **resistors in series**, the **total resistance** is found by adding each of the individual resistances together. $R_{(Total)} = R_1 + R_2 + R_3$.

The **three effects** of an **electric current** are **heating**, **magnetic** and **chemical**.

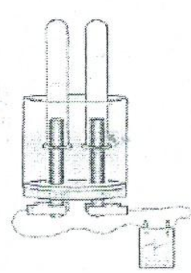
Heating effect



Magnetic effect



Chemical effect

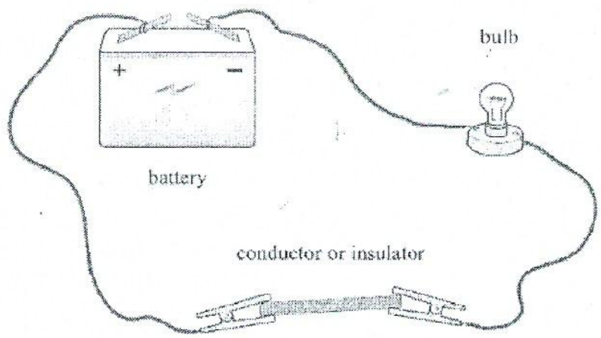


EXPERIMENTS:

50.1 To Distinguish Between Conductors and Insulators

Different materials are placed between the **crocodile clips** to see if they are **conductors** or **insulators** of electricity.

A **conductor allows** the **current** to **flow** in the circuit and the **bulb lights**.
An **insulator** does **not allow** the bulb to light.



50.2 To Verify Ohm's Law

A **circuit** with a **heating element** is set up as shown.
The **voltage** of the circuit may be **changed** using the **voltage dial** on the **power pack**.

The **voltage** is read from the **voltmeter**, which is wired in **parallel** with the **resistor**.

The **current** in the circuit is read from the **ammeter**, which is wired in **series** with the **resistor**.

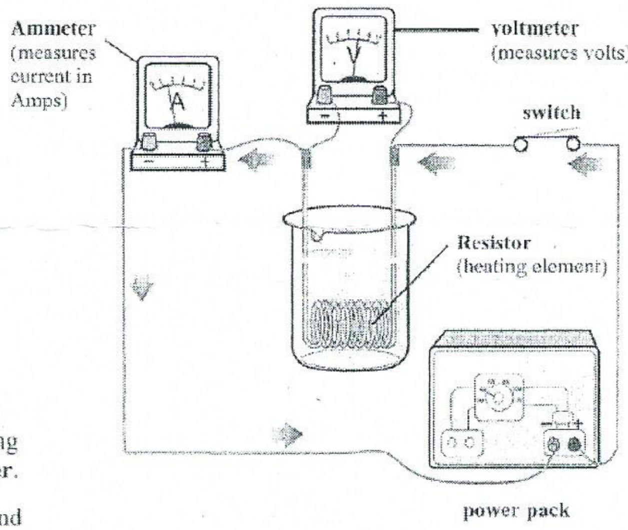
The **resistor** is prevented from heating up too much by immersing it in **water**.

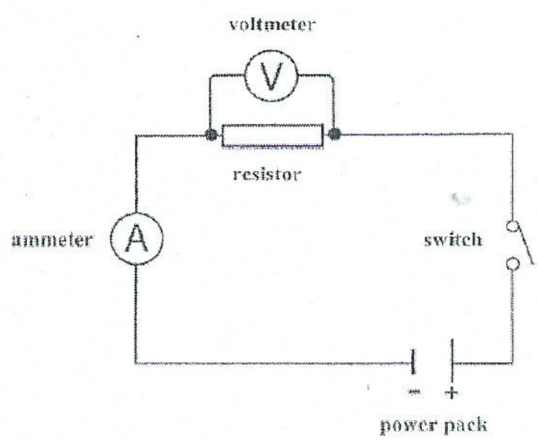
As the **voltage** is **increased**, it is found that the **current** also **increases**.

A **graph** plotted of **current against voltage** gives a **straight line** that passes through the **origin** (0,0).

This **verifies Ohm's Law** which states that, at **constant temperature**, the **current** in a circuit is always in **proportion** to the **voltage** of the circuit.

A **simpler drawing** of the apparatus used is shown on the right.





Uses and Effects of Electricity / Electricity in the Home

- A **fuse** is a **safety device** which **cuts off** the **current** in a circuit if the **current goes above** a certain level. The **thin fuse wire** overheats and **melts** and so **breaks the circuit.** Fuses are now replaced by **circuit breakers.**
- When choosing the **correct fuse** for a circuit, its **amp rating** should be **slightly higher** than the **normal circuit** or appliance requires.
- The terminals of a plug are connected as follows: **Live** on the right (**Brown** wire); **Neutral** on the left (**Blue** wire); **Earth** in the middle (**Yellow/Green** wire). A fuse is inserted on the **Live wire.**
- The **power** of an appliance is a **measure** of how quickly it **converts** electrical energy into other forms of energy. **Electrical power** is measured in units called **watts** (W).
- The **ESB's unit of energy** is the **kilowatt hour** (kWh).
  A **kilowatt hour** is the electrical energy used (converted) by a **1 kW** appliance running for **1 hour.**
- The number of kilowatt hours **(units) used:** = **(number of kilowatts)** x **(number of hours).**
- Cost of electricity = **(number of kilowatt hours or units)** x **(cost per unit).**
- **Direct current** (d.c.) travels in **one** direction only.
  Alternating current (a.c.), supplied by the **ESB, changes direction** many times per second. a.c. can easily be converted to d.c. using a **rectifier.**

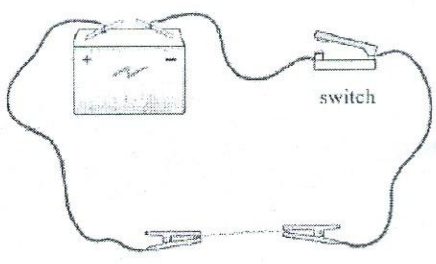
EXPERIMENTS:

51.1 To Show the Action of a Fuse

A **single strand** of fine **wire wool** is placed between the crocodile clips in the circuit.

When the **switch** is closed, the **heating effect** of the **current** heats and **breaks the strand.**

A **fuse** contains a **thin wire** that **melts** and **breaks the circuit** if the current is too big.

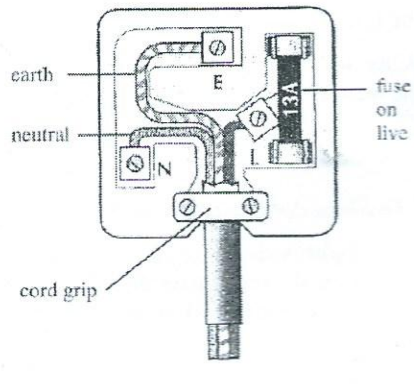


51.2 To Wire a Plug Correctly

About **5** cm of the **white insulation** is removed from the end of the flex.
The **brown** and **blue** wires are cut back by **3 cm.**
About **0.5** cm of the **insulation** is removed from each of the **coloured wires.**

The **exposed ends** of the wires are connected to the **terminals** of the plug; **Blue** to **neutral** on the **left; yellow/green** to **earth** in the **middle;** and **brown** to **live** on the **right.**

All **screws** on the **terminals, cord grip** and **plug** cover are then **tightened** firmly.



Electronics (assumes that current flows from +ve to –ve terminal!)

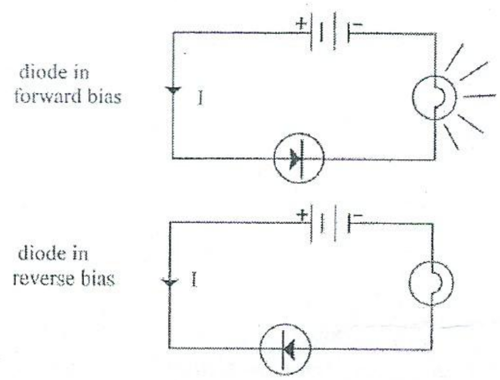
- **Electronics** is the careful and exact **control** of very **small electric currents**.
- A **diode** is an **electronic component** that will allow **current** to flow in **one direction** only.
- A **light emitting diode (LED)** is a **diode** that gives out **light** when a current flows through it.
- **LEDs** use far **less current** than a bulb.
- A **light dependent resistor (LDR)** is a **resistor** whose **resistance depends** on **light**.
- When **light** falls on an **LDR**, its **resistance decreases** and the **current** therefore **increases**.

EXPERIMENTS:

52.1 To Show the Action of a Diode

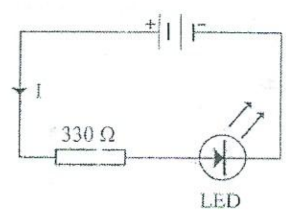
When the **diode** is wired in **forward bias** (**positive** to **positive** of the diode) the **bulb lights**.

When the diode is wired in **reverse bias** (**positive** to **negative** of the diode) the bulb **does not light.**



52.2 To Show the Action of an LED

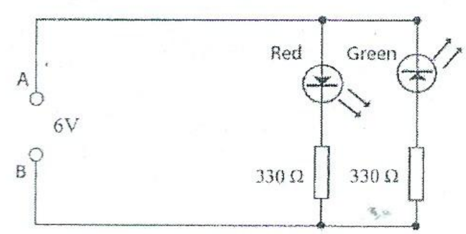
An **LED** gives out **light** when wired in **forward bias** (**positive** to **positive**) as shown.
The **resistor** protects the LED from too high a current.



52.3 Using LEDs to Test the Polarity of a Battery

When **terminal A** is connected to the **positive** of the **battery**, the **red** LED (in forward bias) **lights.**

When **terminal A** is connected to the **negative** of the **battery**, the **green** LED (in forward bias) **lights**.



52.4 To Show the Use of an LDR

When **light** is shone on the **LDR**, its **resistance decreases**, the reading on the **ammeter** shows a **higher current** flowing, and the **bulb** lights **brighter.**

The **resistance** of the **LDR decreases** when **light** shines on it.