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Experiment Manual for Key Stage 3 (Physical Processes)

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Year 7

7I Energy

7J Electrical Circuits

7K Forces And Their Effects

7L The Solar System And Beyond

Year 8

8I Heating And Cooling

8J Magnets And Electromagnets

8K Light

8L Sound And Hearing

Year 9

9I Electricity And Energy

9J Gravity And Space

9K Speeding Up

9L Pressure And Moments

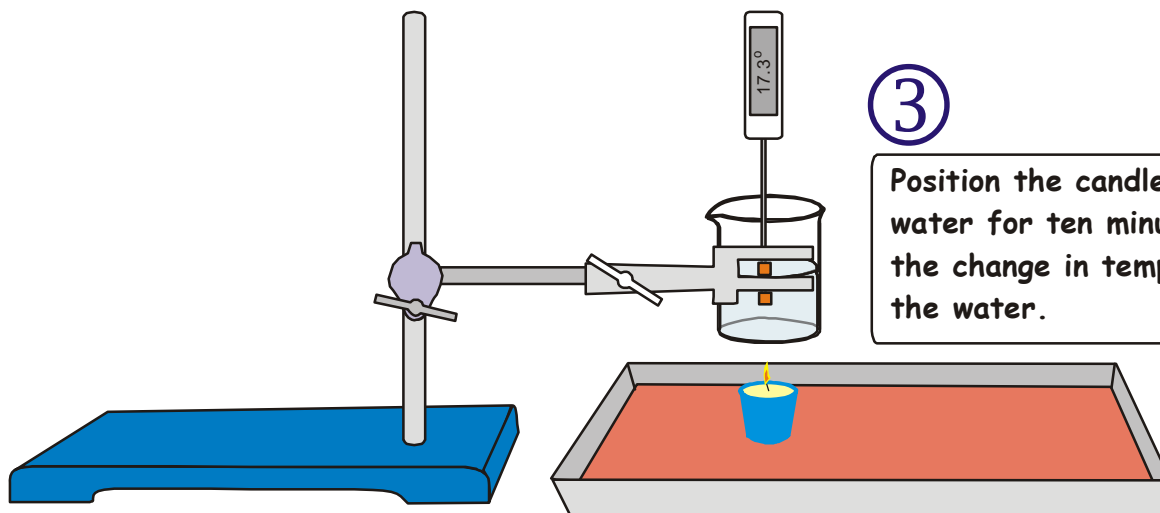
<h1>Unit 7I: Energy Resources</h1>	
	What is energy?
7I1	Energy can be stored - survey
7I2	Energy can be stored - photo survey
7I3	Energy changers - a survey
7I4	Energy can be transformed photo survey
7I5	Energy can be transformed - the light bulb
7I6	Energy can be transformed - the motor
7I7	Energy can be transformed - the heating element
7I8	Energy can be transformed - the solar cell
7I9	Energy can be transformed - the bouncy ball
7I10	Energy can be transformed - the steam engine
7I11	Energy can be transformed - Alka Seltzer ® bomb
7I12	The domino effect
7I13	Energy is lost in transformation - the pendulum
7I14	Energy is lost in transformation - the motor
	Why are fuels useful?
7I15	Energetic content of wax
7I16	Energetic content of Kerosene
7I17	Burning Hydrogen
	What are fossil fuels?
7I18	Formation of coal - cut out and paste
7I19	Formation of oil cut out and paste
7I20	Distillation of coal
	What are renewable energy resources?
7I21	Energy stores - the reservoir
7I22	How to make a solar powered fan
7I23	Construct a hydroelectric generator
7I24	Solar heater I
7I25	Solar heater II
	How do living things use energy?
7I26	Energy stores - food energy
7I27	Energetic content of peanuts and marshmallows
7I28	Electrolysis of water
7I29	Make an electrolysis kit

7I15 Energetic content of wax

Retort stand set 100 ml beaker Digital thermometer Candle Sand tray

①

Add 50ml of water to a 100ml beaker and clamp as indicated opposite.

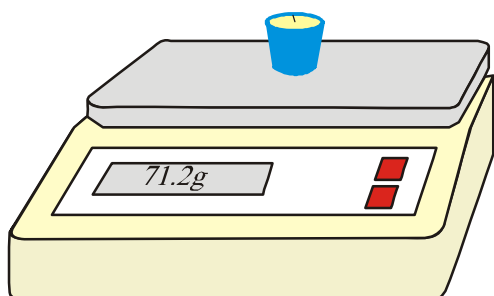


③

Position the candle under the water for ten minutes and note the change in temperature of the water.

 Use a sand tray.

Weigh candle before and after burning



②

Weigh a small candle before and after burning.

What was the mass of the water in the beaker?g

What was the initial temperature of the water?°C

What was the final temperature of the water?°C

If it requires 1 calorie to raise the temperature of 1g of water by 1°C how many calories were released by the candle?

.....

What was: a) the initial mass of the candle?.....g : b) the final mass of the candle?.....g

What was the mass of wax consumed while the candle burned?.....g

Use this information to calculate the calorific content of 100g of candle wax.

.....

.....

7I24 Solar heater I

Tin x 2 Black paint and paintbrush Digital thermometer

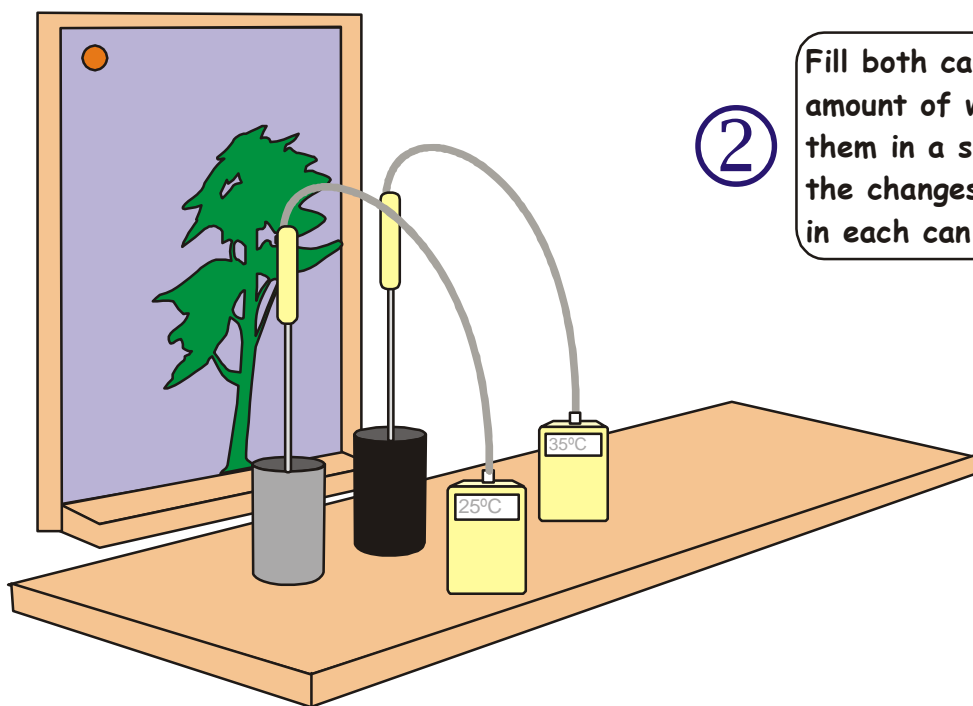
①

Use two Aluminium cans. Paint one of them black.



②

Fill both cans with the same amount of water and leave them in a sunlit window. Record the changes in temperature in each can.



Record the temperature every minute during ten minutes in the table below:

Time (min)	0	1	2	3	4	5	6	7	8	9	10
Temp (°C) (black can)											
Temp (°C) (control)											

Plot the results on the [graph provided](#).

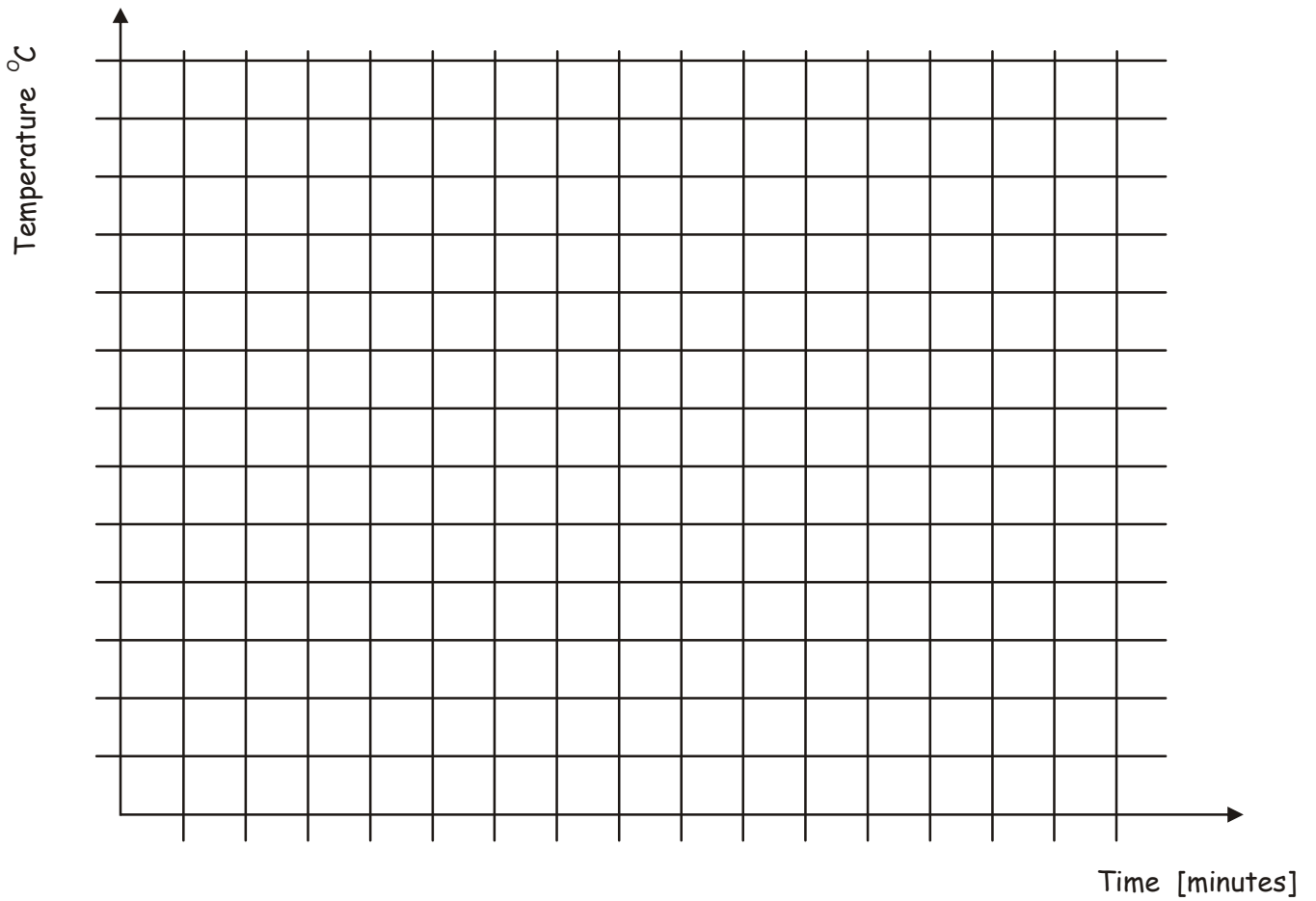
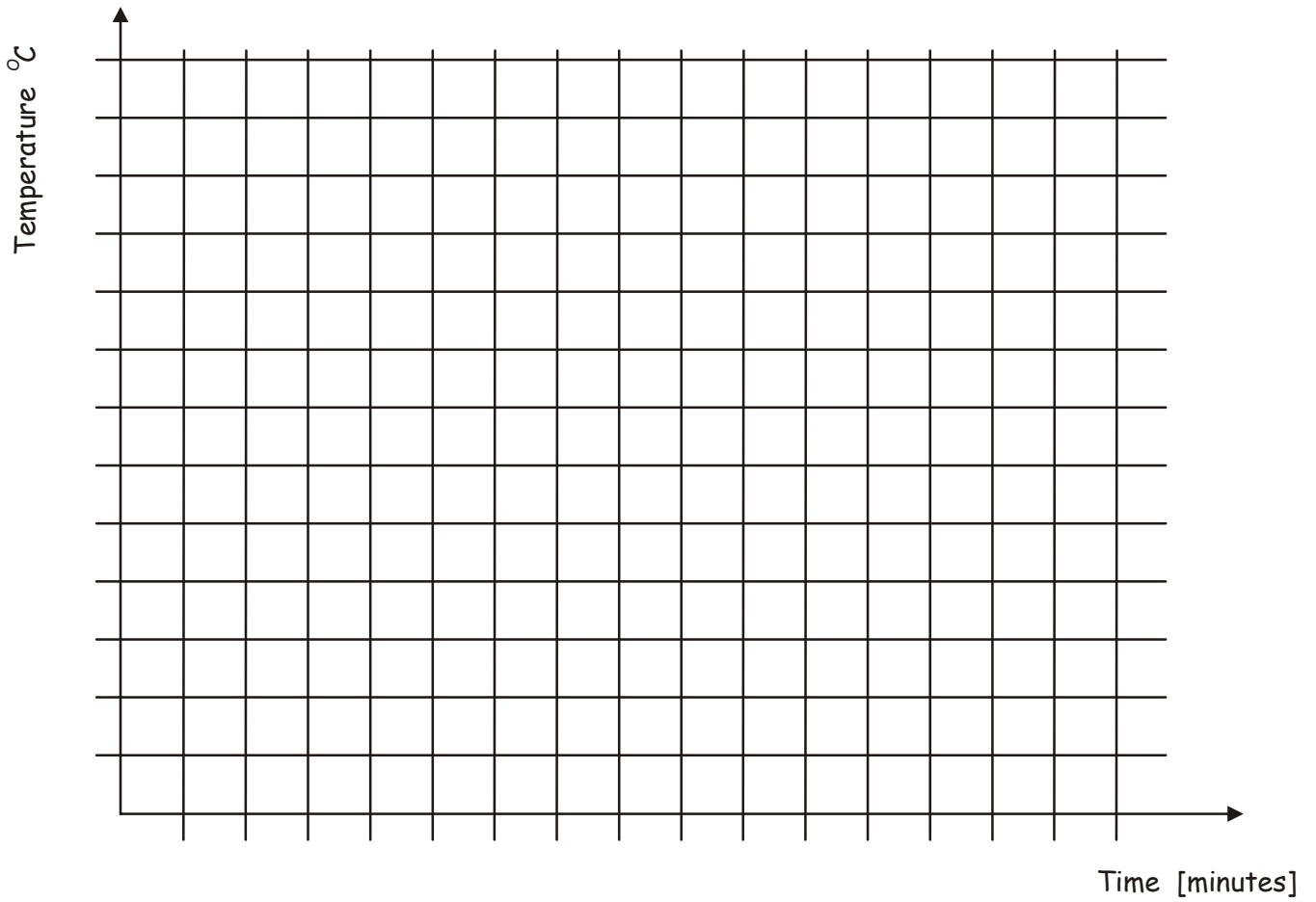
Why was it necessary to have a control in this experiment?

What steps were taken to insure that you carried out a fair test?

Do you notice any difference between the temperatures recorded in each case above?.....

Explain the differences:

7I24 Solar heater I



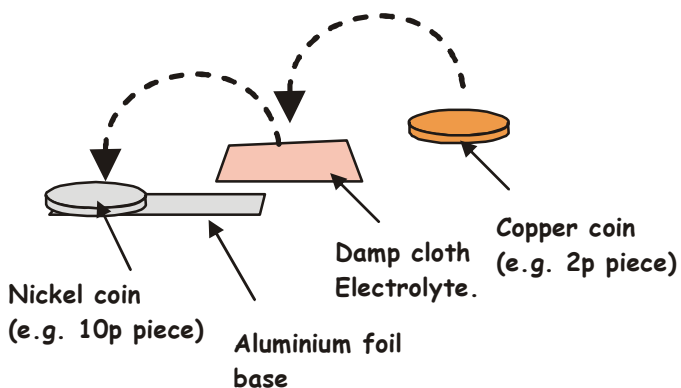
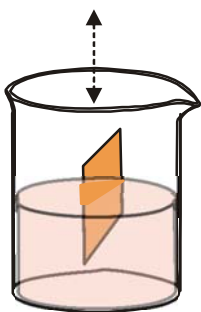
	Unit 7J: Electrical Circuits
	How do electrical circuits work?
7J1	Conductors and insulators
7J2	Electrolytes and non-electrolytes
7J3	Humans conduct
	What happens in a circuit?
7J4	Make a coin battery
7J5	Make a lemon battery
7J6	Different types of batteries
7J7	Find the fault
7J8	Connecting batteries (cells) in series
7J9	How does a light bulb work?
7J10	Connecting light bulbs in series
7J11	Connecting light bulbs in parallel
	How can we explain what happens in electrical circuits?
7J12	An analogy: the water circuit
7J13	Electrical potential - water circuit analogy
7J14	Electrical potential difference I - water circuit analogy
7J15	Electrical potential difference II - water circuit analogy
7J16	Electrical potential difference - thunder clouds I
7J17	Electrical potential difference - thunder clouds II
7J18	Electrical resistance I - water circuit analogy
7J19	Electrical resistance II - water circuit analogy
7J20	Build your own potentiometer
7J21	Using your potentiometer
	What kinds of circuits are useful and what are the hazards?
7J22	Make a quiz board
7J23	Morse code generator - the switch
7J24	Morse code generator - the circuit
7J25	Model ring main lighting circuit
7J26	Hall light switch
7J27	Blow the fuse
7J28	DPDT switch
7J29	The L.E.D
7J30	Current discriminator
7J31	Current discriminator and DPDT switch
7J32	Humidity detector I
7J33	Humidity detector II

7J4 Make a coin battery

Beaker 250 ml Voltmeter Cables + clips Copper and Iron/Nickel based coins Vinegar or lemon juice

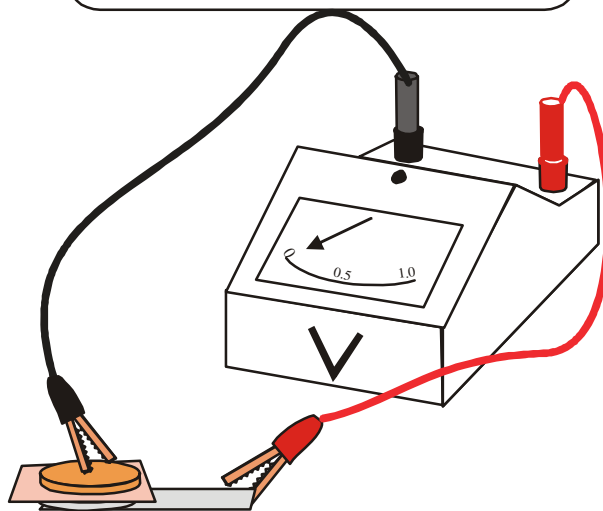
1

Dip some small sections of cloth in vinegar solution and use them to build a dry cell battery as shown below.



2

Measure the electrical potential difference (E.P.D) produced by the combination.



3

Add more cells to the stack and note the E.P.D produced.



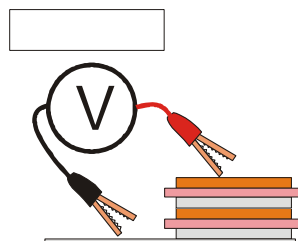
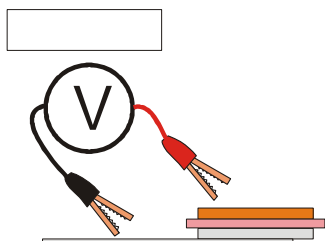
In the battery you have made, which coin represents the positive and which the negative electrodes?

Positive:..... Negative:.....

Why is it necessary to soak the cloth in an acid?

What happens if the coins you use are the same?

Measure the voltmeter reading produced by the combinations below:



What happens to the voltage generated as you increase the number of cells in the pile?

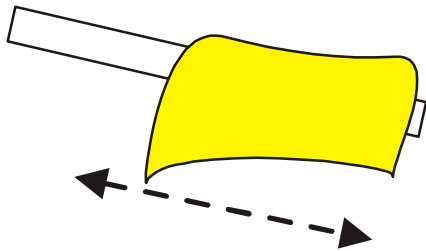
Unit 7K: Forces and their Effects	
	Where do we come across forces?
7K1	Four effects of a force
7K2	Survey of forces
7K3	How to isolate charges
7K4	Forces between charges
7K5	Build your own electroscope
7K6	Polarisation of a conducting sphere
7K7	Deflection of a jet of water
7K8	Attraction of a cereal flake
7K9	How to light a fluorescent tube with a ruler
7K10	Water tension
7K11	Measuring the magnetic force
7K12	Forces in structures
	Why do things float?
7K13	Floating: when forces are balanced
7K14	The up thrust
7K15	Floatability of an object and its density
7K16	The weight of an object in water
7K17	The up thrust produced by different liquids
7K18	Measuring the up thrust using a straw
7K19	Measuring the up thrust using a balance
7K20	Build a densometer
	How do different materials stretch?
7K21	Deformation of a spring
7K22	Comparing springs
7K23	Measure the tension in elastic bands
	What is weight?
7K24	Weight and mass I
7K25	Weight and mass II
7K26	Who can produce the biggest push?
	What does friction do?
7K27	A knot race
7K28	Spinning objects
7K29	Friction I
7K30	Friction II
7K31	Does the weight of an object affect its friction?
7K32	Friction and energy loss in a pendulum
7K33	Friction produces heat

7K8 Attraction of a cereal flake

Cereal flake (e.g. Sugar Puff ®) □ Cotton thread □ Stand set □ Duster □

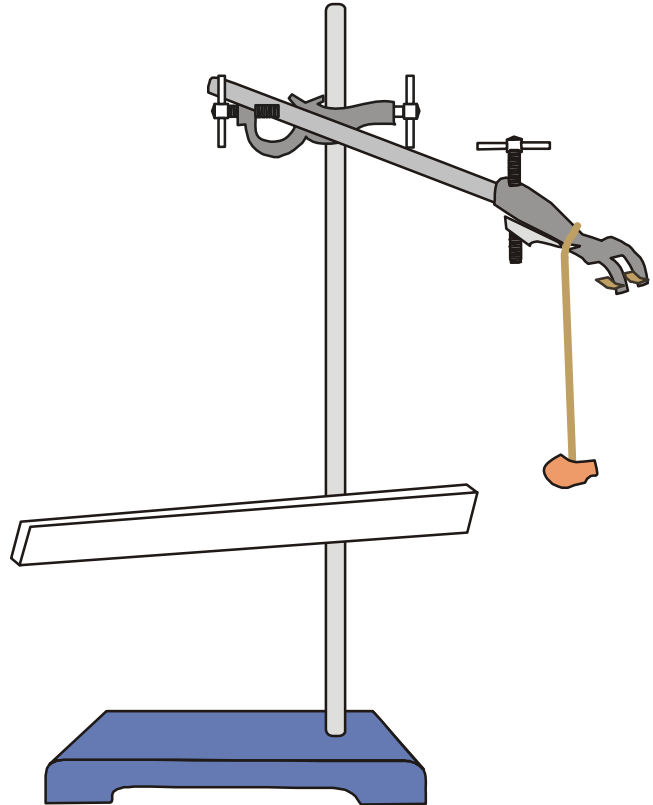
①

Negatively charge a perspex strip and bring it near to the cereal flake and observe what happens.



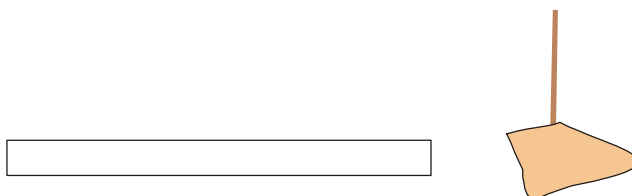
②

Suspend the cereal flake from the retort stand using cotton thread.



Describe what happens as you move the Perspex strip near to the cereal flake:.....

Indicate on the diagram below how the movement of electrons results in an interaction between the cereal flake and the Perspex strip.



Unit 7L: The Solar System and Beyond	
	What is the cause of a year, a month, a day?
7L1	Is the Earth flat? (Eratosthenes' s idea)
7L2	Sun - Earth - Moon model: diameter
7L3	Sun - Earth - Moon model: distance
7L4	Earth - Moon distance
7L5	What is a day?
7L6	What is a month?
7L7	What is a year?
7L8	Variation of hours of daylight with latitude
7L9	Variation of hours of daylight with latitude: data analysis
	How do we see the Sun and Moon?
7L10	Sun's passage viewed at different times of the year (Greenwich)
7L11	Sun's passage viewed from different latitudes (21st June)
7L12	Perspective
7L13	Phases of the Moon
7L14	Demonstrate solar and lunar eclipses using a torch
7L15	Estimate the Moon's diameter using a lunar eclipse
	What causes the seasons on Earth?
7L16	The temperature at the Earth's surface: solar altitude
7L17	The temperature at the Earth's surface: amount of daylight
7L18	UK solar changes throughout the year: data analysis
	What does the solar system consist of?
7L19	Internet survey of the solar system
	What is beyond the solar system?
7L20	Movement of the stars

7L15 Estimate the Moon's diameter using a lunar eclipse

Print and photocopy images on following page Compass and pencil

This photo below shows the initial phase of a Lunar Eclipse. You can see part of the circular shadow produced by the Earth as the Moon starts to enter into the eclipse.

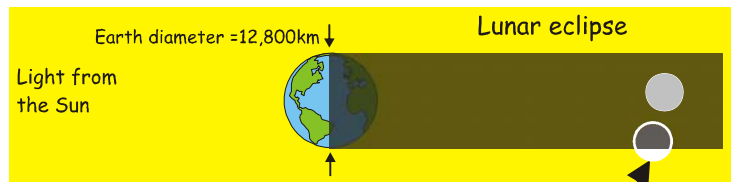


①

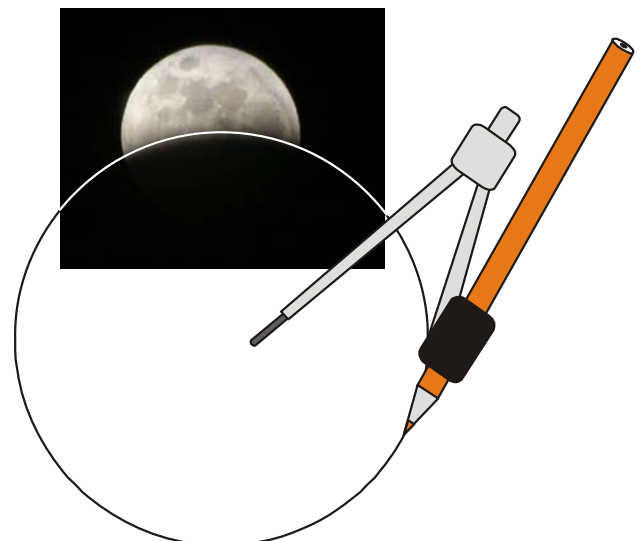
To find the diameter of the Moon you will need to compare the diameter of this shadow with the diameter of the Moon.

②

To do this use the template on the following page and experiment with a set of compasses and a ruler until you find circles that fit.



Use the method opposite to estimate the diameter of the Moon. Templates are provided on the [following page](#).



7L15 Estimate the Moon's diameter using a lunar eclipse



	Unit 8I: Heating and Cooling
	What is temperature?
8I1	Guess the temperature
8I2	Temperature is related to movement
	How do things get hotter or colder?
8I3	Transforming electrical energy into heat
8I4	Transforming light energy into heat
8I5	The Bunsen burner: transforming chemical energy into heat
8I6	Which flame is the hottest?
8I7	Heat flow and differences in temperature
8I8	Big cup - little cup: heat loss problem
8I9	Thermal equilibrium
8I10	A temperature map of your classroom
	How does heat flow from one place to another
8I11	Conductors and insulators
8I12	Conduction in different metals I
8I13	Conduction in different metals II
8I14	Conduction in different metals III
8I15	Convection in liquids
8I16	Convection - make a volcano
8I17	Inverse convection
8I18	Convection in air I
8I19	Convection in air II
8I20	Radiation - simulation of a greenhouse
8I21	The Leslie cube
	How do materials change when they are heated and cooled?
8I22	Expansion in gases
8I23	Expansion in liquids: teacher demo
8I24	Expansion in solids I: teacher demo
8I25	Expansion in solids II: teacher demo
8I26	Crushing can
	How can we reduce energy waste?
8I27	Insulation and cooling
	How can we explain change of state?
8I28	Changes of state
8I29	The effect of salt on the melting point of ice
8I30	Changes of state - evaporation I
8I31	Changes of state - evaporation II
8I32	Changes of state - condensation
8I33	Changes of state - melting: teacher demo
8I34	Changes of state - sublimation: teacher demo

8I11 Conductors and insulators

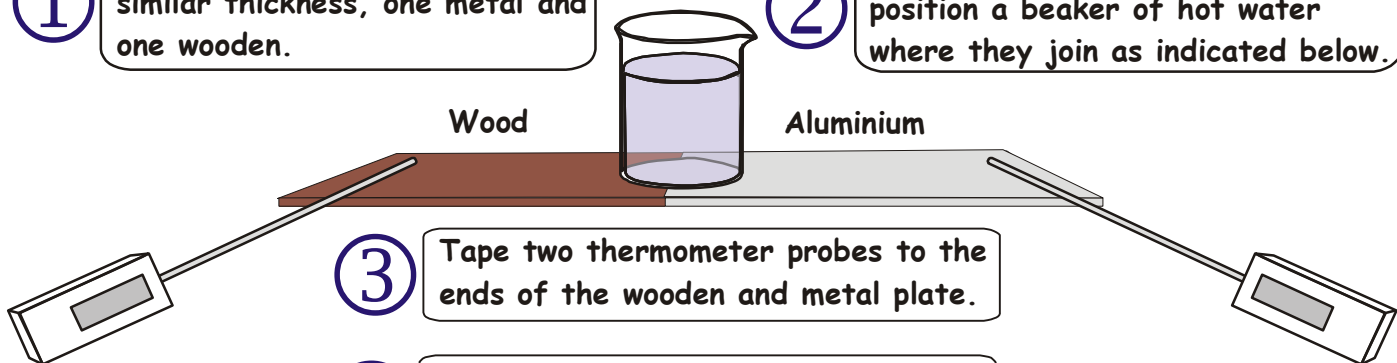
Beaker of hot water Wood strip Aluminium strip Digital thermometer x 2

①

Find two rectangular plates of similar thickness, one metal and one wooden.

②

Place the plates together and position a beaker of hot water where they join as indicated below.



③

Tape two thermometer probes to the ends of the wooden and metal plate.

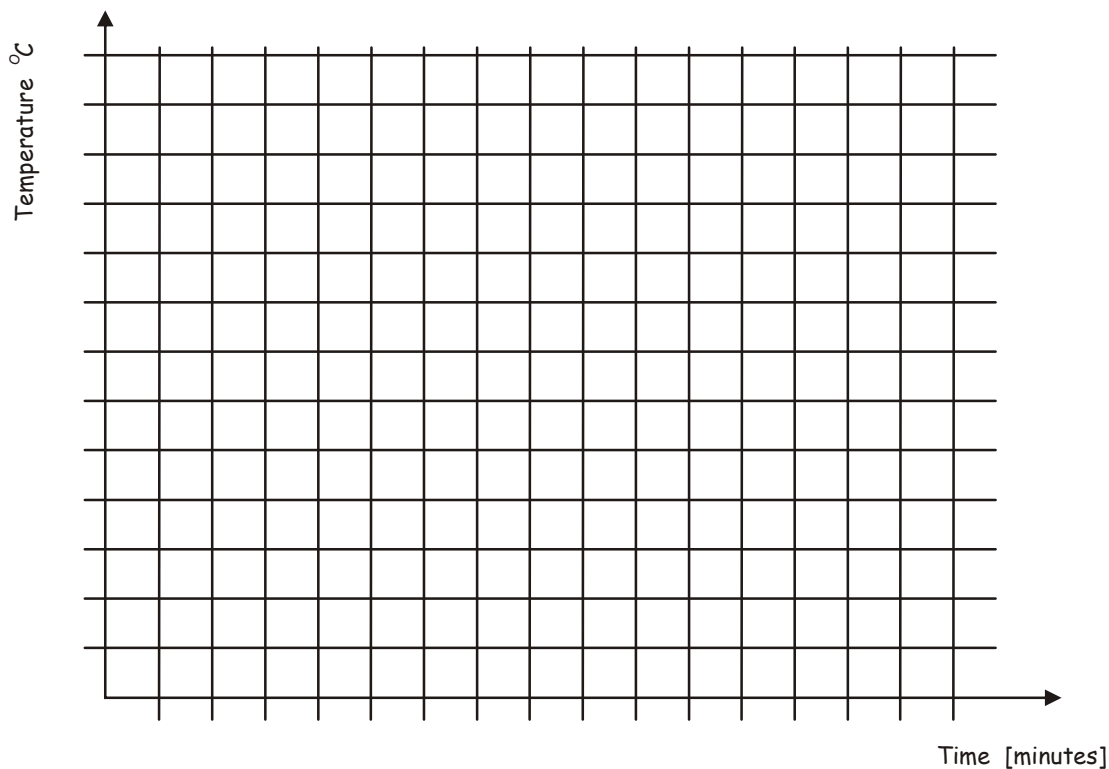
④

Record the temperature in 30 second intervals during a five minute period.

Record the temperature of the wood and Aluminium every 30 seconds for about five minutes:

Time (minutes)	0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	
Temp °C (Aluminium)												
Temp °C (Wood)												

Plot your measurements on the graph shown below:



Explain the results you obtained:

.....

Unit 8J: Magnets and Electromagnets	
	What do magnets do?
8J1	What is a magnet?
8J2	Magnetic material for breakfast
8J3	Test the magnet
	Can magnetism be stopped? Can magnets be made?
8J4	How to create and destroy a magnet
8J5	Make a paper clip float
8J6	Magnetic shielding
	What is a magnetic field?
8J7	How to build a magnetic field viewer
8J8	Magnetic field of a bar magnet
8J9	Magnetic field of two bar magnets
8J10	Magnetic field of a horseshoe magnet
8J11	How to build a compass I
8J12	How to build a compass II
	How can electricity make a magnet?
8J13	The electromagnet
8J14	Oersted effect
8J15	Magnetic field in parallel conductors
8J16	Magnetic field of a solenoid
	How can magnetism make a electricity
8J17	The Faraday effect: a Neodymium magnet in a copper tube
8J18	Make a speaker telephone
8J19	How to make a simple motor

8J4 How to create and destroy a magnet

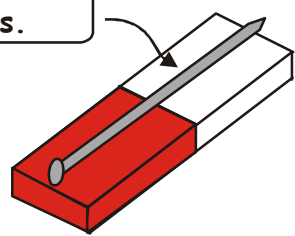
Bar Magnet Iron Nail Tongs Iron filings Bunsen burner Beaker 250 ml + cold water

 Use a ceramic bench mat.

1

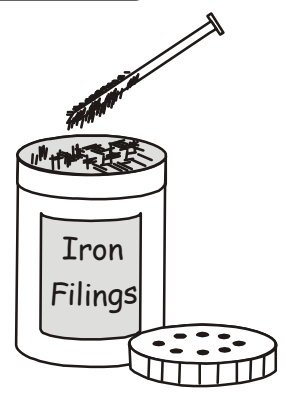
Leave a large nail on top of a permanent magnet for 5 to 10 minutes.

Iron nail



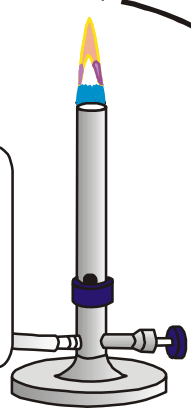
2

Observe how many iron filings the magnetised nail can pick up.



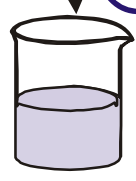
3

Remove the iron filings with a paper towel, heat the nail until red hot then cool rapidly in cold water. Repeat two or three times.

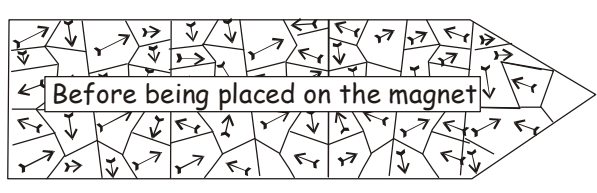


4

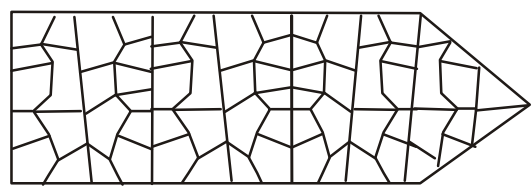
Now test the magnetism of the nail by repeating step two above.



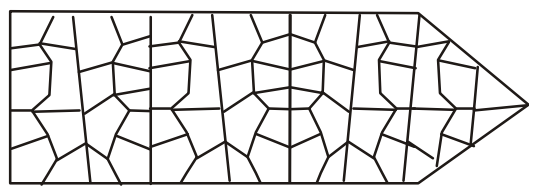
The nail is made of iron which is a magnetic material and consists of billions of small magnetic crystal domains (regions) which are normally disorientated :



Sketch what happens to the orientation of these domains after the nail has been left on a permanent magnet and then after heating and cooling:



After leaving on the permanent magnet



After Heating and Cooling

Explain why heating and cooling a magnet destroys its magnetism?.....

	Unit 8K: Light
	How does light travel?
8K1	Light travels in straight lines
8K2	Light travels in straight lines: shadows
8K3	Light is energy
8K4	Transverse and longitudinal waves
	What happens when light meets an object?
8K5	Transparent, translucent or opaque
8K6	Optical properties of diffusers
	How do we see things? Vision?
8K7	Reflecting light from a yoghurt carton
8K8	Vision - accommodation
8K9	Vision - blind spot
8K10	Vision - integration time
8K11	Binocular vision - field of view
8K12	Integration time: colours on a spinning top
	How do mirrors reflect light?
8K13	The law of reflection
8K14	Multiple reflections
8K15	The retro reflector
8K16	Mirrors
	How are images formed?
8K17	How to make a viewing screen
8K18	How to make a Fresnel lens holder
8K19	How to make a pinhole (shoebox) camera
8K20	Viewing a pinhole camera image
8K21	Project an image of your classroom window
8K22	Form an image of a flame
8K23	Projection of an image onto a screen I
8K24	Projection of an image onto a screen II
8K25	The overhead projector
8K26	Virtual images : a pencil trick
8K27	Make the coin disappear
	Can light be bent?
8K28	Refraction of light
8K29	Convergent and divergent lenses
8K30	Build a beam expander
8K31	Measuring the focal length of various lenses
8K32	Combinations of thin lenses

	What is a spectrum?
8K33	Investigate the colour spectrum
8K34	Prisms and colour
	How can we change colour?
8K35	How to make a light filter
8K36	Filters
8K37	How to make white light
8K38	Mixing colours I - paints
8K39	Mixing colours II - ink jet printer

8K21 Project an image of your classroom window

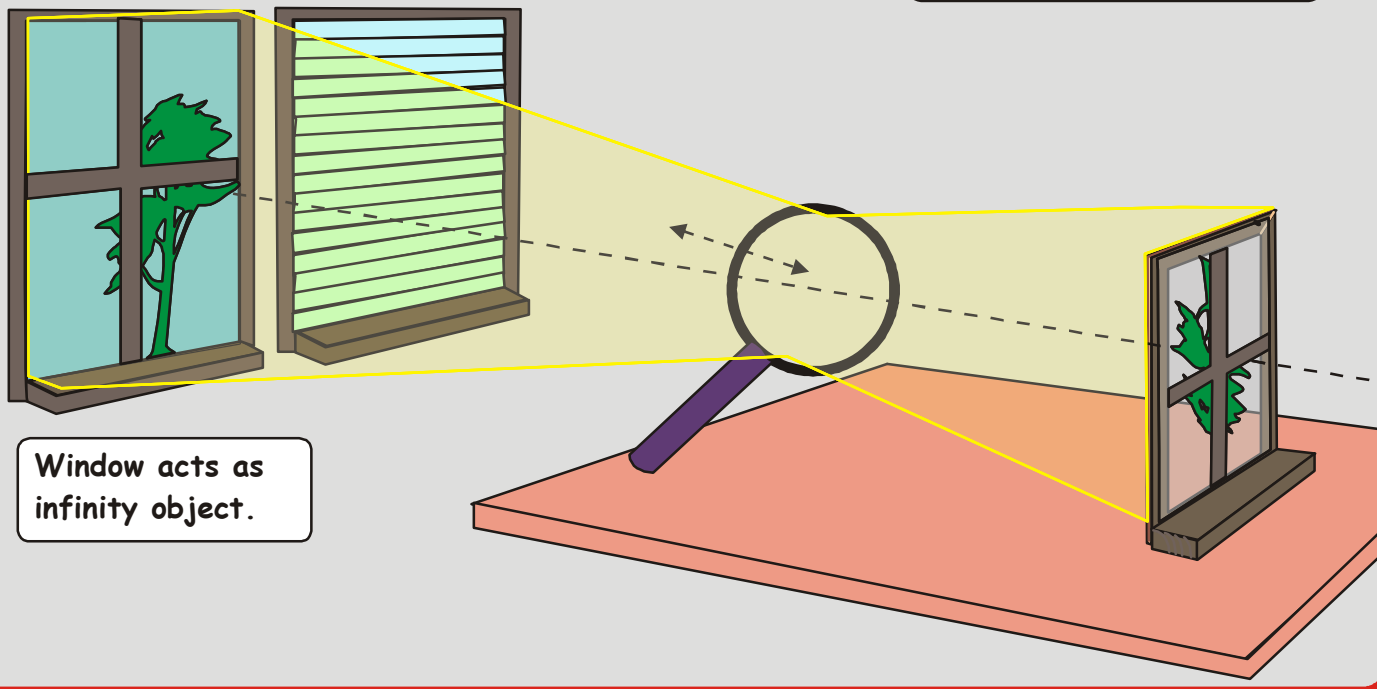
Magnifying glass or lens Viewing screen

1

Turn off the light and pull the blinds down except for one window which will act as an illuminated object.

2

Move the lens towards and away from the screen until you see the image of the window.



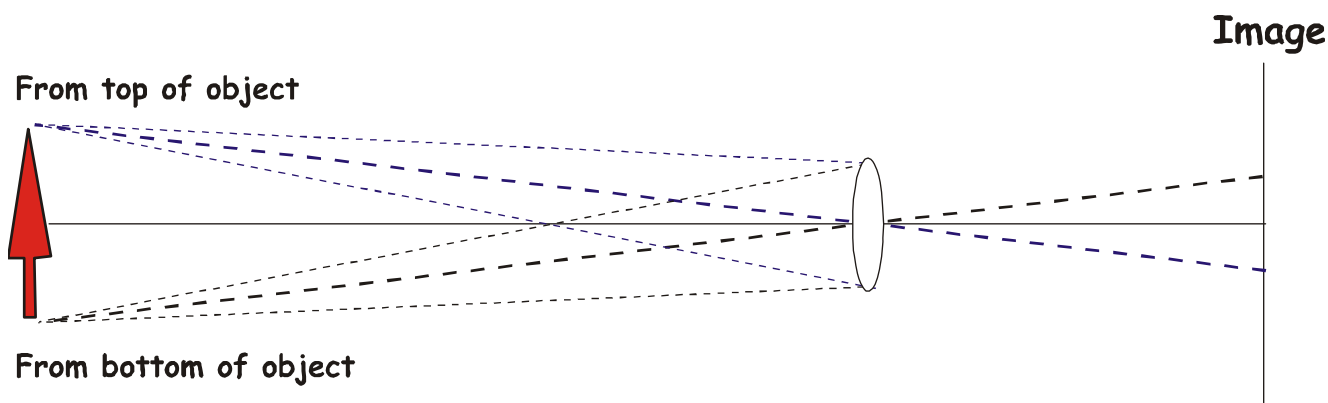
Is the image formed a real or virtual image?.....

How is the image orientated w.r.t the object?.....

The paraxial rays are those that pass from the object through the centre of the lens to the image plane and are not bent by the lens. These have been drawn for you (dotted lines) below.

a) Trace the other rays through to the image plane.

b) Draw the image of the arrow in the image plane

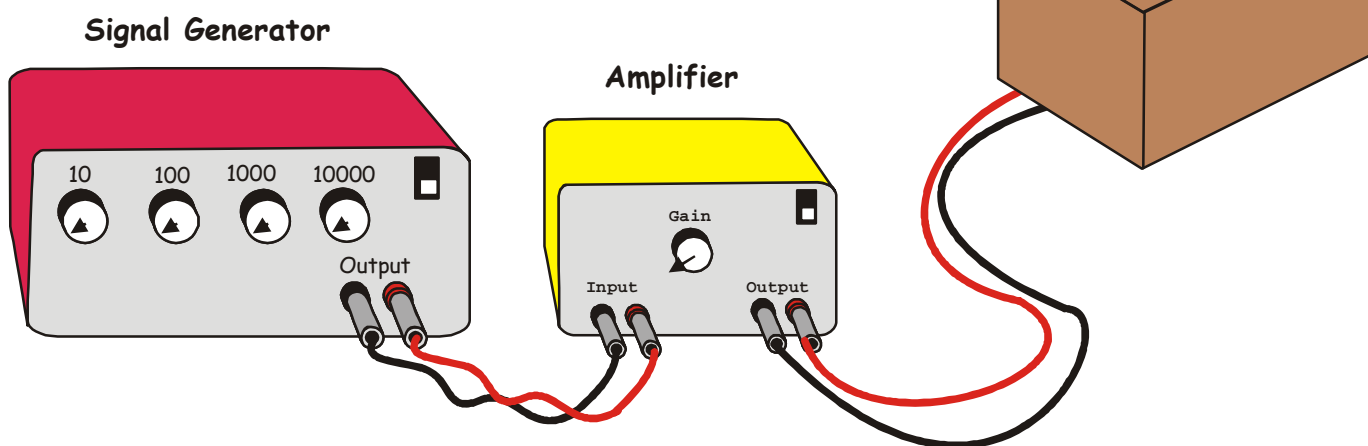


	Unit 8L: Sound and Hearing
	How are different sounds made?
8L1	The orchestra – loudness and pitch
8L2	Good vibrations I
8L3	Good vibrations II
8L4	Vibrations in a speaker
8L5	Pitch and length of a spring
8L6	Pitch and mass of a spring
8L7	Vibrations in a ruler
8L8	Standing waves
	How does sound travel through solids, liquids and gases?
8L9	Sound in a vacuum
8L10	Sound in liquids
8L11	Sound in solids
8L12	Absorption of sound
8L13	Use a slinky to demonstrate a sound wave
8L14	Sound in a string
	How do we hear sounds?
8L15	Model of the ear
8L16	Hearing range - frequency response
8L17	Are two ears better than one?

8L4 Vibrations in a speaker

Speaker Signal generator Amplifier Ping pong ball

- ① Turn a speaker on its side and place a ping pong ball in the cone as indicated below.
- ② Connect the speaker to a signal generator and amplifier.
- ③ Vary the frequency and observe what happens to the ping pong ball.
- ④ Vary the gain of the amplifier and observe what happens to the ping pong ball.



What vibrates in a speaker unit?

How does the frequency effect the behaviour of the ping pong ball?

What happens to the ping pong ball when you increase the gain of the amplifier?

Write the words "frequency" or "gain" along side the following:

The height of the ping pong ball:

How often the ping pong ball bounces:

The loudness of the sound:

The pitch of the sound:

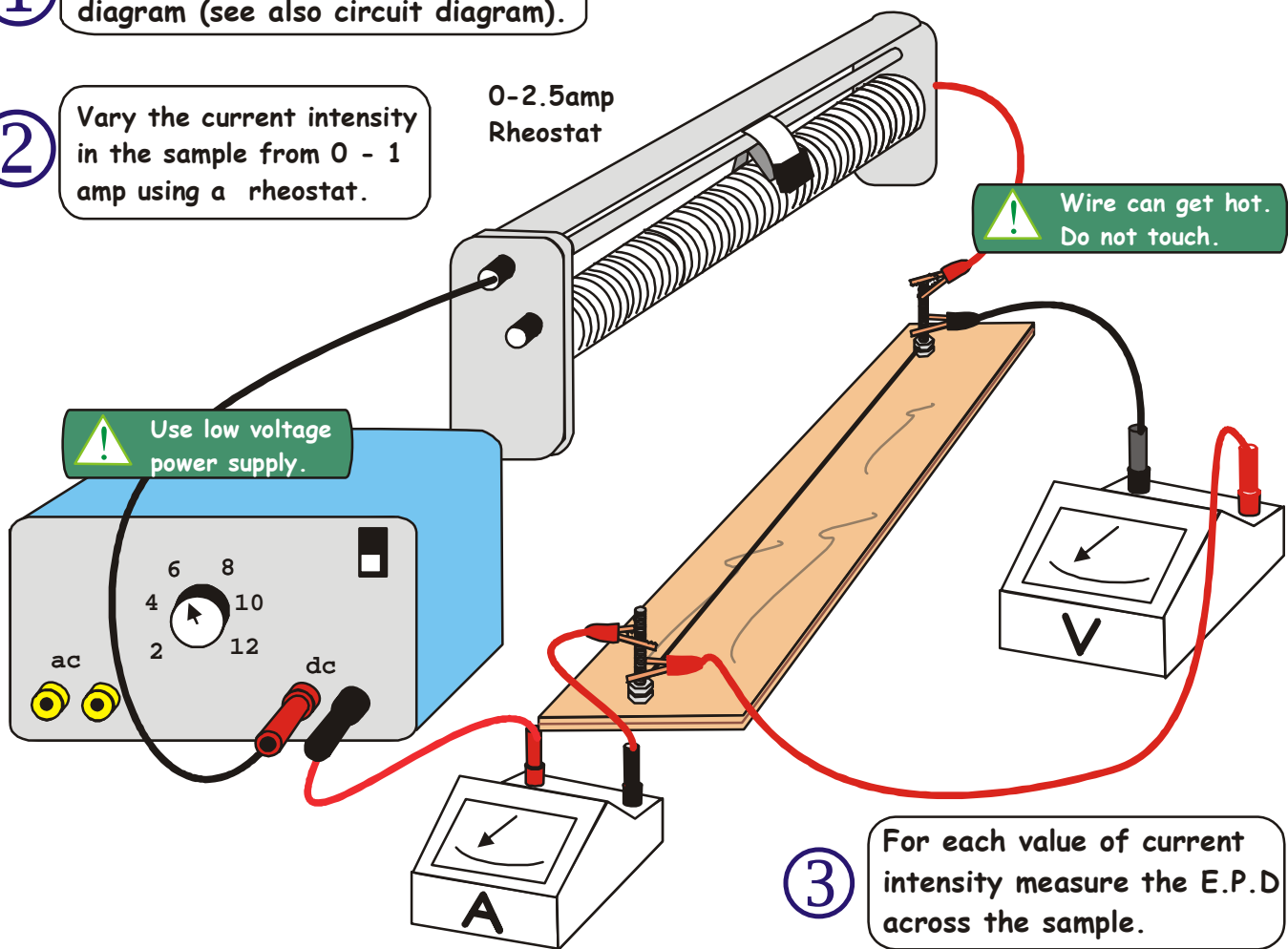
	Unit 9I: Energy and Electricity
	How is energy involved in doing useful things?
9I1	Survey of energy changers
	How does electricity transfer energy?
9I2	Monsieur Coulomb: an introduction
9I3	Monsieur Coulomb: the cell
9I4	Monsieur Coulomb: current intensity
9I5	Monsieur Coulomb: energy transfer
9I6	Investigating a voltaic cell - the electrodes
9I7	Inside a 4.5V flat pack battery
9I8	Inside a dry cell
9I9	Series circuits
9I10	Parallel circuits
9I11	Investigation of Ohm's law
9I12	Ohm's law for a light bulb
9I13	Find the hidden resistance - using Ohm's law
9I14	Find the hidden resistance - quick method
9I15	The resistor code
9I16	Resistance of a conductor I
9I17	Resistance of a conductor II
9I18	Resistance of a conductor III
9I19	Resistance and heat: teacher demo
	What are we paying for when we use electricity?
9I20	Monsieur Coulomb: energy transformed by a component
9I21	Energy transformation in light bulbs
9I22	Calculate your energy bill
	Where do we get electricity from?
9I23	Energy changers - the dynamo
9I24	Connecting solar cells in series
9I25	Connecting solar cells in parallel
9I26	Build a solar panel
9I27	From power station to plug socket

9I11 Investigation of Ohm's law

Low voltage P/S Rheostat 0- 2.5 amp Cables + clips Voltmeter Ammeter Constantan cable 0.2 mm diam.

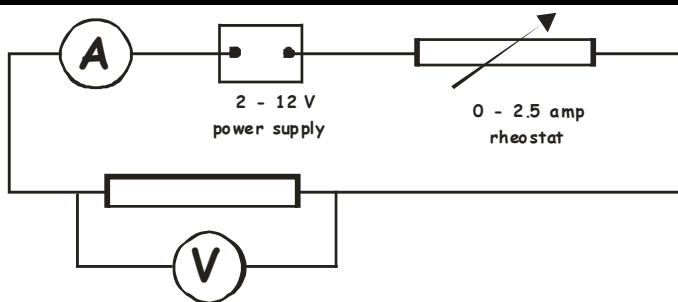
① Set up the circuit as shown in the diagram (see also circuit diagram).

② Vary the current intensity in the sample from 0 - 1 amp using a rheostat.



③ For each value of current intensity measure the E.P.D across the sample.

Vary the current in steps of 0.1 amps by adjusting the rheostat contact. For each current reading measure the electrical potential difference (E.P.D) across the resistance in the table below:

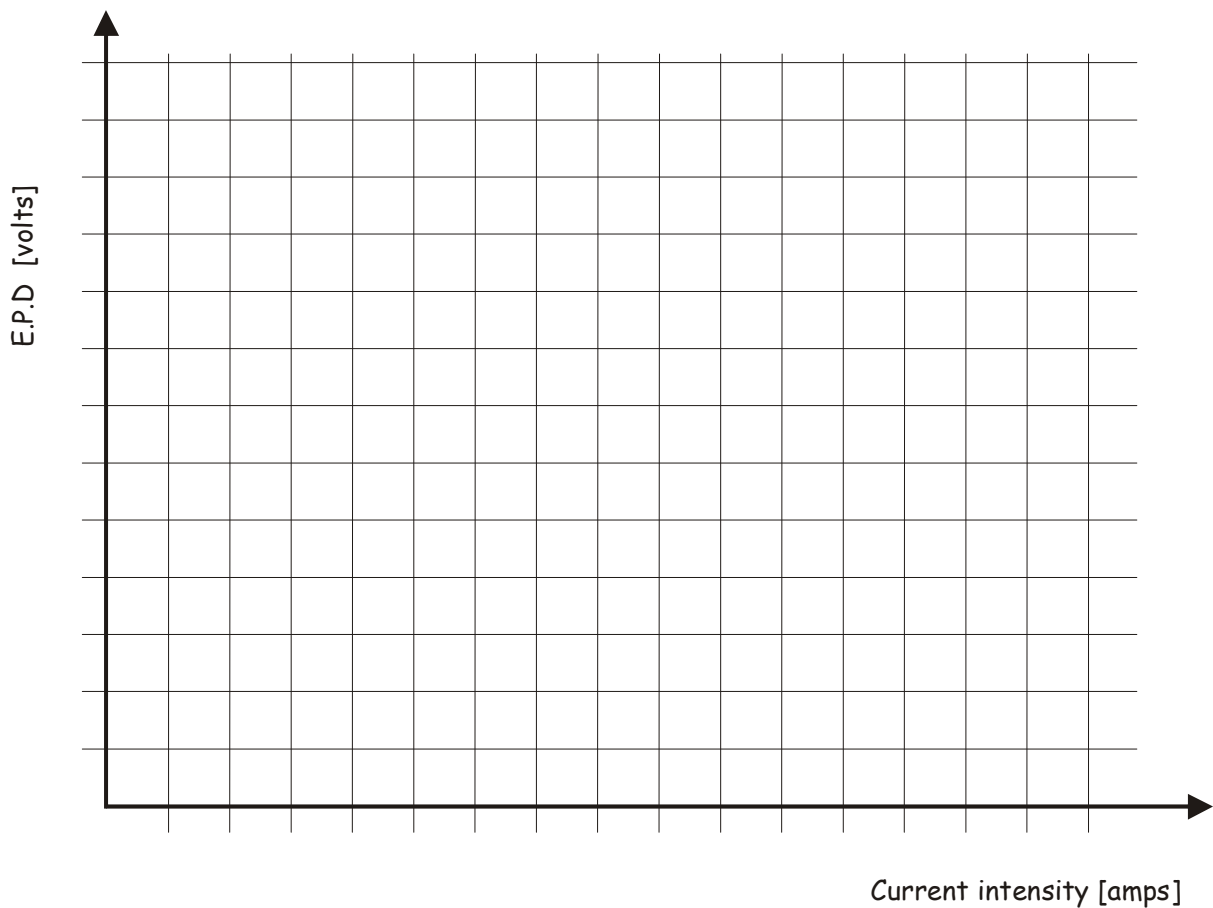
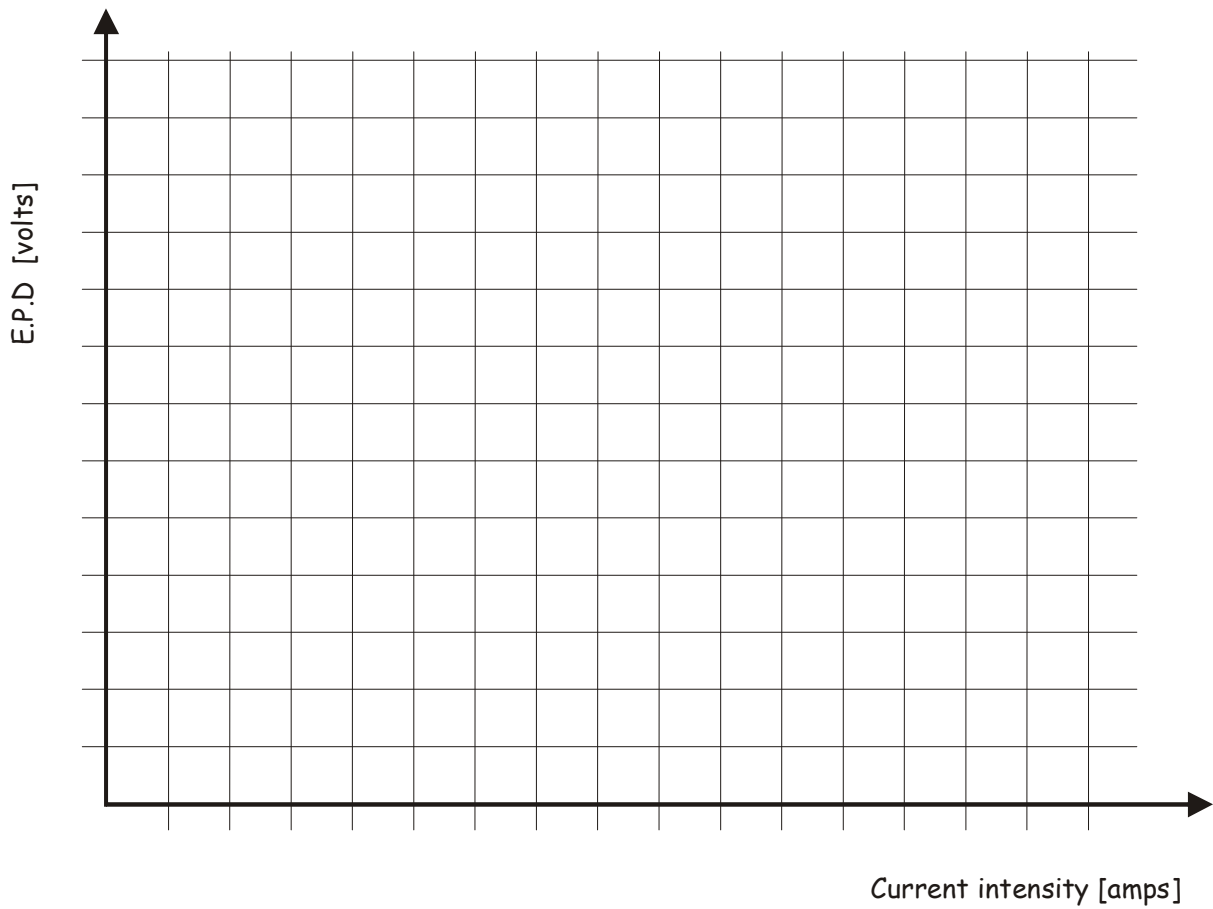


Current Intensity (amps)	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
E. P. D across resistance (Volts)											

Plot a graph of the variation of current intensity with electrical potential difference across the resistance.

Use the graph to estimate the resistance of the sample.

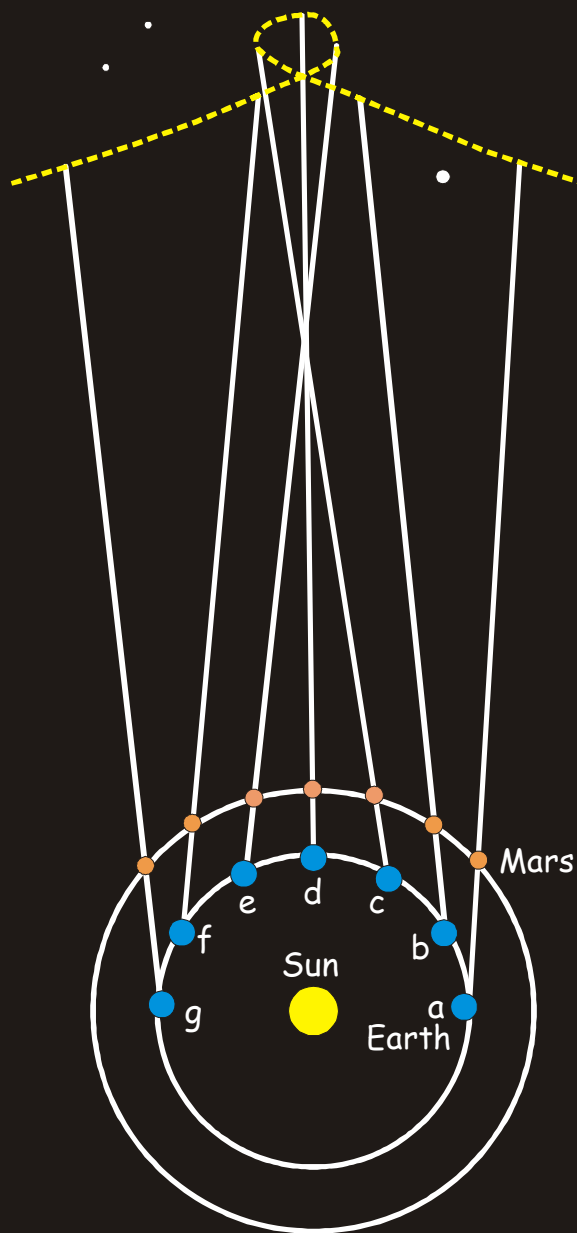
9I13 Find the hidden resistance - using Ohm's law



	Unit 9J: Gravity and Space
	What is gravity?
9J1	Gravity and inertia
9J2	The hammer and feather experiment
9J3	Measuring the acceleration due to gravity I
9J4	Measuring the acceleration due to gravity II
	How does gravity change?
9J5	Internet survey: gravity on different planets
	How have our ideas about the solar system changed?
9J6	The Geocentric model: Aristotle and Ptolemy
9J7	Anomalies I: The apparent motion of Mars
9J8	Anomalies II: The phases of Venus
9J9	The Heliocentric model: Copernicus
	What keeps the planets and satellites in orbit?
9J10	Newton's thought experiment
9J11	Escape velocity
9J12	What keeps a satellite in orbit?

9J7 Anomalies I: The apparent motion of Mars

IWB Print and photocopy work sheet on the [following page](#)



①

Use **the template** on the following page. This shows six positions of the Earth and Mars in their orbits around the Sun.

②

To view the apparent movement of Mars draw lines of equal length through the six positions of Earth and Mars and join up the ends of each line.

What is meant by:

a) an Anomaly?

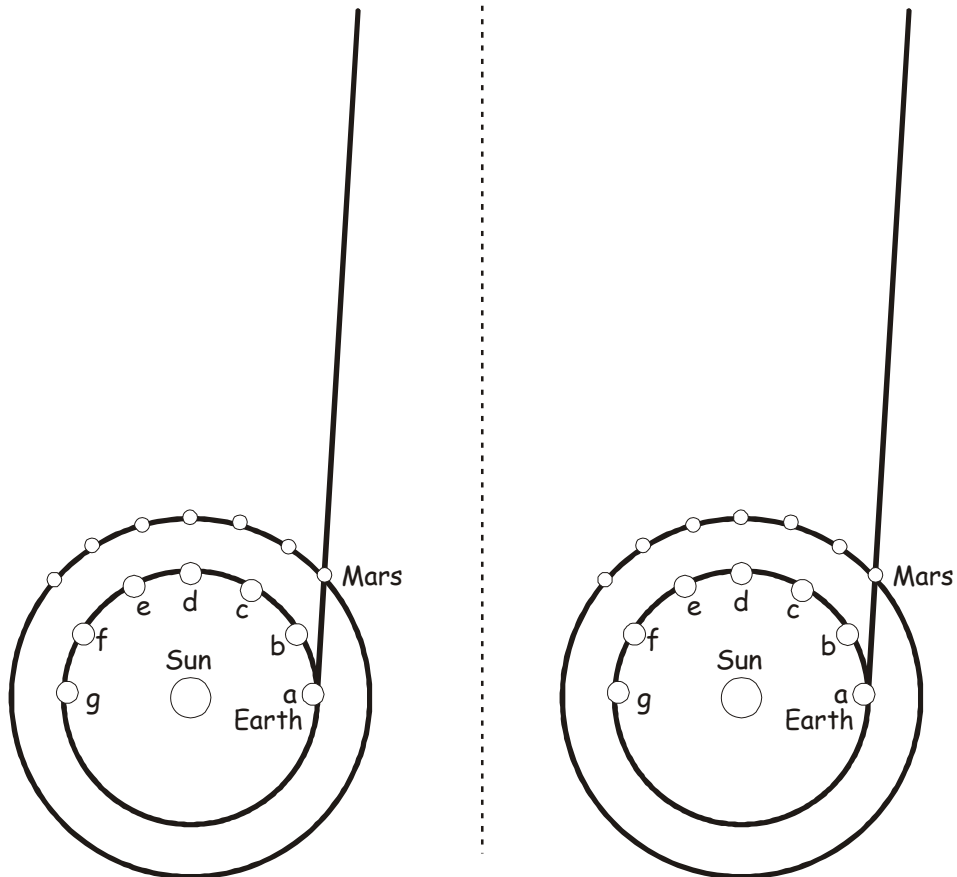
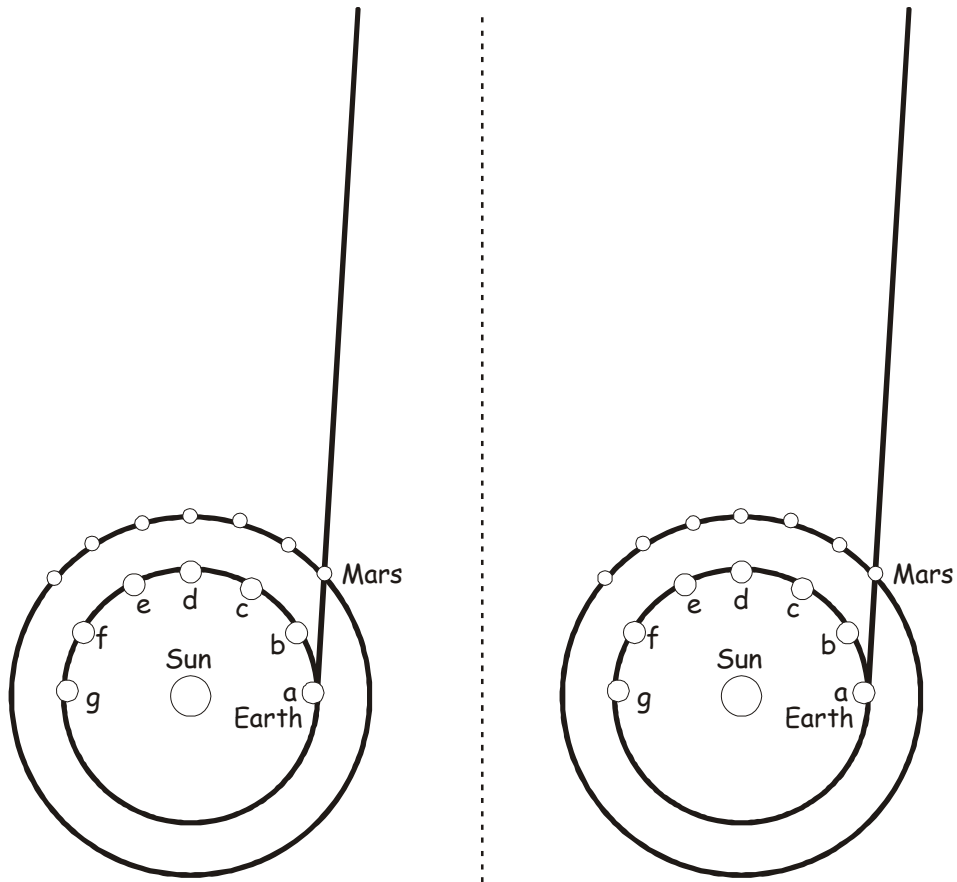
b) Apparent motion?

Why did this "odd" behaviours of Mars present a problem for the *Geocentric Model* of the Universe?

.....

.....

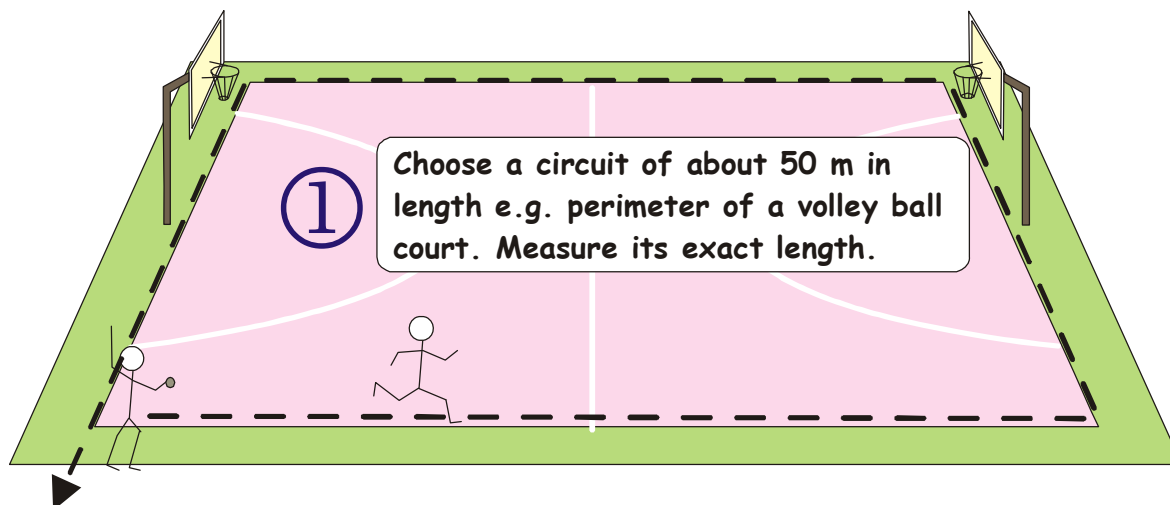
9J7 Anomalies I: The apparent motion of Mars



	Unit 9K: Speeding Up
	How fast is it moving?
9K1	The average speed
9K2	Investigating motion using a ticker tape timer
9K3	School speed trap
	How do forces affect speed?
9K4	Four effects of a force
9K5	Speeding up
9K6	Slowing down
9K7	Stopping distances and speed
9K8	Stopping distances and inertia
9K9	Investigating air resistance I
9K10	Investigating air resistance II
9K11	The speed of a falling object
9K12	Faraday effect
9K13	Build a water propelled rocket
	How can we increase speed?
9K14	Investigating water resistance
9K15	Inertia I
9K16	Inertia II
	How do parachutes work
9K17	Build a parachute
9K18	Investigating parachutes

9K1 The average speed

Stopwatch Tape measure



- ② Run around the course from start to finish without leaving the white line.

Write an expression (opposite) for the average speed in terms of the distance covered and the total time taken:

Average Speed =

Fill in the table below for the members in your group:

Student	Time	Average speed	
		m/s	km/h

The table below shows some typical times that might be recorded in an Olympic stadium. Calculate the average speeds in each case and compare with your own.

Event	Time	Average speed	
		m/s	km/h
100m	9.9s		
200m	19.8s		
800m	1m 42s		
5000m	13 min		
Marathon	2h 5m		

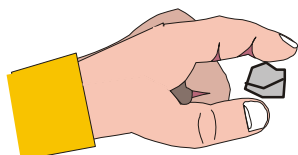
Unit 9L: Pressure and Moments	
What is pressure?	
9L1	Are pins really pointed?
9L2	Pressure of nails
What are pneumatics and hydraulics?	
9L3	Pascal's principle
9L4	Pneumatic press
9L5	Hydraulic press
9L6	Direction of pressure in fluids
9L7	Pressure in fluids I
9L8	Pressure in fluids II
9L9	Pressure in fluids III
9L10	How to make a syringe pump
9L11	How to make a suction pump
9L12	Transmission of pressure I
9L13	Transmission of pressure II
9L14	Compressing liquids and gases
9L15	Archimedes Diablo I
9L16	Archimedes Diablo II
9L17	Air pressure and flow I
9L18	Air pressure and flow II
9L19	How to make a barometer
9L20	Atmospheric pressure I
9L21	Atmospheric pressure II
9L22	Removing air from a bell jar containing marshmallows
9L23	Bernoulli's principle
How do levers work?	
9L24	Investigating levers
How do things balance?	
9L25	Stand up straight boy/girl!
9L26	Centre of gravity of an irregular shape
9L27	How to build a water balance
9L28	Measuring mass with a water balance
9L29	How to build a beam balance
9L30	Calibrating the beam balance
9L31	Using the beam balance
9L32	A hammer trick

9L16 Archimedes Diablo II

Aluminium foil Plastic bottle 500 ml

①

Roll some aluminium foil into a small ball and squeeze it so that it **JUST** floats in the water.

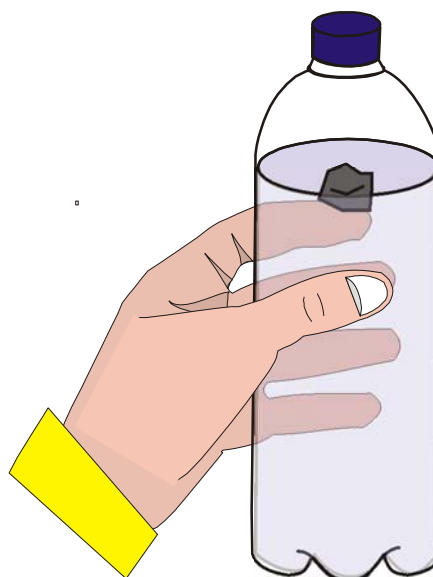


Ball only just floating on water



②

Screw the top on the bottle and squeeze tightly. Observe what happens to the ball.



What happens to the Diablo when you increase the pressure?.....

.....

What happens to the Diablo when you decrease the pressure?.....

.....

Note what happens to the volume of the Diablo as the pressure changes.

.....

Explain your results in terms of changes in the density of the Diablo.

.....

Why does this effect work with a Diablo but not with a block of wood, for example?.....

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