THE ST. MICHAEL SCHOOL

PHYSICS PRACTICAL BOOKLET

DO NOT REMOVE FROM PHYSICS LAB

TABLE OF CONTENTS

PRACTICAL FORMAT

1. TITLE:

The title indicates the topic or section of the syllabus under which the experiment is based. For example, *Thermal Properties* is a suitable title for an experiment to determine the specific latent heat of a substance.

2. AIM:

The aim states exactly what is going to be done in the experiment. An aim usually begins with the word "To". An example of an aim under Mechanical Properties of Materials is "To determine the Young's modulus of a steel wire".

3. APPARATUS:

A list of all essential apparatus and materials should be given. Where possible, write down the length of any material used (e.g. 10.2 cm of wire) and the magnitude of the physical property of components (e.g. 9 V dry cell).

4. DIAGRAM:

A large, line diagram showing how the various pieces of apparatus are utilized in order to carry out the experiment, should be drawn. For example, in an experiment to determine the resistance per unit length of a wire, a circuit diagram is suitable. Your diagram should have a title. Draw neat, horizontal pencil lines to label the main parts of the diagram.

5. METHOD:

List all steps in the procedure, taking care to show the correct sequence of tasks. Use past tense, third person and passive voice. For example, "The switch was closed and the current noted on the ammeter".

6. THEORY:

Briefly explain the principle(s) behind the experiment. Write down any formula (e) which is/are relevant to the experiment.

7. RESULTS:

It is essential to make accurate observations and record such observations properly. When in doubt, double check the steps in the procedure and have the apparatus checked. Data is usually tabulated (Table format) with suitable headings and units, if any. The number of significant figures used in recording numerical data should be consistent.

8. CALCULATIONS:

It is often necessary to perform calculations based on your results. Express your answers to the appropriate number of significant figures. Record the calculated values in the results table using a suitable heading and unit.

9. PLOTTING A GRAPH:

Give your graph a suitable title. Label each axis with the variable and its unit. Choose scales which will enable points to be plotted easily. The resulting graph (line or curve), when drawn should occupy most of the page. Plot points with a sharp pencil using either a dot or cross to mark each point. Draw a line or curve of best fit, which need not pass through all the points (see figures 1, 2).

10. DISCUSSION:

Explain how sources of error may occur while conducting the experiment. Errors may be random or systematic. Random errors occur when measurements are scattered around a mean value. Random errors arise, for example, in taking readings on analog instruments where the observer has to estimate the position of the pointer on a scale. Systematic errors occur when there is a significant difference between the mean and the accepted value. Systematic errors may arise from a faulty instrument, lack of skill on the part of the experimenter or there may be a problem with the method. State any precautions which were taken to ensure reliable and accurate results.

11. CONCLUSION:

There should be a link or connection to the aim of the practical. Write a clear and concise conclusion.

PLANNING AND DESIGNING AN EXPERIMENT

In addition to the preceding section on Practical Format, the following should be noted.

1. HYPOTHESIS:

A hypothesis is a statement which seeks to establish a possible relationship between two variables. In formulating a hypothesis, you should ensure that it is clearly stated in such a way that it can be tested.

2. AIM:

The aim must be relevant to the hypothesis.

3. APPARATUS AND MATERIALS:

List all essential pieces of apparatus and materials.

4. METHOD:

List all steps in the plan in a logically sequenced manner. However, you must use the *present tense*. The factors which are going to be kept constant as well as the responding variable should be stated. Ensure that you state the relevant experimental details.

5. VARIABLES:

State the manipulated variable and rewrite the controlled variables and the responding variable.

6. DATA COLLECTED:

State the readings or measurements which will be taken. For example, the temperature was recorded every minute for ten minutes. A suitable display of results, such as a table with headings and units may be useful.

7. USE OF DATA:

Explain how the data collected will be used to validate or invalidate the hypothesis. In doing so, you should try to link the data, both in support of and in opposition to your hypothesis.

8. LIMITATIONS/ERRORS/ASSUMPTIONS:

Discuss possible sources of error and state any assumptions made in the experiment. Any limitation which may be anticipated in carrying out the plan should be stated and its possible effect on the experiment explained.

LAB 1: HEAT EXPANSION OF SOLIDS

AIM: To investigate the different types of expansions in solids

APPARATUS & MATERIALS:

bar and gauge	bunsen burner
ball and ring	tongs
bimetallic strip	water

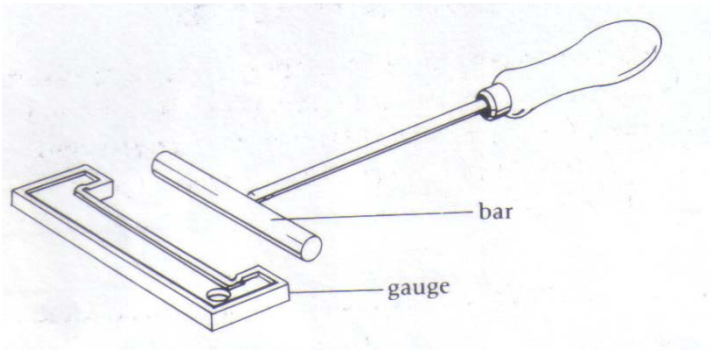


Diagram 1: Bar and Gauge

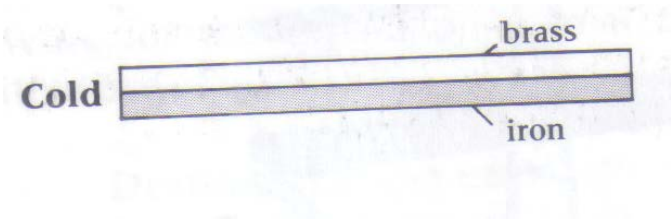


Diagram 3: Bimetallic Strip

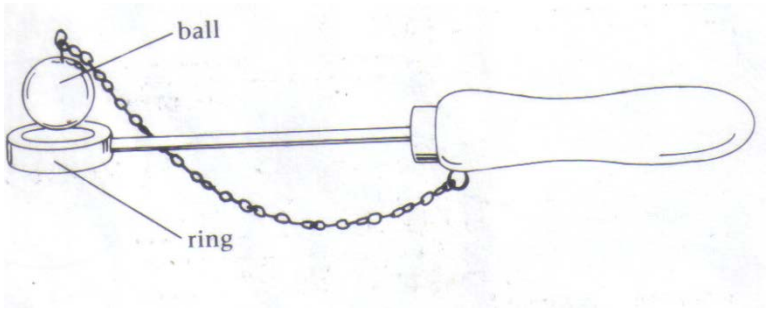


Diagram 3: Ball and Ring

METHOD:

- Fit the ball into the ring when cool and fit the bar into the gauge when cool.
- Heat the ball and the bar over the Bunsen burner flame and test the fit again.
- Cool the ball and bar once more and test the fit again.
- Record all the observations.

- Observe the bimetallic strip when it is cool. Heat the bimetallic strip and record the observations.
- Cool the bimetallic strip and record all observations.

THEORY:

- State the different types of expansion that occur in solids.
- Explain how expansion occurs in solids.

OBERVATIONS:

- State the observations for the ball and ring, bar and gauge and the bimetallic strip. (use a separate paragraph for each observation)

CONCLUSION:

- Explain the observations that occurred in the experiments and which type of expansion occurred.
- Discuss the bimetallic strip and explain its behaviour on heating.

LAB 2: CONDUCTION AND CONVECTION (in water)

AIM: To investigate the conduction and the convection of heat in water.

APPARATUS AND MATERIALS:

test tube	water
bunsen burner	ice cubes
gauze	potassium permanganate
large glass beaker	

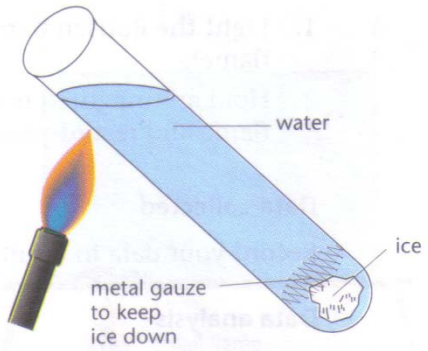


Diagram 1: Conduction of heat in water

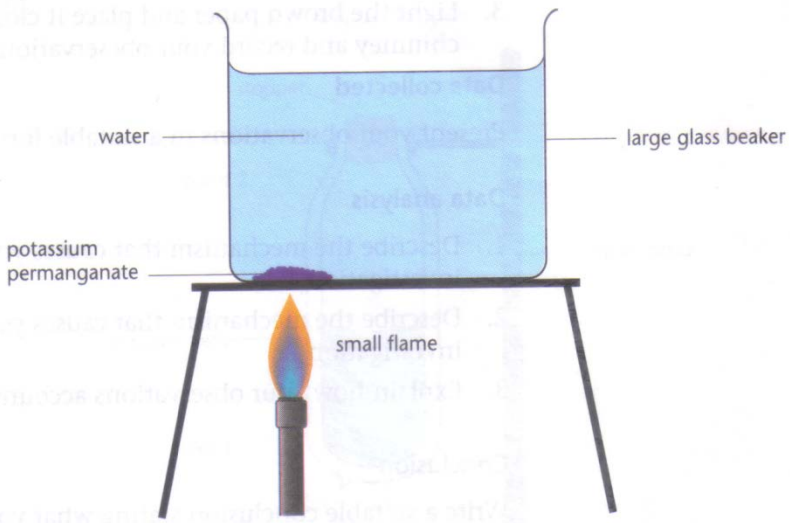


Diagram 2: Convection of heat in water.

METHOD: (Conduction)

- Wedge a piece of ice at the bottom of a test tube so that it cannot float.
- Almost fill the test tube with cold water and heat it near the upper end.
- Record all observations.
- Repeat the experiment, but instead allow the ice to ice to float in the test tube and heat the test tube at the bottom.
- Record all observations.

METHOD: (Convection)

- Fill a beaker with cold water almost to the top. When the water is still, drop a few crystals of potassium permanganate near one side.
- Using a small flame, gently heat the beaker just below the crystals.
- Record all observations.

THEORY:

- Define conduction and convection

OBERVATIONS:

- State all the observations in both experiments.

CONCLUSION:

- Explain the observations that occurred in both experiments.

LAB 3: SPECIFIC HEAT CAPACITY (method of mixtures)

AIM: To determine the specific heat capacity of a brass by the method of mixtures

APPARATUS & MATERIALS:

bunsen burner	brass
thermometer	water
beaker	string
measuring cylinder	styrofoam cup

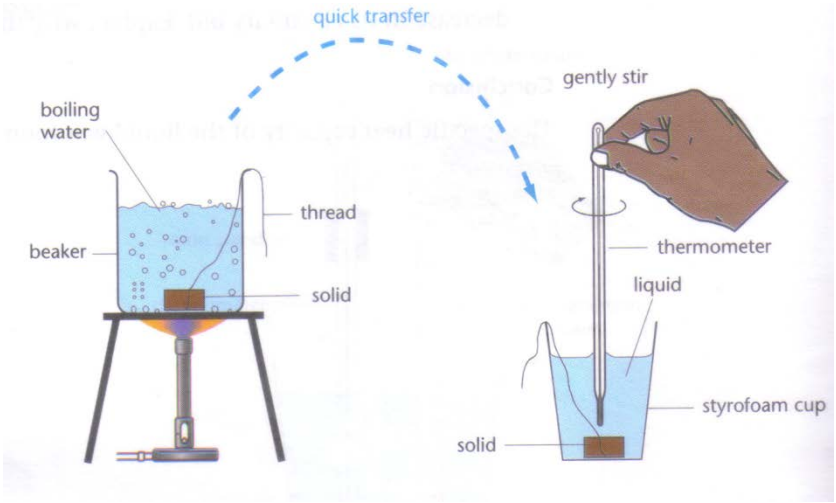


Diagram: Apparatus used for the specific heat capacity of a brass by the method of mixtures

METHOD:

- Heat a 100g brass mass in boiling water at 100 ^{o}C, over a period of time.
- Put 100g of water in a styrofoam cup and measure its temperature
- Shake and quickly transfer the brass mass from the boiling water to the water in the styrofoam cup.
- Stir the water with the brass mass in it with the thermometer until a steady temperature is reached.
- Record the final temperature of the mixture of the brass mass and the water.
- Assuming that no heat was gained by the styrofoam cup, calculate the specific heat capacity of the brass mass.

[Assume that 1cm^3 of water = 1g of water]

THEORY:

- Define the specific heat capacity of a substance. State the formula and units.
- State the formula for the method of mixtures

RESULTS:

- Record all results in a suitable table (showing all headings and units)

CALCULATIONS:

- State formula used and show all working. (remember all units)

CONCLUSION:

- State the specific heat capacity of the 100g brass mass.
- State the main assumption made in the experiment
- Explain why the 100g brass mass was shaken and quickly transferred into the styrofoam cup.
- Why was the mixture of the water and the 100g stirred with the thermometer?

LAB 4: COOLING CURVE OF NAPHTHALENE

AIM: To determine the melting point of naphthalene from a cooling curve

APPARATUS & MATERIALS:

retort stand	naphthalene
boiling tube	water
thermometer	stopwatch
bunsen burner	

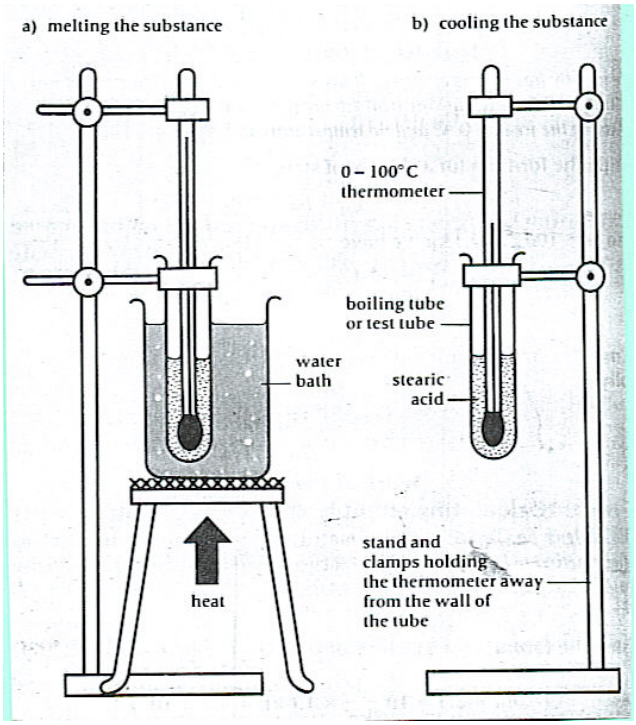


Diagram: Apparatus used for the melting point of naphthalene

METHOD:

- Put some naphthalene in a boiling tube and heat the boiling tube in a water bath as shown in the diagram.
- When all the naphthalene has melted and reached 100 ^{0}C, carefully lift the boiling tube from the water bath.
- Using a stopwatch, record the temperature of the substance every minute until all of it has solidified and cool below it freezing point.

THEORY:

- Define the melting / freezing point of a substance
- Define the specific latent heat. State the formula and the units.

RESULTS:

- Record all results in the table below (showing all headings and units)

Time (minutes)	Temperature (^{o}C)

- Plot a cooling curve (temperature against time) for naphthalene.

CONCLUSION:

- State the melting point of the naphthalene.
- Describe the shape of the cooling curve of naphthalene.
- List the precautions and sources of error in this experiment.

NOTE

1. Having the boiling tube ready mounted in a stand while it is being heated allows it to be lifted safely from the boiling water and allows temperature readings to be taken immediately.

2. Clamping the thermometer separately so that the thermometer bulb does not rest on the wall of the boiling tube gives a better graph because the glass wall of the tube cools below the temperature of the substance inside.

3. Before removing the thermometer, first melt the substance.

LAB 5: REFLECTION OF LIGHT

AIM: To investigate the relationship between the angle of incidence and the angle of reflection.

APPARATUS & MATERIALS:

plane mirror	paper
optical pins	tape
wooden board	protractor
ruler	

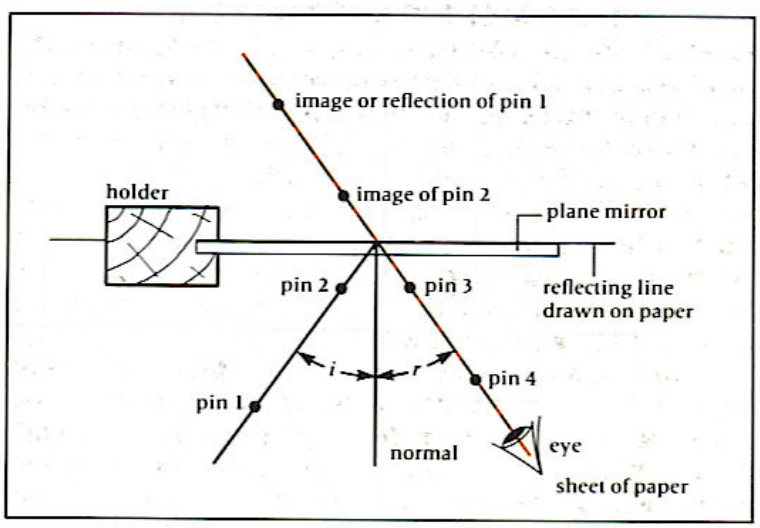


Diagram: Apparatus for the reflection of light

METHOD:

- Fasten a sheet of paper to a drawing board or flat surface into which pins can be pressed easily.
- Mark the reflecting line on the paper.
- Draw a normal at right angles to this line.
- Draw an incident ray at 30 ^{o} to the normal, (***i* = 30°**)
- Press ***pin1*** and ***pin2*** into the paper at the positions shown in the figure above.
- Stand the mirror upright with its reflecting surface on the reflecting line.
- With your eye at bench level, look into the mirror and find a position where the image of ***pin2*** covers ***pin1***. Now press in first ***pin3*** and ***pin4*** so that they in turn cover the images of ***pin1*** and

pin2. ***Pin3*** and ***pin4*** will be in line with the images of ***pin1*** and ***pin2***. ***Pin3*** and ***pin4*** mark the position of the reflected ray.

- Remove all pins and draw the line through ***pin3*** and ***pin4***.
- Measure the angle of reflection, ***r***.
- Repeat the experiment for the other angles of incidences, **0°, 15°, 45°, 60° and 75°**

THEORY:

- State the laws of reflection.

OBSERVATIONS / RESULTS:

- Fasten trace into SBA book. (a fully labelled diagram)
- Record all results in table below (showing all headings and units)

Angle of incidence, *i*	**Angle of reflection, *r***

CONCLUSION:

- Can you draw any conclusion about the angles of incidence, angles of reflection and normal from your measurement?
- Why are the pins placed as far apart as possible?
- List any precautions or sources of errors.

LAB 6: REFRACTION OF LIGHT – GLASS BLOCK

AIM: To determine the refractive index of a rectangular glass block

APPARATUS & MATERIALS:

rectangular glass block	paper
optical pins	tape
protractor	wooden board

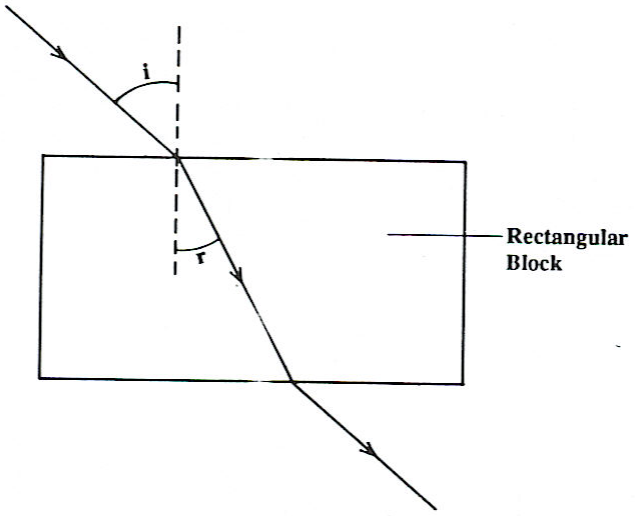


Diagram: Apparatus for the refraction of light

METHOD:

- Fasten a sheet of paper to a drawing board or flat surface into which pins can be pressed easily.
- Draw accurately the outline of the rectangular glass block.
- Using a protractor, draw a normal, in a position as shown in the diagram, and measure the angle of incidence, ***i* = 15°**
- Press ***pin1*** and ***pin2*** into the paper at the positions shown in the figure above.
- Place the rectangular accurately into the outline.
- With your eye at bench level, look into the rectangular and find a position where the image of ***pin2*** covers ***pin1***. Now press in first ***pin3*** and ***pin4*** so that they in turn cover the images of ***pin1***

and ***pin2***. ***Pin3*** and ***pin4*** will be in line with the images of ***pin1*** and ***pin2***. ***Pin3*** and ***pin4*** mark the position of the refracted ray.

- Remove all pins and draw the line through ***pin3*** and ***pin4***.
- Remove the glass block, draw in the emergent ray and the refracted ray and measure the angle of refraction, ***r***.
- Repeat the experiment for the other angles of incidences, **0 °, 30 °, 45 ° and 60 °**
- Tabulate the values of the angles ***i*** and ***r,*** and also using the calculator, the values of ***sin i*** and ***sin r***.

THEORY:

- State the laws of refraction.
- State Snell's Law. State the formula.

OBSERVATIONS / RESULTS:

- Fasten trace into SBA book. (a fully labelled diagram)
- Record and tabulate all results in table below (showing all headings and units)

Angle of incidence, *i*	**Angle of refraction, *r***	***sin i***	**sin r**

- Plot the graph of ***sin i*** against ***sin r***.

CALCULATIONS:

- Calculate the gradient from the graph to determine the refractive index of the rectangular glass block.

CONCLUSION:

- State the refractive index of the glass block.
- State the laws of refraction and Snell's law

LAB 7: LENSES

AIM: To determine the focal length of a converging lens

APPARATUS & MATERIALS:

light source	retort stand
converging lens	lens holder
object screen	image screen
metre rule	

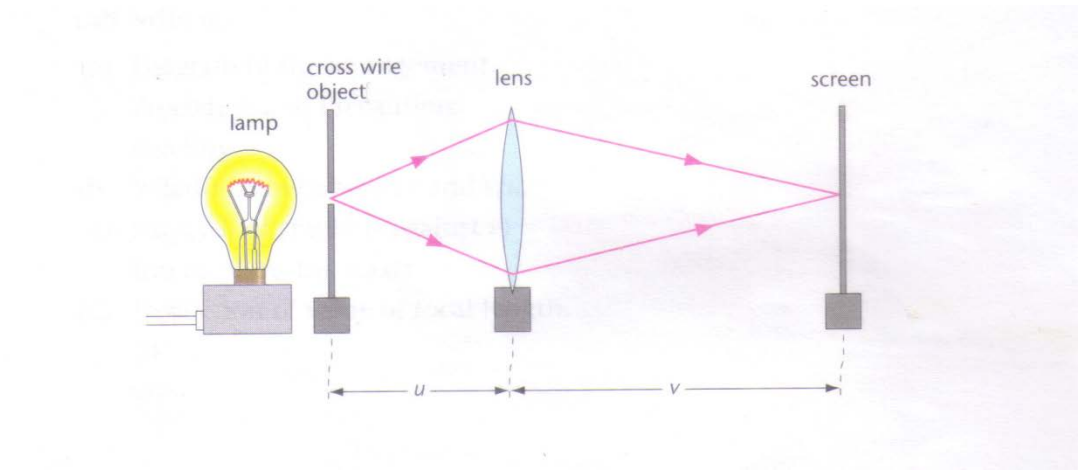


Diagram: Apparatus for the focal length of a converging lens

METHOD:

- Set up the illuminated object screen in front of the lens as shown in the above diagram.
- Adjust the image screen until the object is focussed on it.
- Measure the distance from the illuminated object screen to the lens, ***u,*** and measure the distance of the lens to the image screen, ***v.***
- Keep the illuminated in a fixed position and then move the image screen into various positions until a sharp image is formed on the screen.
- Record six (6) different values of ***u*** and ***v***.
- Calculate the values of ***1/u*** and ***1/v***.

THEORY:

- Define the focal length of lens and state the formula.

RESULTS:

- Record and tabulate all results in table below (showing all headings and units)

u (cm)	**v (cm)**	***1/u (cm-^{1})***	***1/v (cm-^{1})***

- Plot the graph of ***1/u*** against ***1/v*** .

CALCULATIONS:

- Find the value where the straight line intercepts the y –axis on your graph, ***k***.
- Calculate the focal length, ***f***, by using the formula below

$$f = 1/k$$

CONCLUSION:

- State the focal length of the converging lens.

LAB 8: SIMPLE PENDULUM

AIM: To determine the acceleration due to gravity, **g**, using the simple pendulum

APPARATUS & MATERIALS:

metal bob stopwatch

retort stand meter rule

string

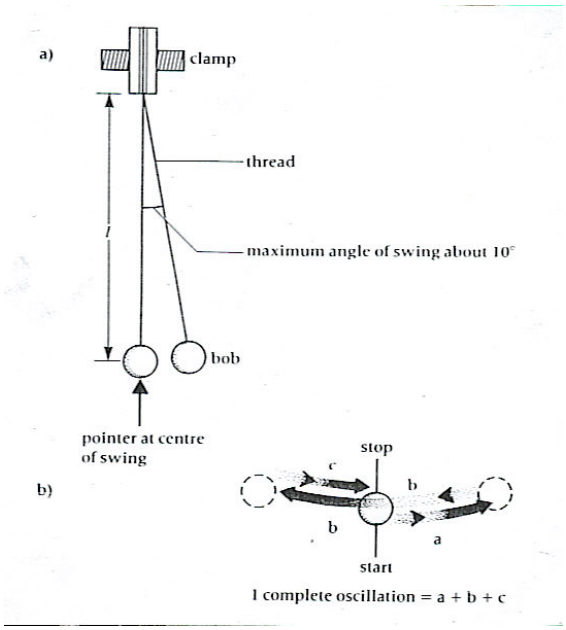


Diagram: Apparatus for the simple pendulum

METHOD:

- Set up pendulum as shown in the diagram with the length, **l**, of about 50 cm. A small metal object was used as the bob
- Fix a pointer opposite the position of the bob when it hangs at rest
- Set the pendulum swinging and check with a protractor that the angle of the swing is not more than 10°.
- Sit in the front of the pendulum so that your eye is level with the bob and right angles to the swing.

- As the bob passes the pointer, start the stopwatch.
- When it next passes the pointer going in the same direction, this is one oscillation.
- Use the countdown method, time for 20 oscillations of the pendulum and calculate the period, **T**.
- Repeat the experiment for six (6) additional values of the length, **l**.

THEORY:

- State the period of the pendulum and formula.

RESULTS:

- Record and tabulate all results in table below (showing all headings and units)

Length **l / m**	**Time for 20 oscillations** **t / s**	**Period** **T / s**	**(Period)^2** **T^2 / s^2**

- Plot a graph of the period, **T^2** against length, **l.**

CALCULATIONS:

- Calculate the gradient, **S**, of the line, showing clearly how you have obtained your answer.
- Find the acceleration due to gravity, **g,** given that

$$g = 4\pi^2 / S$$

CONCLUSION:

- State the acceleration due to gravity, **g.**

LAB 9: MOMENTS

AIM: To determine the unknown weight, W, using moments

APPARATUS & MATERIALS:

metre rule pivot

spring balance retort stand

unknown mass

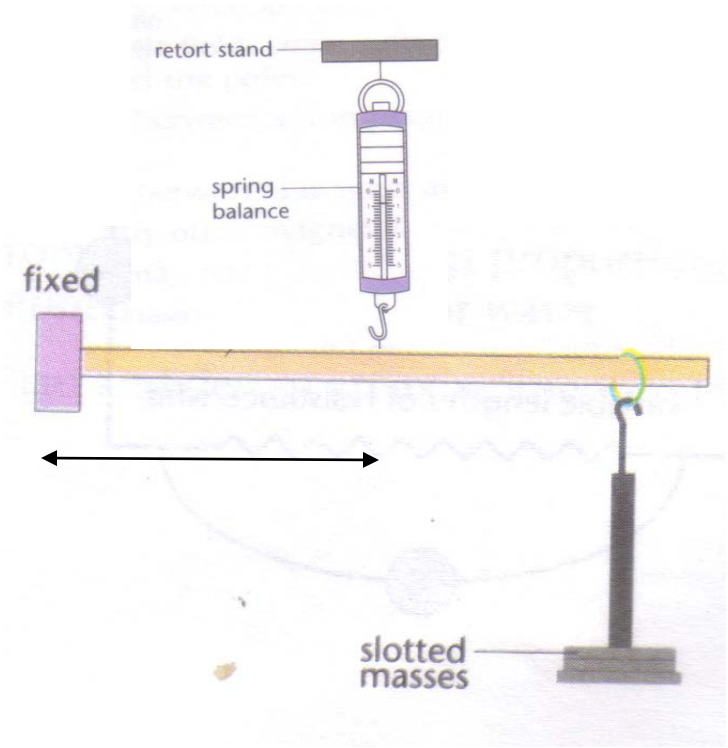


Diagram: Apparatus for finding the unknown weight, W, using moments

METHOD:

- Set up the apparatus as shown in the diagram above.
- Attach the spring balance to the metre rule at the ***50 cm*** mark.
- Attach the unknown weight to the metre rule at the metre rule at the ***70 cm*** mark.
- Hold the spring balance so that the metre rule is in the horizontal position.
- Record the distance, ***y***, and the corresponding reading on the spring balance, ***F***.
- Vary the position the unknown mass on either side of the spring balance to obtain ***six (6)*** additional pairs of ***y*** and ***F*** values.

THEORY:

- Define a moment. State the formula and units.
- State the formula for the moments in balance.

RESULTS:

- Record all results in table below (showing all headings and units)

Length **y / (cm)**	**Force** **F / (N)**

- Plot a graph of length, ***y***, against Force, ***F***.

CALCULATIONS:

- Calculate the gradient, ***G***, of the line, showing clearly how you have obtained your answer.
- Find the unknown weight, ***W***, given that

$$G = 45/W$$

CONCLUSION:

- State the value of the unknown weight.

LAB 10: HOOKE'S LAW

AIM: To determine the ratio for the stretching force and the extension of a spring.

APPARATUS AND MATERIALS:

spiral spring	rule (mm scale)
retort stand	hanger
slotted mass	optical (pin pointer)

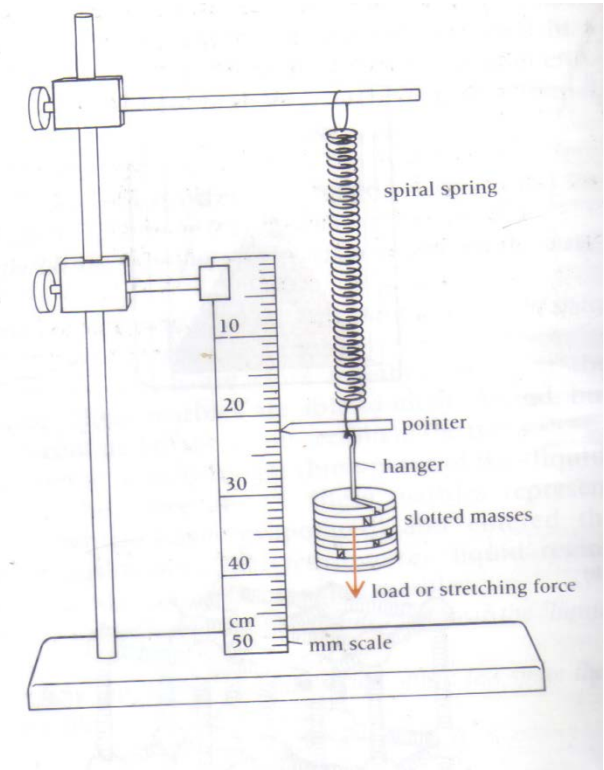


Diagram: Apparatus for Hooke's Law

METHOD:

- Arrange a stand to hold a millimetre scale close to a hanging spiral spring as shown in the diagram above.
- Attach a pointer to the end of the spring and take a scale reading of the pointer for the unstretched, unloaded spring.

- Hang the slotted mass hanger to the end of the spring and take a series of scale readings as slotted masses are added to the hanger, increasing the the stretching force or load.
- Record the readings in a table.
- Calculate the stretching force using F = mg, where g = 10 N/kg.
- Calculate the increase in length or the extension of the spring by subtracting the initial length of scale reading for the unloading spring from all of the loaded readings.

THEORY:

- State Hooke's law and the formula.

RESULTS:

- Record and tabulate all results in table below (showing all headings and units)

Mass on hanger m / (kg)	**Stretching force mg / (N)**	**Scale reading / (mm)**	**Extension of the spring / (mm)**

- Plot a graph of extension against the stretching force.

CALCULATIONS:

- Calculate the gradient of the line to determine the ratio for the stretching force and the extension of a spring.

CONCLUSION:

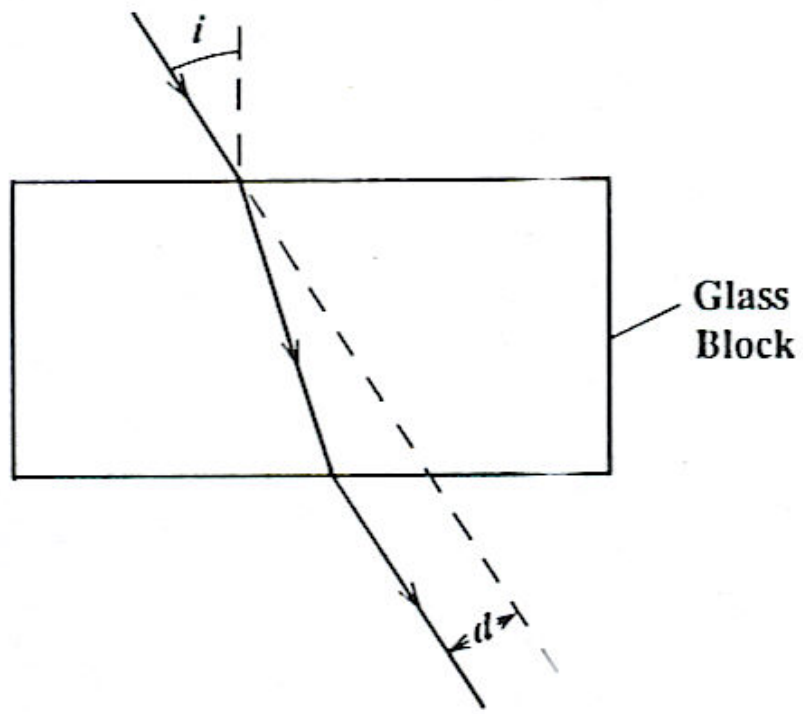
- State the ratio for the stretching force and the extension of a spring.

LAB 11: REFRACTION (lateral displacement)

APPARATUS & MATERIAL:

rectangular glass block	paper
optical pins	tape
protractor	wooden board

EXPERIMENT:



The diagram above shows the passage of light through a glass block. A student suggests that the ratio ***d/i*** is a constant, where ***d*** is the lateral displacement of the ray and ***i*** is the angle of incidence.

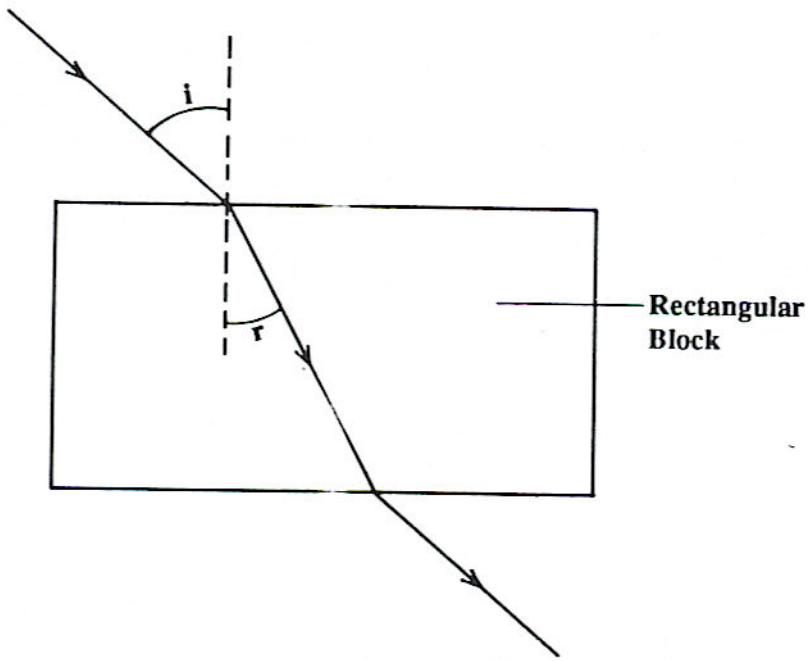
Investigate whether the student's statement is true using THREE values of ***i.***

LAB 12: REFRACTION (*i* double then *r* double)

APPARATUS & MATERIAL:

rectangular glass block	paper
optical pins	tape
protractor	wooden board

EXPERIMENT:



In an examination question about refraction, a boy draws the diagram above and writes

"If angle *i* is doubled, angle *r* will also be doubled".

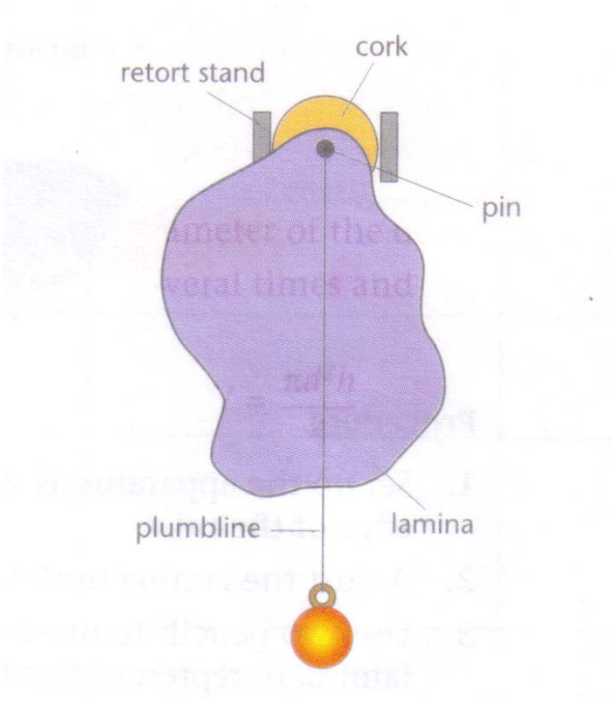
Investigate whether this statement is true for the rectangular block provided using THREE values of ***i*.**

LAB 13: CENTRE OF GRAVITY (plumbline method)

APPARATUS & MATERIALS:

retort stand	irregularly shaped cardboard objects
pin	cork
bob	string

EXPERIMENT:



A student makes the following statement

"The centre of gravity of irregularly shaped objects <u>ALWAYS</u> lies on the object ".

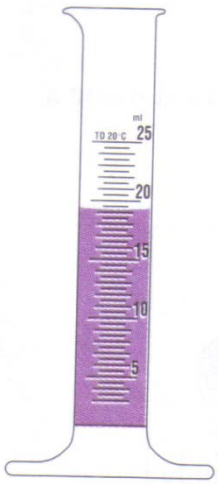
Design an experiment which either approves or disapproves the student's statement. You are provided with four irregularly shaped objects and the apparatus and materials mentioned above.

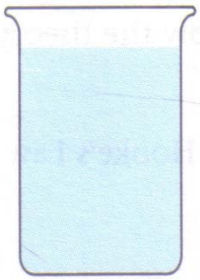
[Submit <u>ALL</u> cardboard shapes in SBA book]

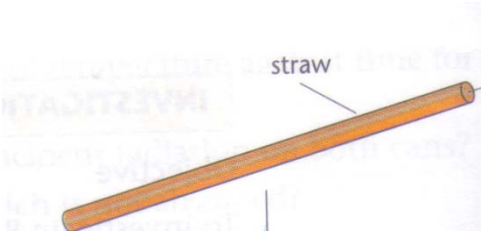
LAB 14: INTERNAL DIAMETER OF A DRINKING STRAW

APPARATUS & MATERIALS:

beaker	drinking straw
measuring cylinder	marker
water	ruler







EXPERIMENT:

You are provided with a drinking straw.

Use the apparatus and materials provided to determine the internal diameter of the drinking straw

Hint: volume of a cylinder = $\pi r^2 h$

LAB 15: MAGNETIC FIELDS

AIM: To determine the magnetic field of a bar magnet

APPARATUS & MATERIALS:

bar magnet paper

compass wooden board

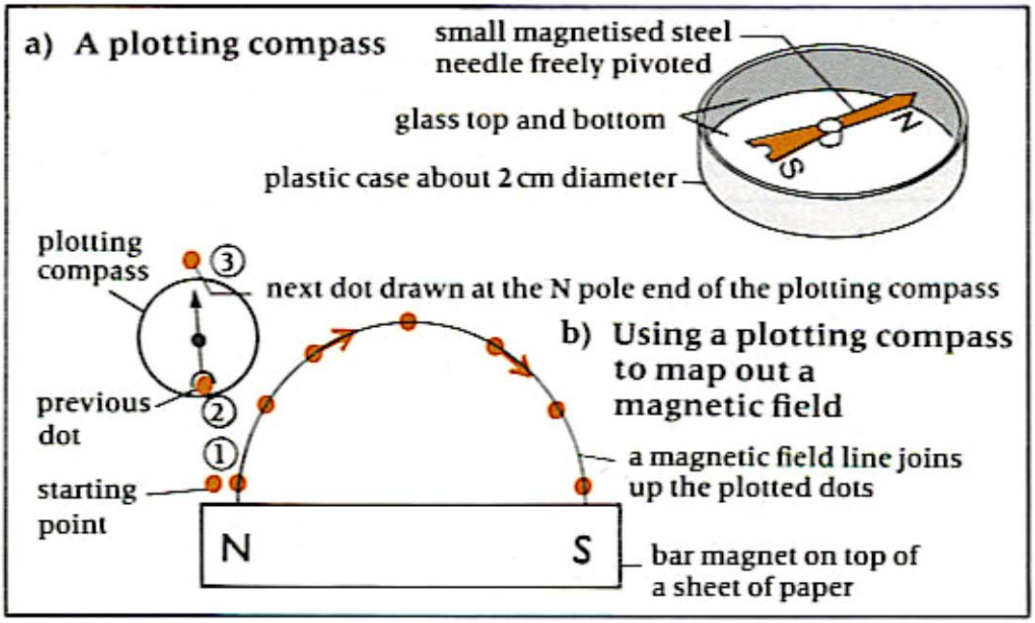


Diagram: Apparatus for the magnetic field of a bar magnet

METHOD:

- Place a bar magnet on a sheet of paper and draw around it.
- Make a dot on the paper near the North Pole of the magnet (as shown in the diagram at ***dot 1***).
- Position the plotting compass so that the curved South Pole end of its needle surrounds the dot.
- Make the next ***dot 2*** near the North Pole end of the plotting compass needle.

- Now move the plotting compass so that its South Pole is over the ***dot 2*** and mark another ***dot 3*** near the North Pole.
- Continue to plot the points in the direction indicated by the North Pole of the compass needle until you reach the South Pole end of the magnet.
- Join up the dots to show the magnetic field lines.
- Repeat the method above and hence construct a number of magnet field lines around the magnet.

THEORY:

- Define the magnetic field and the direction of the magnetic field.

OBSERVATIONS / RESULTS:

- Fasten trace into SBA book. (a fully labelled diagram)

CONCLUSION:

- The magnetic field of a bar magnet is shown in the observations.

LAB 16: CONUCTORS & INSULATORS

AIM: To identify conductors and insulators

APPARATUS & MATERIALS:

bulb	steel wool	sulphuric acid
bulb holder	copper	distilled water
dry cells	lead	copper(II)sulphate
connecting wires	zinc	ammonium chloride
cork	gold	brass
wood	aluminum	ebonite

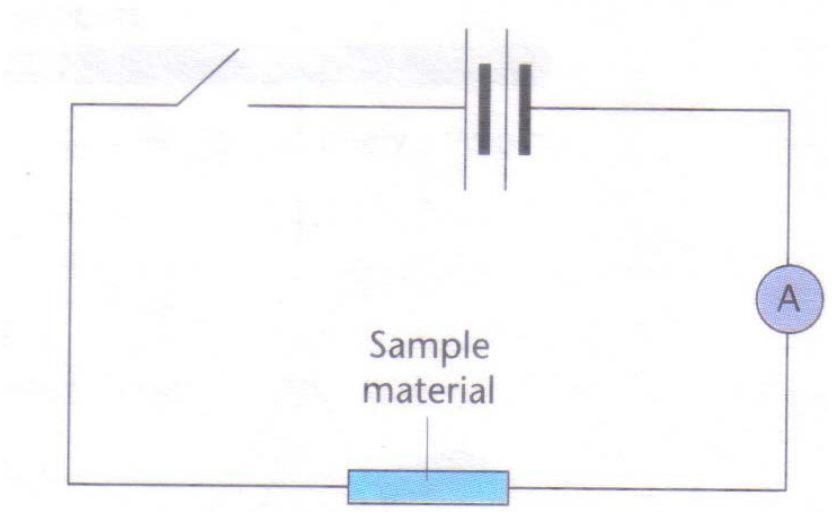


Diagram: Circuit diagram for identifying conductors and insulators

METHOD:

- Set up the circuit as shown in the diagram above
- Connect the various materials at Point A and Point B so that a closed circuit can be formed.
- Record the brightness of the bulb for each material.

THEORY:

- Define conductors and insulators.

RESULTS:

- Record all results in table below (showing all headings)

Material	Brightness of Bulb

CONCLUSION:

- Which of the following are good conductors, poor conductors and insulators?

LAB 17: OHM'S LAW

AIM: To determine the resistance of an unknown resistor.

APPARATUS & MATERIALS:

2 dry cells	voltmeter
rheostat (variable resistor)	ammeter
switch	connecting wires
unknown resistor	

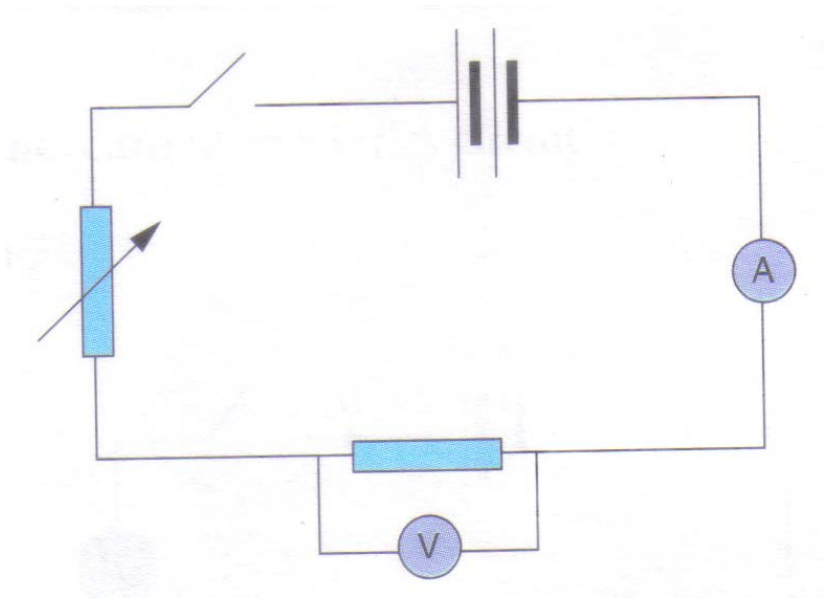


Diagram: Circuit diagram for identifying the resistance of an unknown resistor

METHOD:

- Set up the circuit as shown in the circuit diagram above with the rheostat at the maximum and the switch open.
- Have the circuit check by the teacher.
- Close the switch.
- Record the values for voltage, ***V*** and current, ***I***, when the ammeter is at the highest reading.
- Vary the rheostat and record ***five (5)*** other readings for ***V*** and ***I***. (Open the switch between readings)

THEORY:

- State Ohm's Law and the formula associated with it. State units of resistance.
- How must the ammeter be connected in the circuit.
- How must the voltmeter be connected in the circuit.

RESULTS:

- Record all results in table below (showing all headings and units)

Voltage (V) **/ (V)**	**Current (I)** **/ (A)**

- Plot a graph of voltage, ***V***, against current, ***I.***

CALCULATIONS:

- Calculate the gradient the graph to determine the resistance of the unknown resistor.

CONCLUSION:

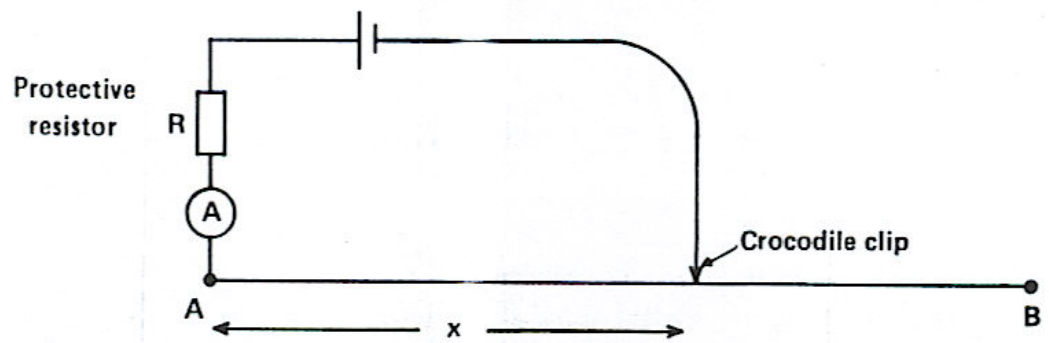
- State the resistance of an unknown resistor

LAB 18: RESISTIVITY

AIM: To determine the resistance per unit length, ***p***, of a wire

APPARATUS & MATERIALS:

metre rule	resistor
crocodile clip	connecting wires
ammeter	batteries
voltmeter	



METHOD:

- Set up the circuit in the diagram above.
- Record the current, **I**, flowing in the circuit for different values of ***x***.
- Measure the e.m.f., **E**, of the cell using the voltmeter provided

THEORY:

- Define the resistivity of a substance.
- State the factors that affect the resistivity of a substance.
- State the formula and units.

RESULTS:

- Tabulate these pairs of values along with the corresponding values of **1/I**
- Record and tabulate all results in table below (showing all headings and units)

Distance (x) /(m)	**Current (I) / (A)**	**1/Current (1/I) / (A^{-1})**

- Plot the graph of **1/I** against ***x.***

CALCULATIONS:

- Calculate the slope **S** of the graph, showing clearly how you obtained your answer.
- Using the equation ***p* = S * E**, find the resistance per unit length of the wire **AB**.

CONCLUSION:

- State the resistance per unit length of the wire

LAB 19: CARBON RESISTORS IN SERIES

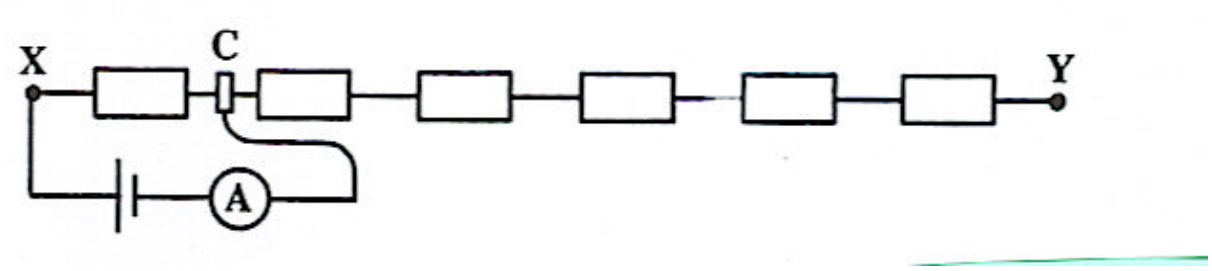
AIM: To determine the resistance, **R**, of a carbon resistor

APPARATUS & MATERIALS:

6 identical carbon resistors ammeter

battery connecting wires

crocodile clip



METHOD

- Set up the circuit as shown in the diagram above where **XY** is the string of six identical carbon resistors and **C** the crocodile clip.
- Record the value of **I**, the current through the ammeter, with one resistor between **X** and **C**.
- Repeat the procedure to obtain pairs of values of **I** and **n**, where **n** is the number of resistors in the circuit between **X** and **C** for **n = 1 to 6**. (**DO NOT** connect the clip **C** to point **X**)

THEORY:

- State Ohm's Law and the formula associated with it. State units of resistance.

RESULTS / CALCULATIONS

- Tabulate these pairs of values along with the corresponding values of **1/I**
- Record and tabulate all results in table below (showing all headings and units)

Number of carbon resistors (n)	**Current (I) / (A)**	**1/Current (1/I) / (A^{-1})**

- Plot the graph of **1/I** against ***n***, starting both axis at zero***.***

CALCULATIONS:

- Determine the slope, **S**, of the graph
- Find the value of R, given that **S=R/E** where **E = 1.5V**
- Record the interception, **K,** on the **1/I** axis and determine the corresponding value of current, I_k.

CONCLUSION

- State the resistance, **R**, of a carbon resistor
- Why should you not connect clip **C** to the point **X**?

LAB 20: RADIOACTIVITY

AIM: To determine the half life of a radioactive decay model

APPARATUS & MATERIALS:

137 dice

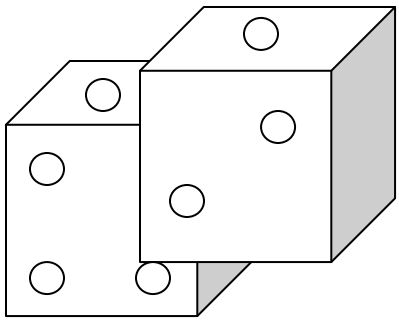


Diagram: Apparatus for identifying the half life of a radioactive decay model

METHOD:

- Shake and throw 137 dice on the table top.
- Remove **ALL** the dice with the six (6) facing upwards and count them. Record this value.
- Collect all the remaining dice. Shake and throw them again, removing all the dice with six (6) facing upwards. Record this value also.
- Repeat this process several times until very few dice are left.

THEORY:

- Define a magnetic field and the direction of the magnetic field.

RESULTS:

- Record the data collected in the table below.

Throw Number	Number of Dice Removed	Number of Dice Left
0	**0**	**137**
1		
2		

- Plot the graph of ***number of dice remaining*** against ***throw number.***

CALCULATION:

- Use this graph to determine the half life of this radioactive decay model. (Show ALL necessary working)

CONCLUSION:

- State the half life of the radioactive decay model

LAB 21: PAPERCLIP PENDULUM

AIM: To investigate the period of a pendulum

APPARATUS & MATERIALS:

paperclips	cork
retort stand	stopwatch
needle	

EXPERIMENT:

In this experiment, you are required to investigate the period of a pendulum.

The paperclips provided may *be* linked together, in a chain, and swung as a single pendulum, as shown in Figure 1 below. ***T***, the period of the pendulum, depends on ***n,*** the number of paperclips linked together.

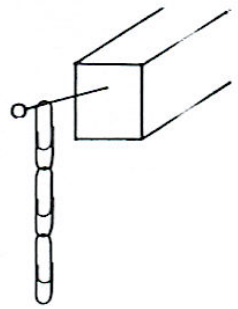


Figure 1

A student suggests that the relationship between ***T*** and ***n*** is

$$T = kn$$ where ***k*** is a constant.

Use the paperclips provided to test this theory for *n* = 3, 6 and 9.

LAB 22: DENSITY OF AN IRREGULAR OBJECT

AIM: To determine the density of an irregular shaped object.

APPARATUS & MATERIALS:

displacement (eureka) can	irregular shaped object
measuring cylinder	water
triple beam balance	string

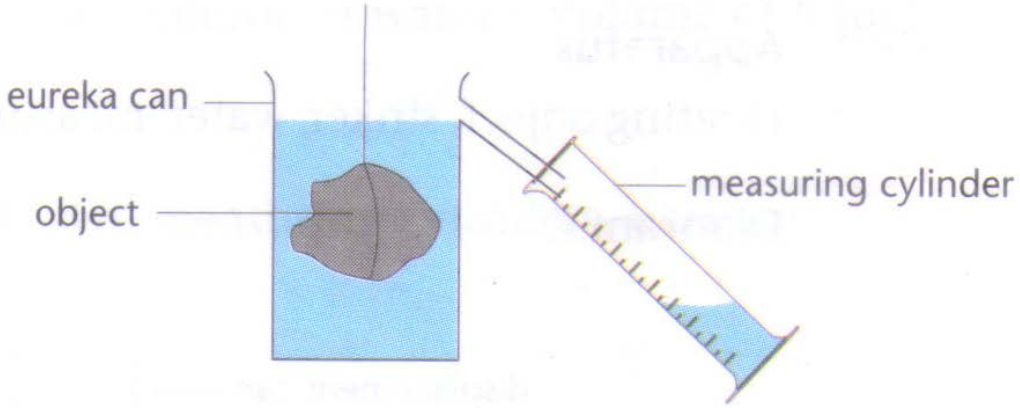


Diagram showing the apparatus

METHOD:

- Find the mass, ***m***, of the irregular shaped object using the triple beam balance.
- Fill the displacement can and allow to drain on a level surface.
- Place the spout into the measuring cylinder and gently lower the stone until it is completely immersed into the water.
- Determine the volume, ***V***, of the displaced water collected in the measuring cylinder at eye level.
- Repeat the procedure and final the average volume of the irregular shaped object.

THEORY:

- Define density of a substance. State formula and units.

RESULTS:

- Record the the values of the mass, ***m***, and the volume, ***V***, of the irregular shaped object in an appropriate format.

CALCULATIONS:

- Calculate the density of the irregular shaped object. (showing all possible working)

CONCLUSION:

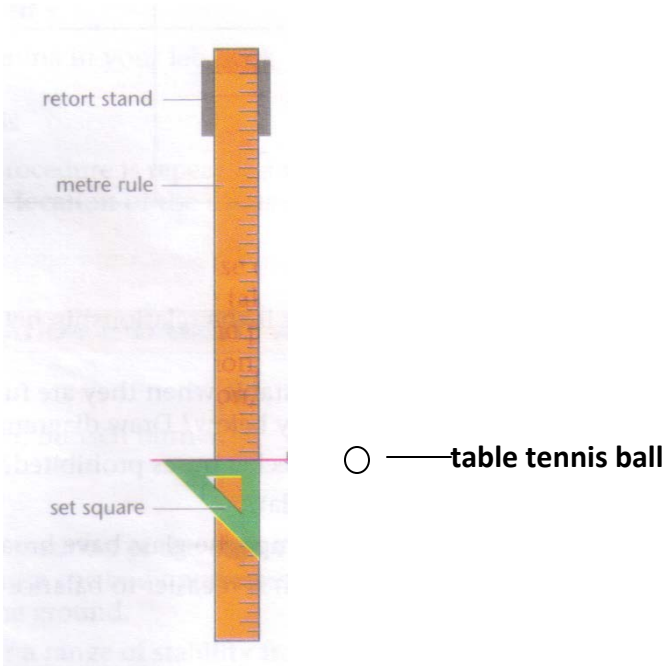
- State the density of the irregular shaped object.

LAB 23: REBOUND OF A TABLE TENNIS BALL

APPARATUS & MATERIALS:

metre rule	retort stand
table tennis ball	8 sheets of paper towel

EXPERIMENT:



A table tennis ball is released from a height $\boldsymbol{h_0}$, of 80 cm, onto a number of sheets of paper towel on a bench top. The height of rebound, $\mathbf{h_1}$, changes with the number of sheets of paper towel used.

Investigate whether the ratio $\dfrac{\boldsymbol{h_0 - h_1}}{\boldsymbol{n}}$ has a constant value,

Where $\boldsymbol{n}$ is the number of sheets of paper towels used.

CRITERIA FOR SBAS

PLANNING AND DESIGNING (P/D)

		MARK(S)
a)	Development of hypothesis (if appropriate)	1
b)	Workable method outlined	1
c)	It should be clear	
	i) which variable(s) is/are to be kept constant	1 or more
	ii) how the dependent variable is measured	1
	iii) how the independent variable is measured	1
	iv) which other variable may affect measurements taken (see d (ii))	1

If the students perform the experiment, the points can be found in the results; if not the points should be found in the description of the method.

d)	One or more points from the following:	1 each
	i) non-standard precautions used to improve accuracy	
	ii) identification of sources of error which may affect the accuracy of the answer and could not be prevented	
	iii) repetition and averaging of readings	

A set of general criteria for assessing the Planning and Designing of electrical practicals is given below.

		MARK(S)
a)	Draws appropriate circuit diagram (symbols, arrangement)	2
b)	Shows how to take appropriate readings, i.e., how the variables are measured	2
c)	Shows how to change the variables, e.g., reversing diode, adjusting rheostat, varying length of wire	1
d)	Shows how results either support or refute the hypothesis OR shows how the values can be substituted into the appropriate formula	1

OBERVATION / RECORDING / REPORTING (O/R/R)

		MARK(S)
1.	Overall organisation of work	
	a) Appropriate sub-headings	1
	b) Sub-headings in logical order	1
	c) Subject matter under appropriate sub-headings	1
2.	Diagram(s) (if needed)	
	Adequate size (1) and fully labelled (3 marks maximum and one mark deducted for each significant label omitted or incorrect)	
3.	Report of method adopted	
	a) Logical sequence in steps	1
	b) Concise account (no irrelevant material)	1
	c) Grammar and spelling: correct	2
	only one or two errors	1
	many errors	0
4.	Recording of readings (when tabulation not suitable)	
	a) Appropriate readings (where necessary)	1
	b) Readings in line with expected results (accurate readings)	1
	c) Units on readings	1
	d) Appropriate significant figures (Consistent with instrument(s) used)	1
	e) Repetition and averaging of readings	1 or 2
5.	Tabulation of sets of readings	
	a) Neat table	1
	b) Headings for tables labelled with quantity/symbol/unit	1
	c) Appropriate significant figures in each column (consistent with instrument(s) used)	1 or 2
	d) Good range of readings	1
	e) Adequate number of readings (usually six, and more when graph is curved)	1

6. Graph construction

a)	Correct quantities plotted on axes	1
b)	Title of graph with axes labelled with quantity or symbol and unit (one mark deducted for each omission)	2
c)	Suitable scale for each axis, 1 each (linear, adequate size, convenient)	2
d)	Fine circled points or sharp crosses, thin line	1
e)	Accurate plotting of all readings (all points correct 3, one incorrect 2, two incorrect 1, three or more incorrect 0)	up to 3
f)	Line of best fit (curved or straight)	1

MANIPULATION AND MEASUREMENT (M&M)

1. Use of a thermometer in a liquid

Criteria for assessment:

i) Liquid is stirred to ensure even temperature

ii) Thermometer bulb completely immersed

iii) Bulb not in contact with container

iv) Immersion time is sufficient for thermal equilibrium

2. Use of measuring cylinder

Criteria for assessment:

i) Appropriate size chosen (if relevant)

ii) Cylinder placed on horizontal surface

iii) Meniscus read to avoid parallax

iv) Bottom part of meniscus read

3. Use of ammeter/voltmeter

Criteria for assessment:

i) Ammeter/voltmeter of suitable range chosen (if appropriate)

OR

Appropriate scale on meter connected and read (if relevant)

ii) Ammeter/voltmeter placed in correct position, from circuit diagram

iii) Ammeter/voltmeter connected with correct polarity

iv) Zero error checked

v) Scale read to avoid parallax

vi) Connections tightened

4. Use of stop watch/stop clock

Criteria for assessment:

i) Zero error checked

ii) Stop watch/stop clock correctly operated

iii) Count-down method used (if appropriate)

iv) Scale read to avoid parallax (if appropriate)

5. Use of a balance for mass determination

Criteria for assessment:

i) Balance placed level

ii) Zero error checked

iii) Balance used with care

iv) Scale read to avoid parallax (where appropriate)

6. Use of Bunsen burner

Criteria for assessment:

i) Bunsen burner attached properly to gas supply

ii) Air hole closed

iii) Match lit before gas turned on

iv) Air hole adjusted

v) Gas supply adjusted

7. Use of a micrometer

Criteria for assessment:

i) Zero error checked

ii) Micrometer closed gently (ratchet)

iii) Scale read to avoid parallax

8. Use of a vernier caliper

Criteria for assessment:

i) Zero error checked

ii) Caliper closed gently

iii) Scale read to avoid parallax

9. Ray plotting

Criteria for assessment:

i) Pins placed far apart

ii) Pins placed vertically

iii) Positions of pins labelled/lines drawn appropriately

iv) Base line of protractor placed on line

v) Centre of protractor correctly positioned

10. <u>Setting up of electrical circuit</u>

Criteria for assessment:

i) Correct circuit diagram drawn (if necessary)

ii) Components correctly positioned, from circuit diagram

iii) Components connected with correct polarity

iv) Circuit wired with switch off

v) Rheostat (or other component to limit current) set at maximum

vi) Circuit switched off between readings

vii) Connections tightened

11. <u>Use of a burette</u>

Criteria for assessment:

i) Burette rinsed with liquid to be used

ii) Burette aligned vertically

iii) Funnel used correctly

iv) Tip filled with liquid

v) Air bubbles removed

vi) Hanging drops removed

vii) Meniscus read to avoid parallax

viii) Bottom of meniscus read

ANALYSIS AND INTERPRETATION (A&I)

			MARK(S)
1.	**Intercept**		
	a)	Accurate read-off to appropriate number of	1
		significant figures (based on number of	1
		significant figures used in plotting graph)	
	b)	Correct unit for intercept	1
	c)	Deduction of a quantity from intercept -	
		accurate answer, to correct number of	1
		significant figures, with unit	2
2.	**Slope or gradient**		
	a)	Large triangle	1
	b)	Formula for gradient correct	1
	c)	Accurate read-off (to appropriate number of	1
		significant figures, same as in the readings)	(1)
	d)	Calculation of gradient accurate	1
	e)	Appropriate significant figures, and unit, for gradient	2
	f)	Deduction of a quantity using gradient -	
		answer correct, appropriate number of significant figures, with unit	2
3.	**Calculations**		
	a)	Formula correct	1
	b)	Substitution correct	1
	c)	Answer with unit	1
	d)	Answer to appropriate number of significant figures	1
4.	**Conclusions**		
	a)	Conclusion follows from data or graph	1
	b)	Conclusion justified using data or graph	1
	c)	Unavoidable source(s) of error/	
		uncertainty in chosen method identified	1 or more