Tips by Sir Hakeem(and important topics)

q)Measurement for metre rule

All readings are written to one dp

6.0cm will be 0. 06 m

50cm to 0.500m

Q2) Measurement for metre rule

If one Newton is divided into ten parts then all readings are written to one dp, otherwise whole number

Angle from protractor

All readings of protractor should be written in whole degree

-Parallax error

-Newton metre parallax error

-Protractor error

-Parallax error is reduced by making line of sight perpendicular to scale

-Verticality of metre rule checked by set square or plumbline

Centre of protractor is placed exactly at two joining lines. Horizontal line of protractor mus coincide with horizontal line of line without parallax error

Metre rule can be clamped vertically by using set square. Make sure surface is smooth and horizontal

Plumb line is used to check vertical position of the object

Volume of water in the beaker:

Lower Meniscus is measured

Water is adhesive/sticks to wall. Thus for accurate reading, meniscus is read without parallax error

Level of eye must be seen as level of lower meniscus

In case of mercury paper, upper meniscus is measured

Oscillation is measured by using stopwatch of at least count and reaction time of observer 0.1 or 0.2 secs which can be reduced by taking average of several readings. Least count is 0,01 second

All readings of digital stopwatch are recorded up to 2 dp e.g 5.00

Oscillation of ripples of water in a beaker can be recorded by stopwatch to reduce reaction time. Count 20 Oscillations at least. Take average by average time by no of Oscillations by time period. Reaction time of observer 0.1 or 0.2 secs

Experiment to find heat capacity of liquid/power of candle/diameter of cylinder/circumference of beach ball

<u>Errors in heat capacity</u>

-Heat loss in surroundings

-Absorbed by container

So calculated value is less than original value when loss is ignored

<u>Problems in diameter</u>

Thread in a reel is not of uniform thickness

Cylinder is not uniform from one end to another

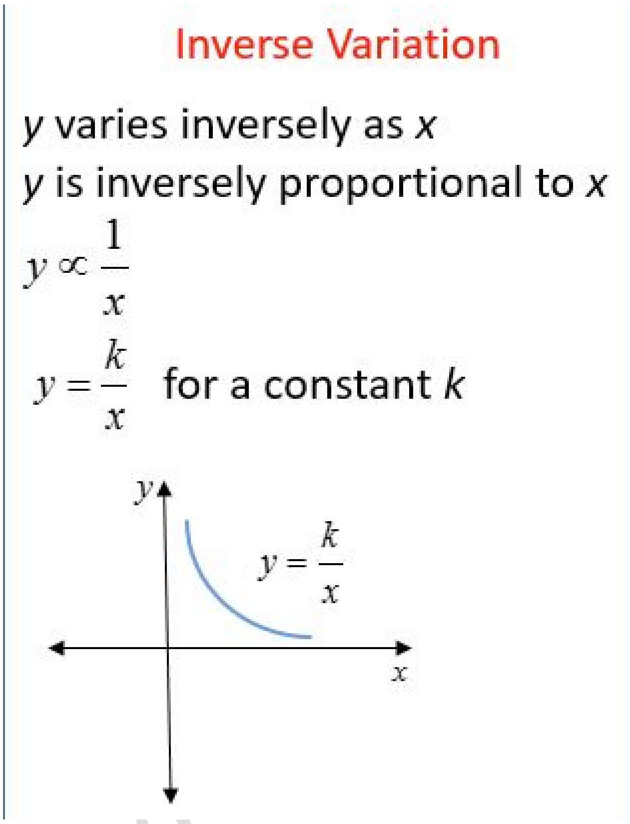
Difficult to wind off thread over cylinder uniformly

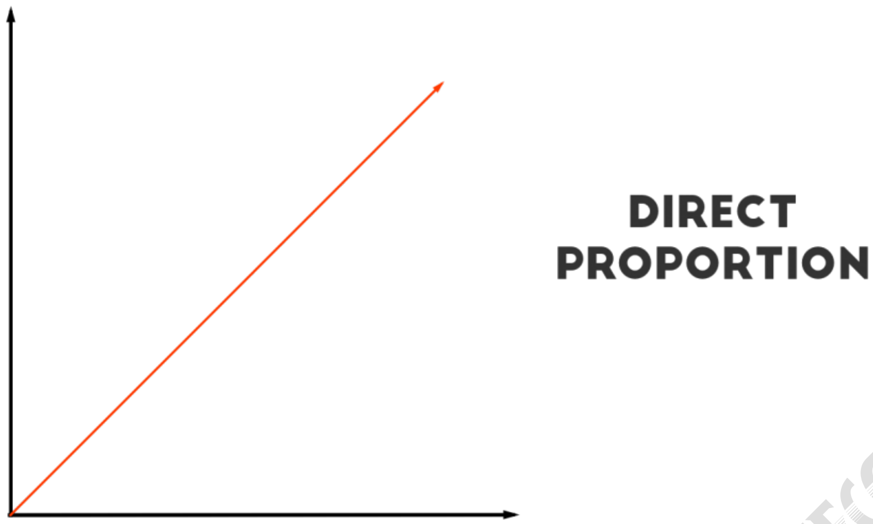
Beach ball error: Measuring tape has large least count and beach ball shrinks when tape is placed at surface

Ray diagram: from ray box to measure angle of incidence/reflection /refraction /emergence and dispersion of light

Diagram for electric field for two similar charges and two similar currents. Forces experienced by charge/current

Numerical value of any experiment to complete the table and show that the relation is inversely proportional





Gradient of the graph by drawing the tangent and showing proper sf

Calculation of quantity related to gradient along with it's SI units

Thermistor,LDR,LED AND DIODE

Combination of resistors

Combination of cells with advantages and diode

THERMISTOR depends upon heat temperature. It's resistance decreases with temp.

LDR depends directly on light intensity(directly proportional)

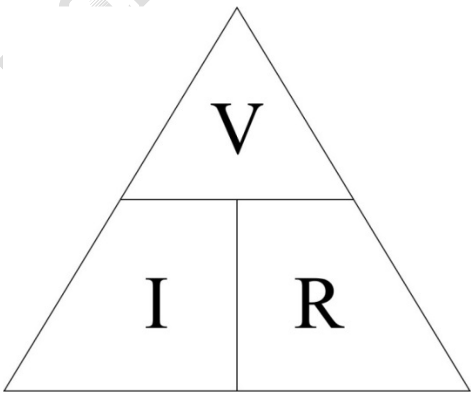
Diode is used to allow one directional current. When battey of diode is reversed, current is blocked

Used in rectification

Batteries in series- high voltage for short period

Batteries in parallel-same voltage for longer period

To find resistanc R=V/I



Formula of CRO

Once **T** has been measured, the frequency **f** can then be found. The period **T** is inversely proportional to frequency **f** :

$$T = \frac{l}{f}$$

To find heat capacity, current and voltage. And time required for energy supplied, initial and final temp is recorded IVT+MC Λ Q

Mass can be measured by electronic balance

Power of candle can be measured by P=EA. E= MC ∆ T

Light experiments are drawn in experiments

Examiner Tips

General Tips for both Paper 3 & 4 - Practical Test and Alternative to Practical

• When asked to take a single reading, make sure you include the unit.

• Do not write anything you are not asked for – you are not expected to write an account of the experiment unless asked to do so.

• If you are asked to "use your results" to explain something, then quote them, do not just mention the theory you know!

• If you are reading a measuring instrument, give all the values on the scale, e.g. on a hundredth of a second stopwatch, write 9.24 s – not 9 or 9.2 s (and not 09:24 s).

• Significant figures are important in the practical papers. Do not quote too many – or too few! Give just the right number. Many marks are lost by giving too few significant figures. This usually occurs when reading a scale where the value is on a major mark, e.g. 6 V . If the scale measures to 0.1 V , then the reading is 6.0 V , and you must include the point zero! There are usually 2 or 3 significant figures in most readings. Think carefully if you ever use more or less.

• In calculated values, you should never give more significant figures then were used in the data, e.g. the average of 27.95, 26.54 and 27.36 is actually 27.28333333 but should be given as either 27.28 to the four significant figures given in the data or 27.3 as the variation of the readings suggests that four significant figures are too many.

• Normally you can measure an instrument to the accuracy shown by the smallest scale division. However

- If using a liquid in glass thermometer, you should be able to estimate within the degree markings, e.g. to 0.5oC or even 0.25oC.

- If using a ruler you can usually measure to about 0.3-0.5 mm even though the smallest division is a mm.

• Make sure you understand technical terms used in the question; for example extension means the increase in length increase in length of a spring when a load is added; calibration means "to put a to put a

scale on a measuring instrument ", which applies to any measuring instrument.

• When measuring vertical heights, a setsquare should always be used to ensure the ruler is vertical. The setsquare can be shown correctly positioned in a diagram.

• Make sure you can explain the difference between the source of error and what you could do to reduce it, e.g. in transferring a hot object from one place to another: the source of error is the heat it loses during the transfer and you could reduce this error by reducing the distance it has to be moved.

• If a question asks for the effect of changing something such as ”the length of the wings” then make sure your answer shows a comparison, e.g. “the long er the wings, the longer the time to fall”.

• When measuring time or length be careful to explain the meaning clearly; for example “longer” can mean either a longer time or a longer length. There is no confusion if you use the words “a longer time” or “a shorter time”.

When recording your readings in a table:

• Write down all your readings clearly. Do not do a calculation in your head or on your calculator without writing the readings down first and saying what they are. Then the examiner can see what you have done and give you the credit you deserve.

• Write both the quantity and unit in the heading. Note that the quantity means current, not "reading on the ammeter”. Don’t write the unit after every reading in the table which makes it difficult to see the values clearly; a heading should say current / ampere current / ampere or just I / A.

• You do not need a column labelled”reading number” which just goes 1, 2, 3 1, 2, 3 etc. If you are given a table outline in which to record your results, this will use one of them and you will not have enough columns for your results.

• Make sure you have taken sufficient readings, e.g. if you are asked to measure the temperature of a cooling liquid for five minutes, then a reading every minute gives you too few readings. Every 30 seconds is acceptable.

• Make sure you record readings that cover the whole range; for example record the temperature for the full time suggested in the question and don't forget to note down the temperature when you start the stopwatch.

• Make sure all the readings of one quantity in a table have the same number of decimal places as these reflect the accuracy of the measuring instrument. Trailing zeros are often missed out.

Paper 4 Tips - Alternative to Practical

This paper asks you questions about how you would perform practicals in the laboratory at your school. So you need experience of actual practicals not just alternative to practical papers.

When you observe your teacher demonstrating experiments, you should:

• watch closely how the apparatus is set up.

• think about any problems with the apparatus that occur during the experiment.

• think about any sources of error in taking the readings.

When you do practical work at school, you should:

• handle the apparatus carefully.

• think about how the apparatus is set up.

• ask your teacher for help if you are not sure.

• think about how you take down the readings in a clear table – never just write numbers on a page, as you may well forget what they were later!

• think about the number of significant figures in your readings.

Answering the examination Paper

• When answering questions about sources of error in an experiment, just writing "more accurate" is usually not enough - more detail is required

• Sometimes the answers appear too obvious, but they are good practical points; .for example when choosing a measuring cylinder of the correct size to measure the volume of some marbles, the measuring cylinder must be large enough to hold all the marbles!

• If a question involves familiar equipment used in a novel way, e.g. circuits or ray diagrams:

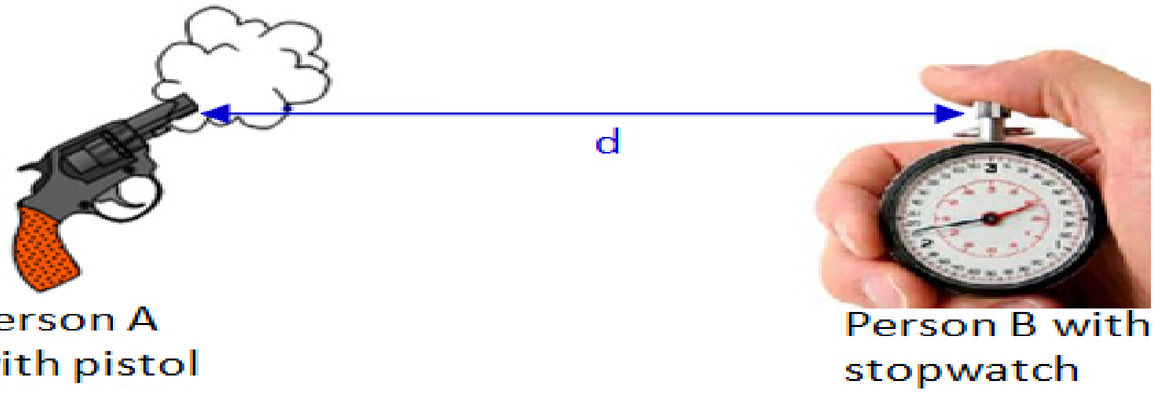
- take time to look at the equipment used in the question; do not assume that it is the same as an experiment you have seen before.

- follow round the circuit or the rays of light to be sure you understand what is happening.

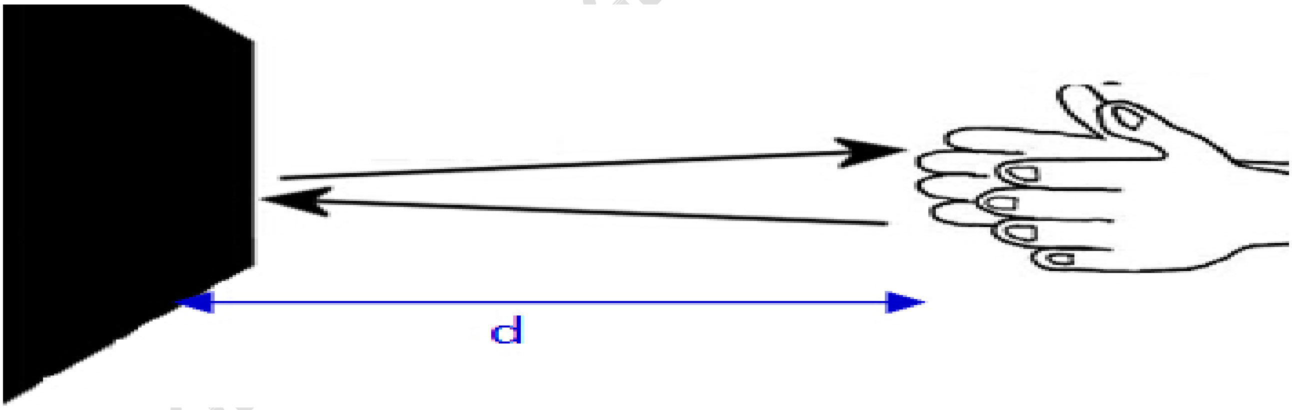
Some experiments

Measuring Speed of Sound

Procedure:
1. Measure a distance d from person A to person B in an open field using measuring tape.
2. Person A fires the pistol.
3. Person B starts the stopwatch when he sees the flash of pistol and stops it when he hears the sound. The time interval t is recorded.
4. Using speed = d / t , we can calculate the speed.



Indirect Method (Echo Method)



Procedure:
1. Measure the distance d from the wall to the clapper in an open field using measuring tape.
2. Make a sharp clapping sound and repeat the sound at regular intervals to coincide with the echoes. In other words, the second clap coincides with the echo from the wall from the first clap.
3. Start counting the clap at zero as the stopwatch is started, count the number of claps and stop the stopwatch at 50 claps.
4. Repeat step 3 to find the average time for 50 claps. Hence, calculate the time interval t between claps.
5. Using speed = 2 d / t, we can calculate the speed.

Pendulum

THE SIMPLE PENDULUM:

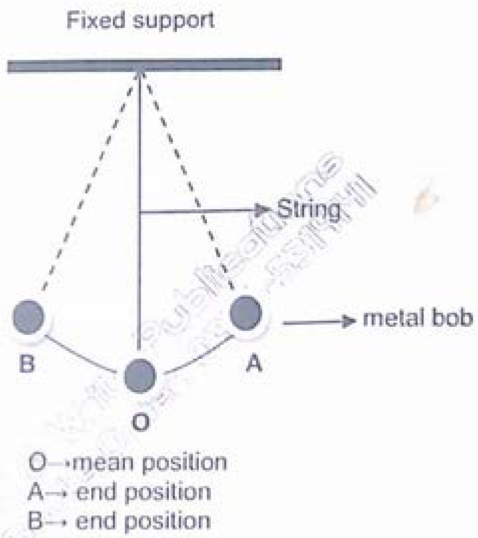
A simple pendulum consists of a metal bob, attached at the end of string, hanging from a support.

BASIC TERMS OF PENDULUM:

- **Oscillation:**
  One complete round trip of a pendulum is called oscillation. i.e. from O→A→B and back to O.
- **Time Period (T):**
  Time taken by a pendulum to complete one oscillation.
- **Frequency (f):**
  It is number of oscillations completed in one second.

$f = \frac{1}{T}$

where f = frequency, measured in Hertz (Hz).



How to determine time period of a Pendulum using stop watch?

- Set the pendulum into motion.
- Note time for 20 oscillations by using stopwatch.
- Find the time for one oscillation by using the formula:

$T = \frac{t}{n}$

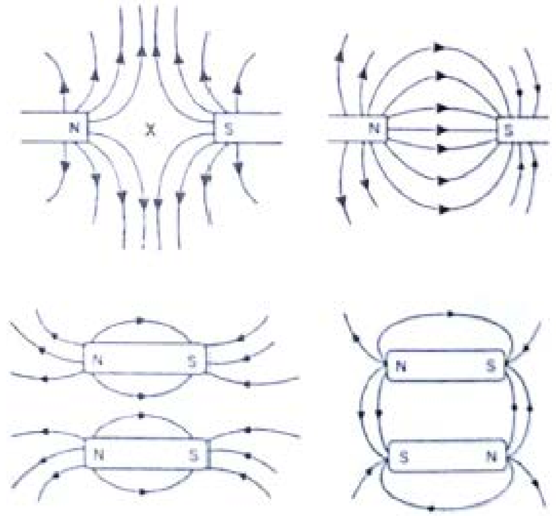
Where
t = time noted by watch.
n = no. of oscillations.
T = time period.

Plotting magnetic field

Magnetic Field:

"The space around a magnet within which it can exert force on magnetic objects" .
The direction of magnetic field is represented by magnetic field lines. The magnetic field lines have following properties:

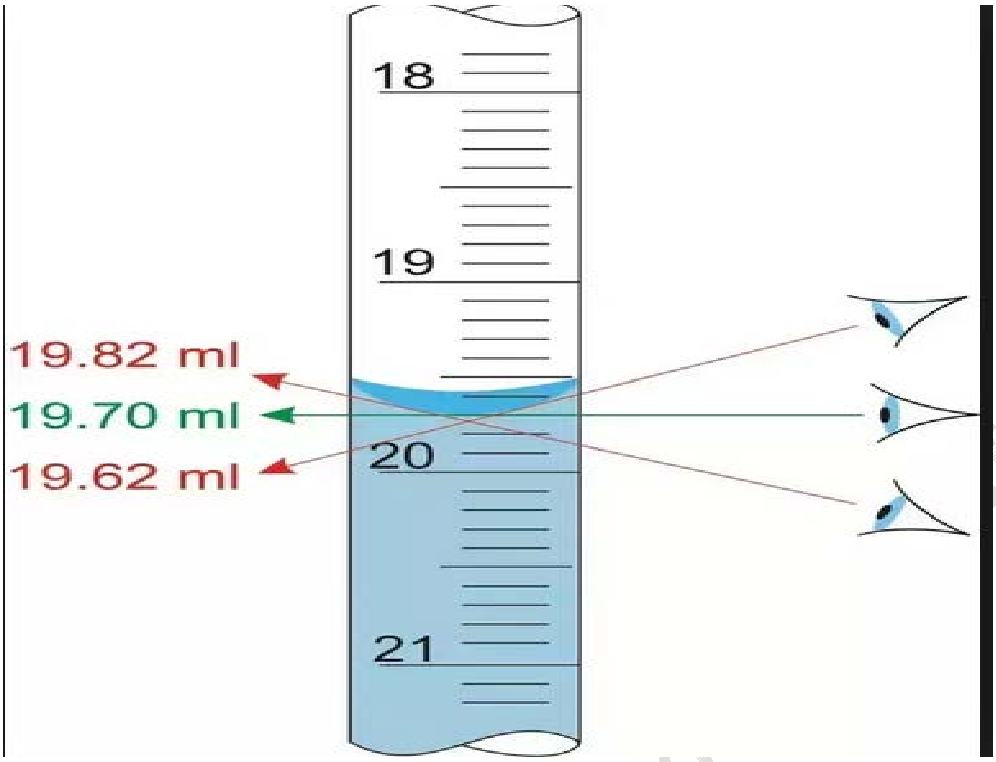
- Magnetic field lines start from N-pole and end on S-pole.
- Lines do not intersect each other.
- If lines at a point are closer, the magnetic field is stronger there and vice versa.
- The magnetic field lines between two like poles produce neutral point. At this point resultant field is zero.



PLOTTING OF MAGNETIC FIELD LINES WITH A COMPASS:

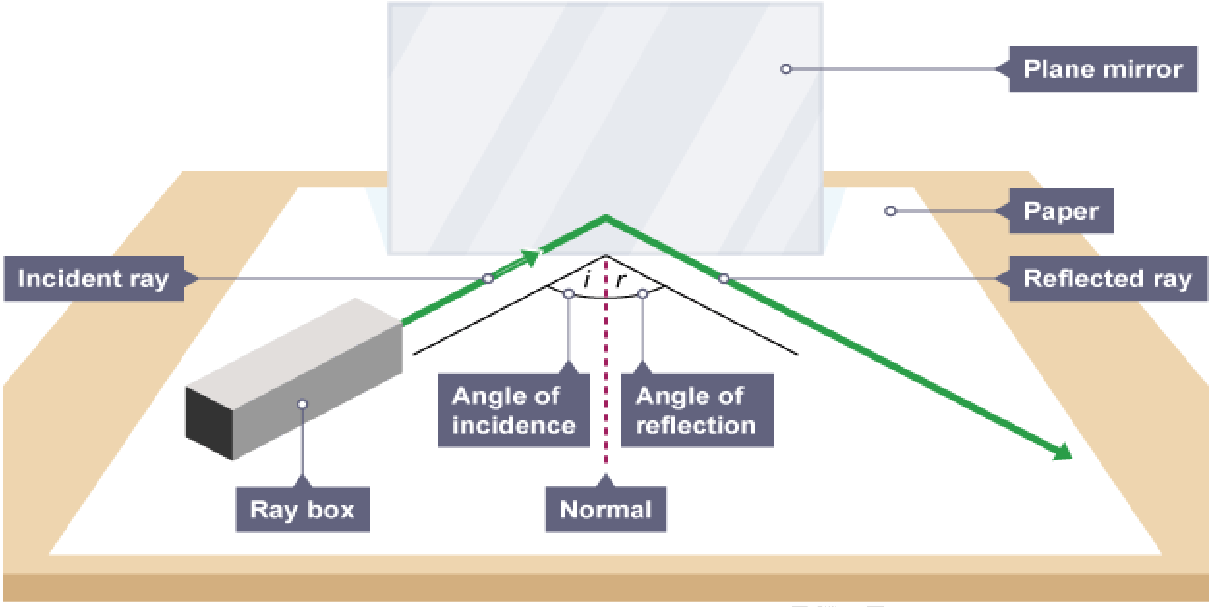
Keep the plotting compass near the N-pole of magnet. Mark a dot where compass needle points. Shift the S-position of needle on dot and mark a new dot where the compass now points. Similarly mark a series of dots from North to South pole of magnet. Join these dots to plot magnetic field lines around a bar magnet.

Parallax error



Parallax error is an **error** caused by humans, while measuring a quantity if your eye is not at the proper angle to the scale you're reading, it will cause **parallax error.** Place your eye at the level of the appropriate measurement marking when measuring the level of a liquid in a graduated cylinder. Read the lower part of the curved surface of the liquid -- the meniscus -- to gain an accurate measurement and avoid parallax errors.

Ray box practical with plane mirror



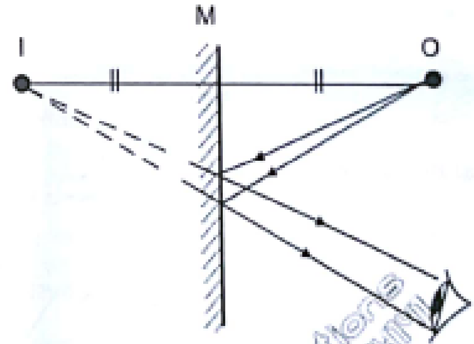
To investigate the reflection of light by a plane mirror.

Method

1. Set up a ray box, slit and lens so that a narrow ray of light is produced.
2. Place a 30 centimetre (cm) ruler near the middle of a piece of plain A3 paper. Draw a straight line parallel to its longer sides. Use a protractor to draw a second line at right angles to this line. Label this line with an 'N' for 'normal'.
3. Place a plane mirror against the first line.
4. Use the ray box to shine a ray of light at the point where the normal meets the mirror. This is the incident ray.
5. The angle between the normal and the incident ray is called the angle of incidence. Move the ray box or paper to change the angle of incidence. The aim is to see a clear ray reflected from the surface of the mirror.
6. Using a pencil on the paper, mark the path of:
    - the incident ray with a cross
    - the reflected ray with a cross
7. Remove the mirror. Join the crosses to show the paths of the light rays.
8. Measure the angle of incidence and angle of reflection for the mirror.
9. Repeat steps 2 - 8 for several different angles of incidence.

Experiment: **To locate position of image in plane mirror.**

Apparatus:
Mirror strip, Drawing board, Paper, Paper pins, Pencil, Protractor, ruler.



Procedure:

- Fix the paper on drawing board. Insert a paper pin P on paper, before the mirror strip.
- Draw two incident rays from Pin, on mirror.
- Draw the reflected rays from mirror obeying laws of reflection i.e. i=r.
- Extend the reflected rays backwards. The point of intersection of extended lines gives the position of image of Pin P.

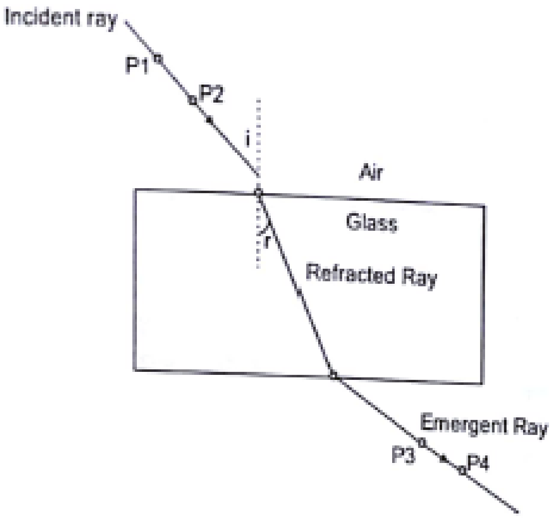
Characteristics of Image: The image produced in plane mirror has following characteristics:

- Image size is equal to object size.
- Image distance is equal to object distance.
- Image is upright.
- Image is virtual.
- Image is laterally inverted.

Experiment: **To find refractive index n= Sin i/ Sin r of a glass block.**

Apparatus: Glass block, drawing board, paper, pencil, ruler, Paper pins, Protractor.

Procedure:



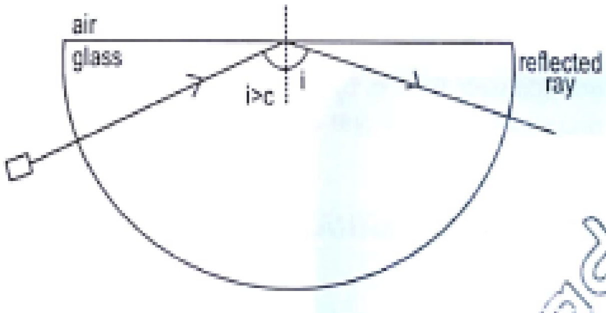
- Place the glass block on paper and mark its boundary.
- Insert 2 pins P1 and P2 on one side of glass block, making incident ray.
- Insert 2 more pins P3 and P4 on the other side of glass block, in the straight line of image of P1 and P2.
- Remove the pins and complete the Fig. by drawing incident, refracted and emergent rays.
- Measure angles i and r with protractor and use formula n = Sin i/ Sin r.

2. The angle of incidence is greater than critical angel i.e. i > c.

Experiment: To demonstrate the total internal refraction.

Apparatus: Ray box, semi circular glass block, paper drawing board, pencil, Protractor.

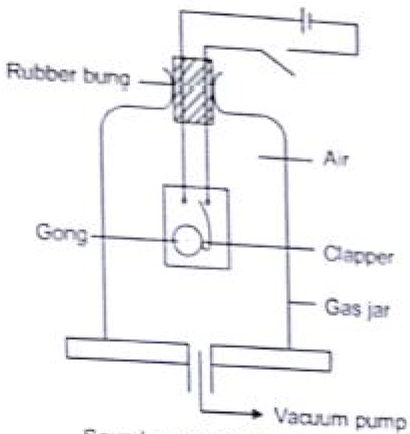
Procedure:



- Keep these micircular glass block on paper, fixed on drawing board.
- Fall the light ray from ray box, on the circular side of glass block.
- Keep on increasing the angle of incidence of ray, such that the ray bounces back into glass.
- The reflection of light ray from straight side of glass block shows the total internal reflection.

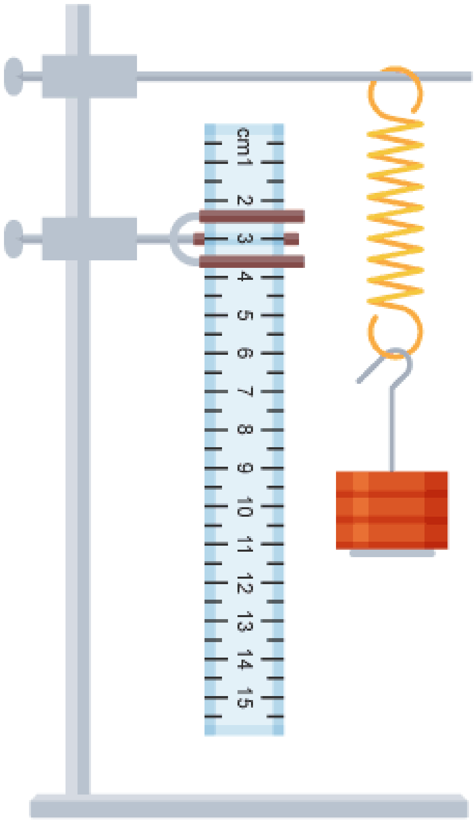
To demonstrate that medium is required for transmission of sound.

Sound waves require a medium in order to travel from one point to other. Since sound waves travel in the form of compressions and rarefactions, if there is vacuum, then no compressions and rarefactions are produced and sound energy is not transferred.



Sound cannot travel through vacuum

Fix an electric bell in a glass jar. When current is passed, the ringing bell is heard. The air in the glass jar is gradually pumped out with vacuum pump. The sound slowly becomes softer. When air is completely pumped out, no sound is heard from the ringing bell.



Investigate the relationship between force and extension for a spring

There are different ways to investigate the relationship between force and extension for a spring. In this required practical activity, it is important to:

- make and record length accurately
- measure and observe the effect of force on the extension of springs
- collect the data required to plot a force-extension graph

Hooke's law states that the extension of a spring is directly proportional to the force applied, provided that the elastic limit is not exceeded. The aim of the experiment is to investigate the relationship between a force and the extension of a spring, and see if the spring obeys Hooke's law.

Method

1. Secure a clamp stand to the bench using a G-clamp or a large mass on the base.
2. Use bosses to attach two clamps to the clamp stand.
3. Attach the spring to the top clamp, and a ruler to the bottom clamp
4. Adjust the ruler so that it is vertical, and with its zero level with the top of the spring.
5. Measure and record the unloaded length of the spring.
6. Hang a 100 g slotted mass carrier - weight 1.00 newtons (N) - from the spring. Measure and record the new length of the spring.
7. Add a 100 g slotted mass to the carrier. Measure and record the new length of the spring.
8. Repeat step 7 until you have added a total of 700 g.

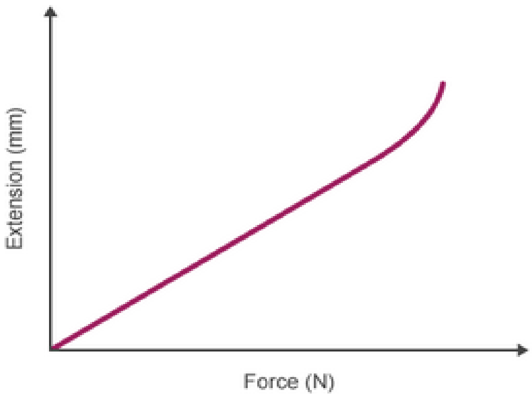
Results

Results

Force (N)	Length (mm)	Extension (mm)
0 (unloaded)	22	0
1.00	52	30
2.00	83	61
...		

Analysis

1. For each result, calculate the extension:
   - extension = length - unloaded length
2. Plot a line graph with extension on the vertical (y) axis, and force on the horizontal (x) axis. Draw a suitable line or curve of best fit.
3. Identify the range of force over which the extension of the spring is directly proportional to the weight hanging from it.



Evaluation

It is important to keep the ruler vertical. Suggest another way to improve the accuracy of the length measurements.

Evaluation

It is important to keep the ruler vertical. Suggest another way to improve the accuracy of the length measurements.

Hazards and control measures

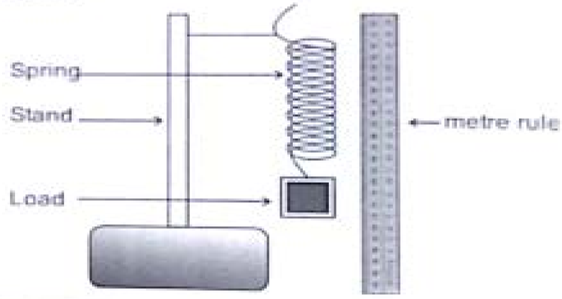
Hazard	Consequence	Control measures
Equipment falling off table	Heavy objects falling on feet, eg bruise/fracture	Use a G-clamp to secure the stand
Sharp end of spring recoiling if the spring breaks	Damage to eyes and/or cuts to skin	Wear eye protection, use support and gently lower masses whilst loading the spring
Masses falling to floor if the spring fails	Heavy objects falling on feet, eg bruise/fracture	Gently lower load onto spring and step back

Experiment to verify Hook's law.

Apparatus: Spring, metre rule, stand, weights or loads.

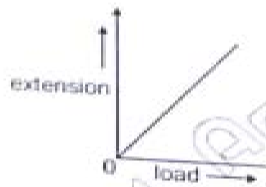
ARRANGEMENT & PROCEDURE:

- Attach a spring with stand and measure its original length (ℓ_1) with rule.
- Attach a load or weight at the end of spring. Measure stretched length of spring (ℓ_2) with rule.
- Similarly, attach different loads at the end of spring and measure the stretched lengths of spring for each load.
- Record the results in the table



No. of Obs.	Original length (ℓ_1)	Final length (ℓ_2)	Extension(ℓ_2-ℓ_1)	Load/weight
	Cm	Cm	Cm	N
1				
2				
3				
4				
5				

- Draw the graph between extension and load, the graph is a straight line, passing through origin So Hooke's law is verified.

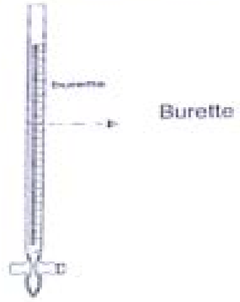


To determine density of Liquid:

Apparatus: beam balance, burette, beaker and stand.

PROCEDURE:

1. Find the mass (m_1) of an empty beaker with beam balance.
2. Shift a known volume (V) of the liquid from burette into beaker.
3. Find the mass (m_2) of beaker and the liquid with beam balance.



Calculation:

The mass of liquid = $m = m_2 - m_1$
Use the formula:

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

to find density of given liquid.

TO DETERMINE DENSITY OF REGULAR OBJECT:

Apparatus: beam balance, ruler, regular shaped object

Procedure:

1. Determine the mass of regular object with beam balance.
2. Measure the length (ℓ), breadth (b) and height (h) by using a meter rule.

Calculation:

The volume of object = $\ell \times b \times h$
Use the formula,

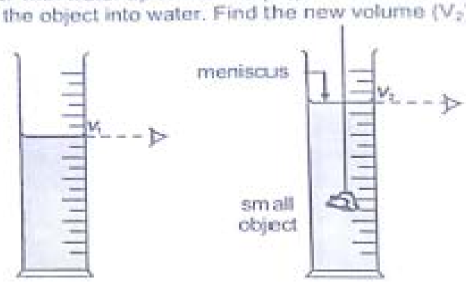
$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

TO DETERMINE DENSITY OF IRREGULAR OBJECT:

Apparatus: Beam balance, measuring cylinder, irregularly shaped object.

Procedure:

1. Find the mass of irregular object with Beam balance.
2. Fill measuring cylinder with water up to volume (V_1)
3. Completely immerse the object into water. Find the new volume (V_2).



Calculation:

The volume of irregular object = $V_2 - V_1$

Use the formula: density = $\frac{\text{mass}}{\text{volume}}$

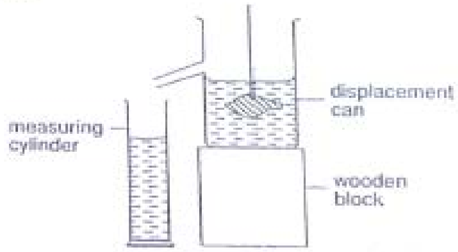
to determine density of irregularly shaped object.

Precautions:

- Avoid parallax error.
- Place the measuring cylinder on a flat surface.
- Read the volume from bottom of meniscus.
- The object must be completely immersed into liquid.
- Measure mass of object, before measuring its volume.

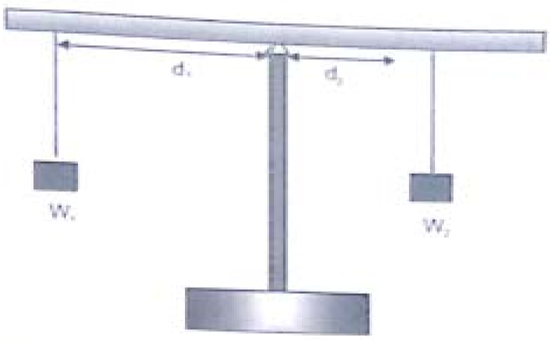
Note:

- If object floats in water, then tie a sinker to object. Subtract the volume of the sinker from the final reading.
- If the object is too big to be lowered into the measuring cylinder, use a displacement come to determine volume of solid.



Experiment: To investigate the Principle of Moments

Apparatus: Uniform metre rule, load (W_1), load (W_2), strings, knife edge, Retort stand.



Procedure:

1) Set up the apparatus as shown in Figure with the knife edge at the 50 cm mark
2) Balance the system by adjusting the distances d_1 and d_2.
3) Vary d_1 and change d_2 so that the system is balanced for 5 sets of d_1 and d_2.
4) Calculate the anticlockwise moments $W_1 \times d_1$ and the clockwise moments $W_2 \times d_2$ and tabulate as follows:

Table:

W_1	d_1	W_2	d_2	$W_1 \times d_1$	$W_2 \times d_2$

To determine position of c.m or c.g of plane lamina of irregular shape by plumb line.

Apparatus: Irregular lamina, Stand, Plumb line, Cork and Pin.

Fig. Plumb line

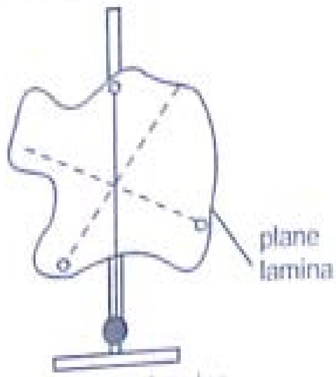


Fig. Irregular Lamina

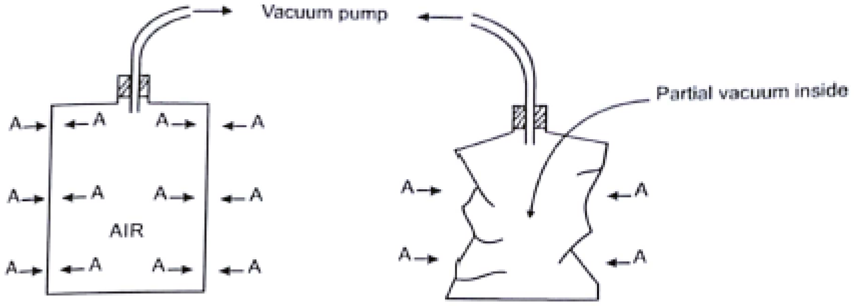
1. Make three small holes near the edges of the lamina.
2. Suspend the lamina through one of the holes using a pin.
3. Hang a plumb line on the pin in front of the lamina.
4. When the plumb line is steady, draw a line on the lamina along the plumb line.
5. Repeat the above procedure for the remaining two holes.
6. The point of intersection of the three lines on the lamina is the position of centre of mass or centre of gravity.

Precautions:

1. The lamina should be free to swing about its point of suspension.
2. The parallax error must be avoided.

EXPERIMENT TO DEMONSTRATE ATMOSPHERIC PRESSURE:

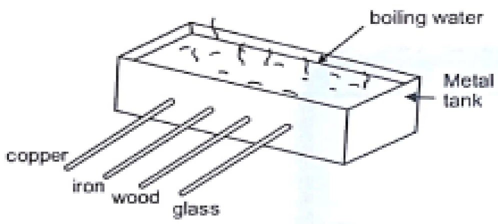
Fig. shows a thin-walled metal can, attached to a vacuum pump. Before the air was pumped out, the pressure inside the can is equal to that outside. As the air is pumped out, a partial vacuum of very low pressure forms inside the can and immediately the great external atmospheric pressure crushes the can. It is assumed that the material of the can is thin or flexible.



Effect of atmpspheric pressure

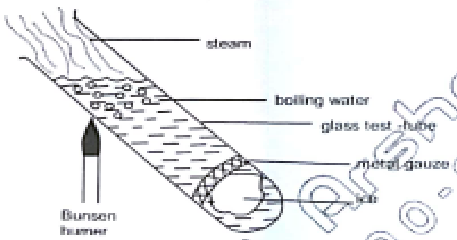
Experiments to demonstrate conduction, convection and radiation.

Experiment# 1: ***To investigate the thermal conduction through different solids.***



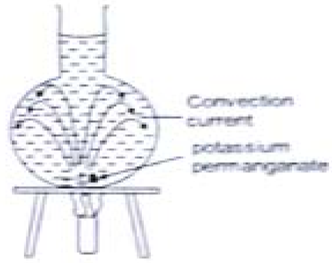
Four rods of different materials but of the same size, coated with wax are inserted in a metal tank. Pour boiling water into tank, so that the ends of rods are submerged. The level to which wax melts on different rods, determines the conduction rate of solids.

Experiment # 2: ***To demonstrate that water is a poor conductor of heat.***



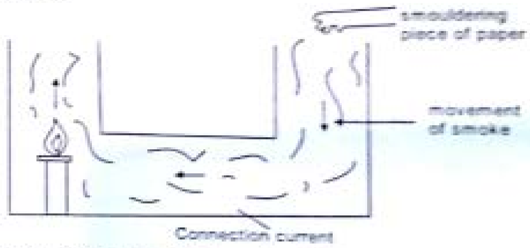
Place the ice cube at the bottom of test tube which is filled with water. Cover the ice cube with wire gauze, so that ice cube may not float. Heat the test tube at the upper end. It has been observed that water boils at the top but ice does not melt at the bottom. It shows that water is a poor conductor of heat.

Experiment #3: ***To demonstrate convection through the liquid.***
Fill the flask with water. Keep few crystals of Potassium Permanganate ($KMnO_4$) at the bottom of flask. Heat the flask from bottom. The water at the bottom being less dense rises upwards, along with crystals of $KMnO_4$. The purple streaks moving upwards and then downwards are observed in the flask, which show the presence of convection current.

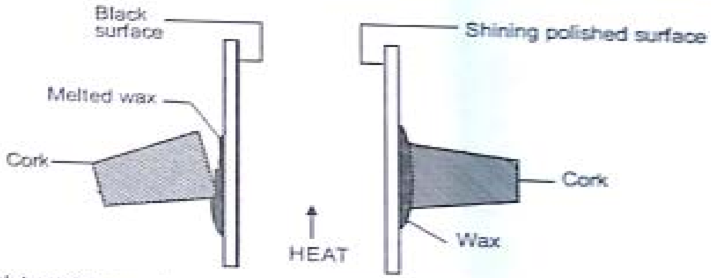


Experiment # 4: ***To demonstrate convection through air.***

Keep the burning candle at the bottom of chimney A and smoldering paper at the top of chimney B. The hot air above candle rises upwards and more dense air along with smoke enters from chimney B and travels towards chimney A. The path of smoke indicates presence of convection current.

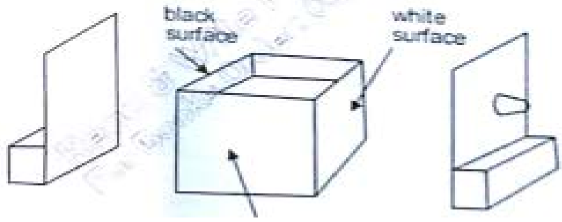


Experiment # 5: ***To demonstrate that black surface absorbs more infer red radiations than white surface.***



Take two metal plates of same size, one is dull black and other one smooth shiny. Stick Corks with wax on opposite sides of the plates. Heat the plates equally. It has been observed that wax attached to black plate melts and its Cork falls down earlier than that of white plate.

Experiment # 6: ***To demonstrate that black surface emits more infra-red radiations than white surface.***
Take a metal tank and fill it with hot water. Make one side of container dull black and other shiny white. Keep two metal plates holding wax and Cork at equal distances on both sides of tank. It has been observed that wax melts earlier and Cork falls down, from the plate facing black side of tank.



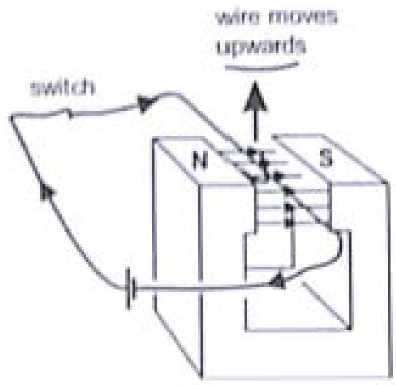
ELECTRICAL SYMBOLS:

Common devices in electric circuits.

Symbol	Device	Symbol	Device	Symbol	Device
	Switch		Lamp		Galvanometer
	Cell		Fixed resistor		Ammeter
	Battery		Variable resistor (or rheostat)		Voltmeter
	Power supply		Fuse		2 way switch
	Wires joined		Coil of wire		Earth connector
	Wires crossed		transformer		Capacitor

EXPERIMENT TO DEMONSTRATE THE FORCE ON A CURRENT CARRYING CONDUCTOR:

When a current carrying wire is placed in a magnetic field then a magnetic force is produced on the wire. Suppose a stiff copper wire is placed at right angles to the field, provided by U-shaped magnet. When switch is closed, a current flows through the wire. The wire moves upwards, indicating that an upward force acts on wire.



Observations:

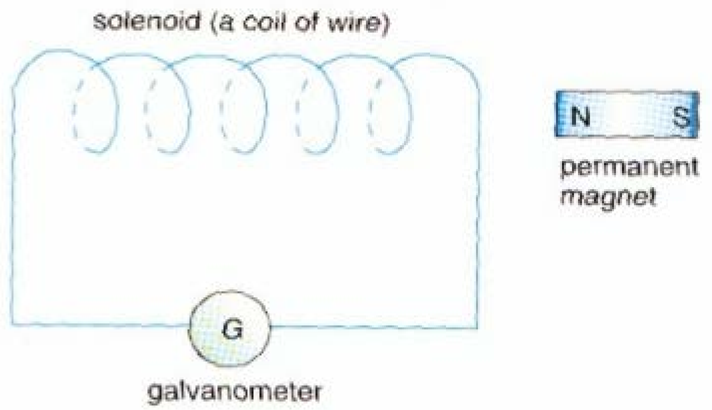
The magnitude of magnetic force on the current carrying conductor is increased:

- By increasing strength of a magnetic field.
- By increasing amount of current passing.

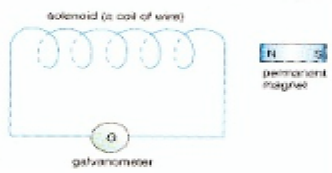
The direction of magnetic force on the current carrying conductor is reversed:

- By reversing the direction of current.
- By reversing the direction of magnetic field.

Experiment to show that a changing magnetic field can induce an emf in a circuit



a) Faraday's solenoid experiment



- Set up the apparatus as shown in the diagram.
- A permanent magnet is inserted into a solenoid connected to a sensitive galvanometer.
- The galvanometer needle deflects as the permanent magnet move within the solenoid.
- This shows that e.m.f. can be induced when there is a changing magnetic field.

Factors affecting the magnitude of the induced emf

Procedure	Galvanometer response
Insert N pole of 1 bar magnet into solenoid	Slight deflection
Insert N pole of 1 bar magnet into solenoid at twice the speed	Greater deflection
Insert N pole of 2 bar magnets into solenoid	Greater deflection
Insert N pole of 1 bar magnet into solenoid with twice the number of turns	Greater deflection

Factors affecting the magnitude of the induced emf

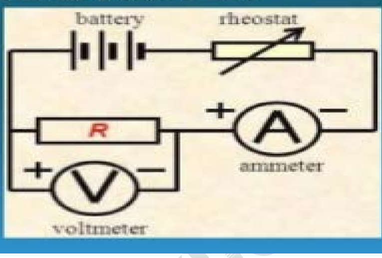
- The speed with which the magnet is inserted into or withdrawn from the solenoid.
- The strength of the magnet.
- The number of turns in the solenoid.

Describe an experiment to measure the resistance of a metallic conductor using a voltmeter and an ammeter and make the necessary calculations.

Resistance

- Aim: To measure electrical resistance of metallic conductor.
- Apparatus:
  - DC Supply
  - Rheostat (Variable Resistor)
  - Voltmeter
  - Ammeter

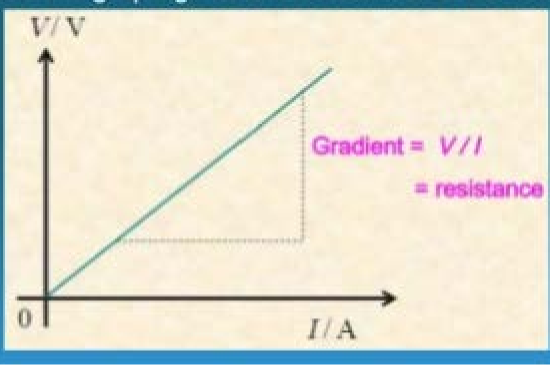
- Procedure:
  - Arrange the apparatus as shown below



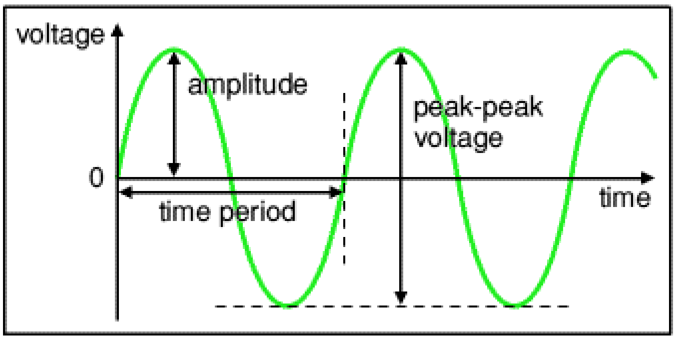
- Procedure
  - Adjust the variable resistor the maximum resistance to get a small current flows in the circuit.
  - Record the ammeter reading (*I*) and voltmeter reading (*V*).
  - Adjust the variable resistor to allow a large current to flow in the circuit. Record the values of *I* and *V*.
  - Repeat for another 5 sets of *I* and *V*.

- Graph
  - Plot the graph of *V* (V) and *I* (A).
- Calculation
  - Determine the gradient of the graph

- Result
  - The gradient of the graph gives the resistance of the load R



Compiled by: Mustafa Asif



- **Amplitude** is the maximum voltage reached by the signal. It is measured in **volts, V**.
- **Peak voltage** is another name for amplitude.
- **Peak-peak voltage** is twice the peak voltage (amplitude). When reading an oscilloscope trace it is usual to measure peak-peak voltage.
- **Time period** is the time taken for the signal to complete one cycle. It is measured in **seconds (s)** but time periods tend to be short so milliseconds (ms) and microseconds (µs) are often used.
  1ms = 0.001s and 1µs = 0.000001s.
- **Frequency** is the number of cycles per second. It is measured in **hertz (Hz)**, but frequencies tend to be high so kilohertz (kHz) and megahertz (MHz) are often used.
  1kHz = 1000Hz and 1MHz = 1000000Hz.

Frequency and time period

Frequency and time period are the inverse of each other:

Frequency and time period

Frequency and time period are the inverse of each other:

$$\textbf{frequency} = \frac{\textbf{1}}{\textbf{time period}}$$

and

$$\textbf{time period} = \frac{\textbf{1}}{\textbf{frequency}}$$

Physics ATP Question/Answer Notes
Imran Mirza

Q1. How to check for zero error in
a: (i) Vernier caliper
(ii) Micrometer screw gauge
(iii) Meter rule
(iv) Stopwatch
Ans:
(i) Close the jaws of the vernier caliper fully. When the zeros of both MAIN SCALE and
VERNIER SCALE are not aligned together, the zero error is present.
(ii) Before placing an object, turn the thimble until the spindle and anvil meet. If the reading
on the thimble is not alligned with the zero mark on the datum line, a zero error is present.
(iii) Refer to this.
(iv) Just check what the stopwatch reads on reset. If it isn't 00:00, a zero-error is present.
Readings are subtracted accordingly.
Q2/3. How to check for zero error in
(i) Voltmeter
(ii Ammeter?
Ans: For both of them, disconnect them (from the circuit) and check if the pointer is pointing
at the zero mark on the scale. If they aren't, a zero-error is present.
Q4/5. Why the pointer reading ammeter/voltmeter is gently tapped before taking a reading?
Ans: To reduce the friction between the needle and the pivot.
Q6. When making a ray diagram, why should rays and normal be as thin as possible?
Ans: Thin lines make it possible to obtain precise readings; with thick lines it is difficult to
measure accurate angles (of incidence, reflection etc.).
Q7. What is the purpose of a rachet in a micrometer?
Ans: To prevent undue pressure from being exerted.
Q8. A liquid reaching the maximum temperature quickly. Give one reason.
Ans: It is due to convectional currents. The water expands and gains heat energy and its
density lowers down, and it moves upwards and the lower part of the apparatus is replaced
by cold water which has higher density.

Q9. Why is the temperature 20°C marked on the measuring cylinder?
Ans: The scale on the cylinder is calibrated to give accurate readings when the liquid is at
20°C.
Q10. Why an image is measured from a position behind the screen rather than front?
Ans: If it was measured from the front, it would block the rays of light and disturb the
apparatus.
Q11: WHAT IS A MEANT "GOOD ELECTRICAL" CONNECTION?
Ans: It means that the components are connected properly and are tightly screwed in the
circuit. This also reduces the circuit's internal resistance.
Q14: STATE ONE PRECAUTION, OTHER THAN AVOIDING PARALLAX ERROR THAT
SHOULD TAKE WHEN USING A SCHOOL LAB THERMOMETER, TO ENSURE
ACCURATE MEASUREMENT OF TEMPERATURE?
Ans: Check the mercury level when the reading becomes steady. If the thermometer is in a
liquid, make sure it is 1/3rd immersed and that the liquid is stirred before taking the reading.
Q16: WHAT IS THE AFFECT OF "LENGTH" OR "M ASS" ON TIME PERIOD OF
PENDULUM?
Ans: Length - The period of a pendulum increases with length.
Mass - No effect.
Q17: WHAT ARE THE CONDITIONS TO GET ACCURATE FIXED POINTS?
Ans: Immerse 1/3rd of the thermometer into the funnel containing ice, avoid parallax error
when reading the temperature on the thermometer, use ice shavings to ensure good
contact between the bulb of the thermometer and the ice, wait for the temperature to
become steady before taking the reading, etc. Ice point is 0°C and steam point is 100°C.
Q18: WHY WHILE DETERMINING THE BOILING POINT OF WATER, THERMOMETER IS
HELD IN STEAM?
Ans: Because the steam is pure and has specific melting point. If the reading is taken from
the water, it may not accurate as water may not be pure.

Q20: WHAT OBSERVATION MADE DURING THE EXPERIMENT WOULD CONFIRM THAT THE GIVEN METAL IS A GOOD CONDUCTOR OF HEAT?

Ans: Experiment - Using 4 rods (copper, iron, glass and wood) which have the same dimensions, coat one end of the rods evenly with wax. Then fill a tray of water in boiling water and submerge the end of the rods in the tray. From observation, the wax melts the farthest along the copper rod, showing that copper (a metal) is a good conductor of heat while the other rods (insulators) are poor conductors of heat.

Q22: WHAT IS THE PUPOSE OF LAGGING?

Ans: Lagging is done to provide heat insulation (in boilers, pipes etc.) and trap heat from escaping.

Q23: HOW YOU MIGHT CHECK THAT YOU HAVE MADE GOOD ELECTRICAL CONNECTIONS?

Ans: Ensure that all components are screwed in tightly and that they work properly. If the resistance of the circuit is low, the electrical connection is usually good.

Q24: GIVE A REASON FOR MAKING THE LENGTH OF EACH NORMAL AT LEAST 6CM?

Ans: This will help in measuring angles accurately as the radius of a protractor is normally 6cm.

Q25: WHAT ADVANTAGE IS THERE IN USING TRACING PAPER FOR THE SCREEN?

Ans: The image of the object can be viewed without obstruction of light. Also, the size of the image can be conveniently measured by using a metre rule on the back of the tracing paper without disturbing the apparatus.

Q26: WHY THE EYE NOT PLACED TOO CLOSE TO THE END OF THE RULE?

Ans: If the object is too close, the distance between the object and retina is low and hence the image of the object is not formed on the retina, so we cannot see the object clearly.

Q27: WHAT WOULD BE THE EFFECT ON THE IMAGE IF THE CENTRE OF THE

OBJECT AND THE CENTRE OF THE LENS ARE NOT AT THE SAME HEIGHT?
Ans: If they aren't parallel to each other, the image will be partial or blurred.
Q28: WHAT IS THE PURPOSE OF VARIABLE RESISTOR?
Ans: To adjust the current in the circuit.
Q30: BEFORE CLOSING THE SWITCH, WHY IS THE RHEOSTAT ADJUSTED TO ITS
MAXIMUM VALUE?
Ans: This makes sure minimum current f lows in the circuit, so when the circuit is closed the
ammeter doesn't get damaged.
Q31: WHY IS A COMPASS TAPPED WHEN BEING USED?
Ans: To eliminate friction on the compass needle.
Q32: WHAT IS THE ADVANTAGE OF USING SMALLER COMPASS?
Ans: It is can be used to allign the weak magnetic fields.
Q33: WHY SHOULD CARD MOVE FREELY ON THE PIVOT? (referring to a card being
hung from a hole on a support)
Ans: To ensure the card does not stick to the pivot due to friction (which ensures that the
card is hanging in equilibrium position).
Q34: WHAT IS PLUMBLINE?
Ans: A line from which a weight is suspended to determine the depth or verticality.
Q35: WHY THE PLUMBLINE SHOULD HANG SO THAT IT ALMOST TOUCHES THE
CARD?
Ans: This will help in avoiding parallax error.
Q37: WHAT IS THE MEANING OF OF C WRITTEN ON A THERMOMETER?
Ans: It means the temperature is measured in Celcicus.
Q38: WHAT PRECAUTIONS ARE TO BE TAKEN WHILE MAKING A CIRCUIT?
Ans: Ensure that all connections are tight, make sure the components are functional and
clean, use a DC supply with low voltage (to minimize potential hazards), make sure the
power supply has a rating nearly equal to the lamp or bulb, make sure ammeter is in series
and voltmeter is in parallel, etc.
Q39: WHAT IS A JOCKEY?
Ans: A jockey is a metal slider that wears away a line of the insulation so it can make
electrical contact with the metal underneath.

Q40: HOW WOULD YOU CLEAN THE DIRTY JOCKY?
Ans: Rub the jockey with sand paper.
Q41: HOW COULD LID HELPS TO KEEP THE CONTENTS OF LAGGED CONTAINER
FROZEN?
Ans: It prevents heat from the surroundings entering the container.
Q42: WHY THERMOMETER HELD IN STEAM FOR DETERMINING THE UPPER FIXED
POINT OF THERMOMETER?
Ans: Because the steam is pure and has specific melting point. If the reading is taken from
the water, it may not accurate as water may not be pure.
Q43: WHAT COULD CAUSE THE POINTER TO AT POSITION BELOW 0?
Ans: By reversing the polarity..
Q44: STATE THE PRECAUTIONS WHILE TAKING A READING FROM
i. Voltmeter
ii. Ammeter
Ans: Check for zero-error, tap them before taking the reading, avoid parallax-error, etc.
Q45: WHAT WILL BE THE EFFECT ON THE CIRCUIT IF THE DIRTY JOCKEY IS USED?
Ans: A dirty jockey will hinder the flow of current in the circuit BECAUSE the resistance will
increase dramatically.
Q46: HOW WILL YOU "RECORD" READINGS?
Ans: Using the appropriate instruments, the readings are recorded and noted (on a piece of
paper, etc.)
Q47: HOW WILL YOU DISPLAY / REPRESENT YOUR READING?
Ans: The relevant quantities can be tabulated.
Q48: HOW WILL YOU FIND RESULT FROM YOUR REPRESENTED READINGS?
Ans: A graph can be plotted between the relevant quantities and results can be obtained by
deducing data from the graph (e.g. averages, a quantity from the graph, etc.).
Q49: WHAT PRECAUTIONS WOULD YOU TAKE WHILE TAKING READINGS FROM
MEASURING INSTRUMENTS? (GENERAL PRECAUTIONS)
Ans: Avoid parallax error, wait for a steady reading, remember to add/subtract if there are
zero-errors, etc.
Q50: WHAT IS AN OSCILLATION?

Ans: The process of the bob swinging back and forth steadily and coming back to its original
position.
Q52: HOW WILL YOU NEASURE THE LENGTH OF A PENDULUM?
Ans: Using a meter rule and set-square. Place the meter rule close to the thread and note
the length of the upper and lower ends of the pendulum (l1 and l2). The length l is
calculated by l2 - l1.
Q53: WHAT IS THE USE OF SET SQUARE?
Ans: They are used to allign the ruler to get the correct reading. They help to avoid parallax
errors.
Q55: WHAT IS A MEASUREMENT?
Ans: The size, amount of degree of a physical quantity.
Q56/57: What is an accurate/precise reading?
Ans: Accuracy - the measure of how close you are to the true answer.
Precision - the measure of how closely all your individual measurement match each other.
Q58/59/61: Define responsiveness, range and sensitivity of a thermometer.
Ans: Range - The minimum and maximum temperatures that the thermometer can
measure.
Sensitivity - It is the length of increase of the liquid per degree rise in temperature.
Responsiveness - How quickly the thermometer can register a change in temperature.
Q60/62: How can we increase the responsiveness, range and sensitivity of the
thermometer?
Ans:
To increase range:
(a) make the thermometer stem longer
(b) make the bore(capillary) bigger
(c) use a liquid with a lower expansivity
To increase sensitivity:
(a) make the bore smaller
(b) use a bigger bulb
(c) use a liquid with a higher expansivity
To increase responsiveness:
(a) use a thin glass bulb
(b) use a liquid that conducts heat better
Q63: WHY THE BORE OF CAPILLARY TUBE IS UNIFORM?

Ans: This improves the thermometer's sensitivity (by giving a large change in length of
the mercury thread for a small change in temperature).
Q64: WHY THE WALLS OF LONG TUBE ABOVE THE BULB ARE MADE THICK? Ans: Acts as a magnifying glass to easily read the mercury thread in the
stem.
Q65: WHAT IS THE ADVANTAGE OF SMALL SIZE OF THERMOMETER? Ans: It makes it cheap to produce, portable, etc.
Q66: WHY THE MERCURY IS CONTAINED IN A THIN-WALL GLASS BULB?
Ans: This allows for rapid conduction of heat through the thin glass wall to the
mercury contained in the bulb.
Q67: WHAT IS THE PUPOSE OF CONSTRICTION IN THE CLINICAL THERMOMETER?
Ans: The constriction prevents mercury from flowing back into the bulb.
Q68: WHAT DOES THE STATEMENT MEAN, THAT THE SCALE OF THERMOMETER IS
LINEAR?
Ans: It is the uniform expansion of liquid to temperature.
Q69: WHY THE CROSS-SECTION OF THE STEM OF THERMOMETER IS PEARSHAPED?
Ans: This acts as a magnifying glass in one direction for easy reading of the mercury
thread.
Q70. What factors to consider before measuring something?
Ans: The magnitude should not exceed the limit of the instrument, and the instrument must
be sensitive enough to detect a meaningful measurement.
Q80. When iron fillings are used, why must the current be large?
Ans: So that the field is stronger and hence the field can be detected.
Q81. Why must smaller fillings be used?
Ans: So that the weaker magnetic fields are also shown.
Q82. Why must the oscillations be counted from center of swing?
Ans: The chain is moving the fastest at the center of swing.
Imran Mirza (MSc Physics. PGCC. Scotland, UK)

Best fit graphs(https://www.chemguideforcie.co.uk/2016paper5/graphs.html)

Graphs

Introduction

You will need:

- a **very sharp** HB pencil. CIE insist in their Examiner's Reports that you draw graphs using an HB pencil. Nothing else will do for plotting the points or drawing the line. Make sure that you have a pencil sharpener as well.
- a really good clean rubber. You need to be able to rub out mistakes leaving no trace.
- a good ruler for straight lines. A transparent ruler is useful for drawing best fit straight lines because you can easily judge where all the points are relative to the line you are drawing.

Everything else apart from the points and any lines you draw should be in ink.

Which variable goes where?

The ***independent variable*** is the one which you are deciding to change. For example, you might be measuring something at various different times which you choose, or at various different temperatures, or at various different concentrations. Each of these would be the independent variable.

The ***dependent variable*** is the one which changes because of the changes in the independent variable. For example, the volume of a gas produced might be dependent on how long the experiment is running for. The volume is dependent on the time.

- The independent variable always goes on the x-axis.
- The dependent variable always goes on the y-axis.

Drawing best fit lines

The data which you are given to plot is likely to have two separate problems deliberately built-in - and that's true whether you end up with a straight line or a curve.

The results that you are given to plot will all have some "experimental error" added. That means that however accurately you plot them, they probably won't all fall on a straight line or smooth curve.

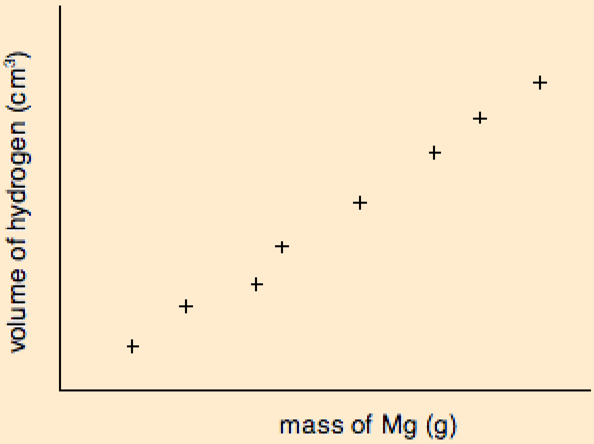
It is quite likely that at least one of the results that you are given will be anomalous. That means that the point is so far from the pattern shown by the rest of the points that it must have been wrong. You are quite likely to have to explain what might have caused it to be wrong. We will look at that later.

Drawing straight line graphs

Plotting the points

Suppose you were plotting the results of an experiment in which variable masses of magnesium were added to an excess of dilute sulphuric acid, and you measured the volume of hydrogen given off each time.

Here are the results:



This is fairly obviously going to be a straight line, but before you do anything else ask yourself if there are any points which don't seem to fit tidily on that straight line - so-called "anomalous" points.

In this case, the third point falls underneath the trend for all the rest of the points. Before you do anything else, check that you have plotted it correctly!

Assuming that they are plotted correctly, ***do not*** include any anomalous points when you draw your line!

You are quite likely to be asked to account for any anomalous points you find. In this case, the point is below the trend line. A smaller volume of hydrogen was recorded than you would expect. What might cause that?

There are various possible reasons. You might have measured the volume of the hydrogen wrongly, recording a smaller volume than you should have. Or there might have been a leak of hydrogen from the apparatus before you collected it.

Alternatively, you might have mis-weighed the magnesium. Perhaps you didn't have as much magnesium as you thought you had.

The reasons will vary from experiment to experiment, but your answers should be as precise as possible. You won't get any credit for saying "There must have been an experimental error." You have to explain what the error might have been, and why it made the point too high or too low.

Drawing the line

The first thing to ask yourself each time is whether the line should go through the origin (0,0).

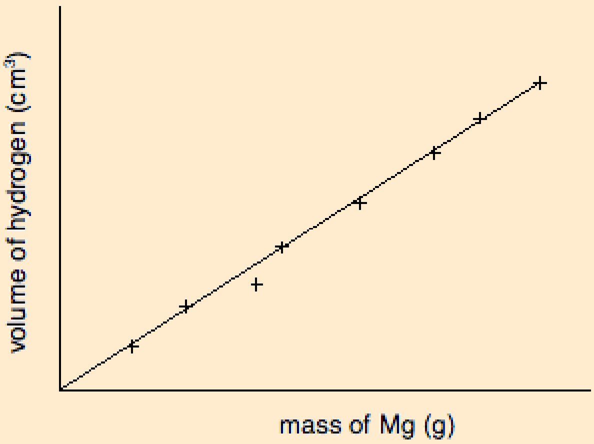
In this case, if you had zero mass of magnesium, you would obviously get zero hydrogen produced - so the line must go through the origin.

That is really helpful! That gives you one point which is absolutely certain, with no experimental error. That may well help you to decide exactly where to place your line.

You are then going to draw a line of best fit which needn't necessarily go through any of the points which you have plotted (apart from the origin in this particular case).

Draw your straight line with a ruler so that there is as even a scatter of points either side of the line as you can manage (ignoring any anomalous points).

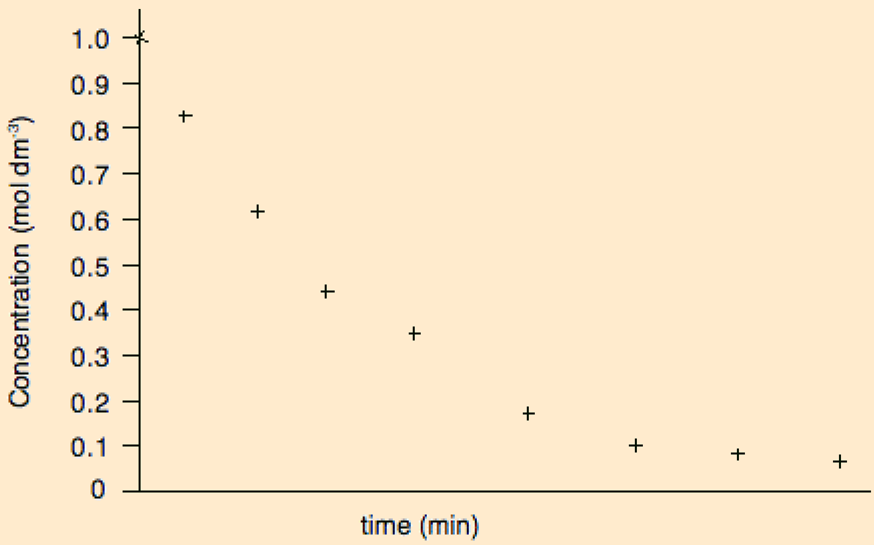
Your final graph will look something like this:



Drawing curved graphs

This is no different from drawing straight line graphs, except that a good curve is a bit more difficult to draw well.

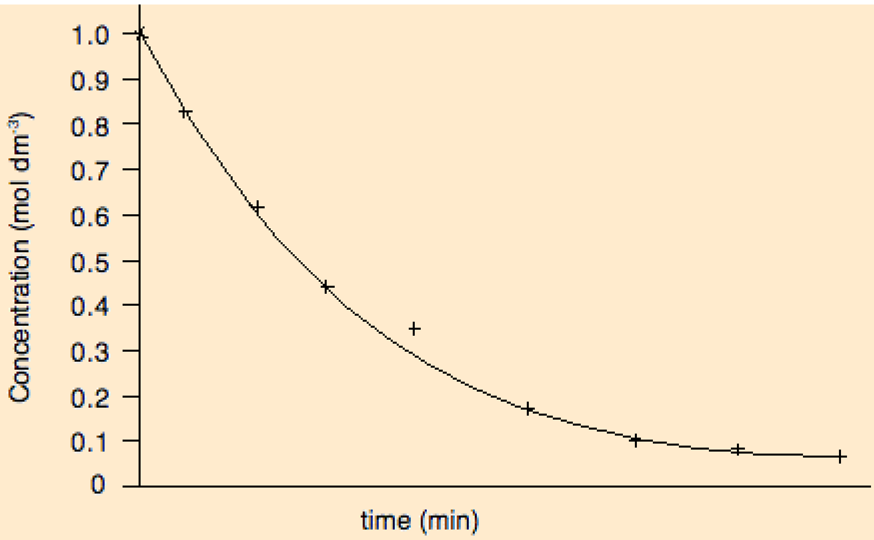
This graph shows data gathered during a rate of reaction experiment in which the concentration of a reactant was measured against time. I am including a vertical scale on this graph because I shall need it further down the page.



Are there any anomalous points? Yes - the fifth point looks a bit higher than the trend. When you draw the curve, leave it out.

Does the line go through the origin? Obviously not - although the first point at zero time could be taken as more accurate than the other concentrations because this is the solution you started with, and so you should know accurately what the original concentration was.

So your curve will look like this:



Curves are obviously more difficult to draw than straight lines especially if your results have an amount of experimental error.

You can buy flexible rulers which will stay in whatever shape you bend them into. The only disadvantage is that they usually aren't transparent, and so it is difficult to judge when you have a proper best fit curve until after you have drawn it.

If you are drawing the curves free-hand, help yourself by taking advantage of the way your wrist and arm moves. If you hold a pencil and rest your wrist on a table, and just move your wrist, you will draw a fairly smooth curve. If you want your curve to have a bigger radius, you could pivot your arm around the elbow joint instead.

In the graph we've drawn above, you would have to turn the paper upside-down to take advantage of this, of course.

Sometimes it takes several attempts to draw the best curve. Start off by drawing the line lightly, and then make it firmer when you are satisfied. At the end, ***rub out*** all the attempts that went wrong. You ***must*** end up with only one clean line!

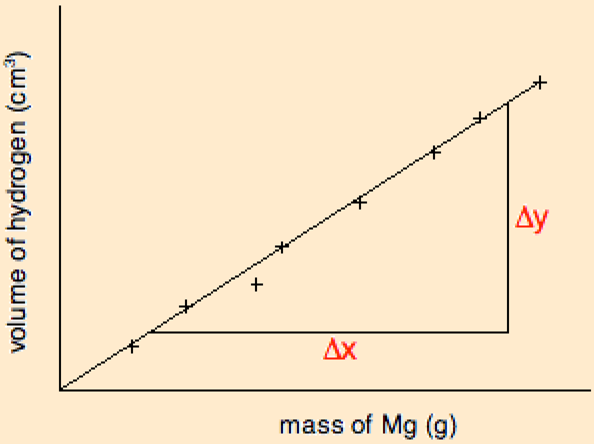
Measuring gradients

It is highly likely that you will be asked to measure the gradient (or slope) of your graph. If you have a straight line, the gradient will obviously be for the whole line. If it is a curve it will be at some point on the curve.

Measuring the gradient of a straight line.

The slope is measured by drawing a large triangle as shown below. Examiners will expect you to make the triangle large to make measurements more accurate.

You should ***not*** use points that you have plotted for the end points of the triangle unless they happen to fall exactly on the line.



In this particular case, where the line goes through the origin, you could perfectly well use the origin as one of the ends of the triangle.

The slope is given by the change in the y-axis value divided by the change in the x-axis value - $\Delta y/\Delta x$. In this case, it would be measured as volume of hydrogen per gram of magnesium.

The examiners will almost certainly ask you to record the co-ordinates of the points you have used to draw your triangle. They use these to check that you have calculated the slope accurately.

You ***must*** give the co-ordinates of each point in the standard format of (x, y). In this case, you would quote the co-ordinates of the end points of your triangle as). Be careful with this. Examiner's Reports constantly criticise students for not giving these correctly. That is just a complete waste of a mark.

Positive and negative gradients

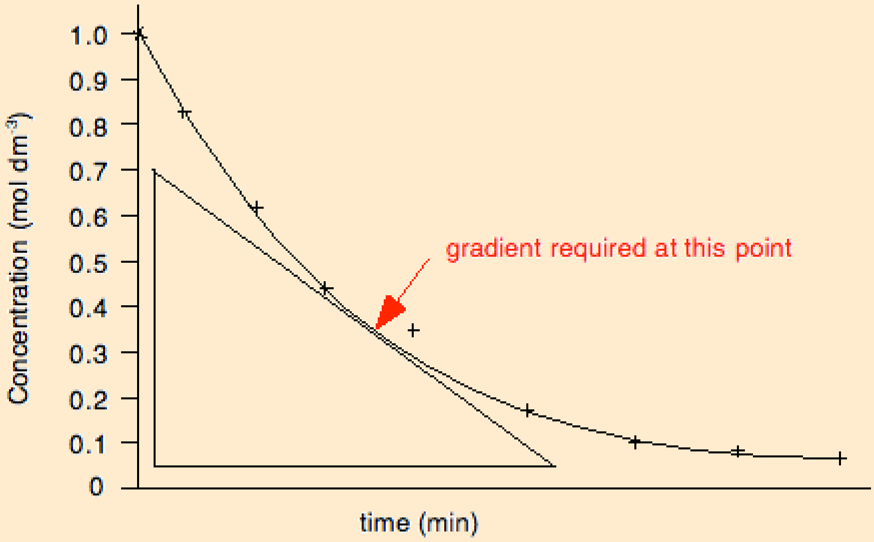
If your graph is sloping upwards (as this one is), the gradient is positive. The volume of hydrogen is increasing with the mass of magnesium.

If the graph is sloping downwards, then the gradient is negative, and that must be shown in your answer. There is an example of this below.

Measuring the gradient of a curve.

Obviously, in this case, the slope is changing all the time, and so you will be asked to find the gradient at some particular point.

To do that, you draw a tangent to the curve at the point, and use this to draw a triangle similar to the one above.



In this case, the gradient would be recorded as the change in concentration per minute at that point - again by measuring Δy/Δx. But this time, the concentration is falling with time, and so the gradient must be recorded as negative. If you get the sign wrong, you will lose the mark.