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P9EM1_Study_of_Magnetic_lines_of_force

Aim: To trace the magnetic lines of force of a bar magnet.

Apparatus: 2 Bar magnets, thick paper, iron filings etc.

Theory: Many similarities exist between electric and magnetic phenomena. A magnet has two opposite poles, referred to as north and south. Opposite magnetic poles attract each other, and similar magnetic poles repel each other, exactly as happens with electric charges. When a magnet is kept at a place, it influences the space surrounding itself. The effect a magnet has around its surrounding is called the magnetic field of the magnet. Magnets are surrounded by magnetic fields. A magnetic field can be thought of as consisting of lines of force. The forces of magnetic attraction and repulsion move along the lines of force. A magnet has two opposite poles, referred to as north and south. Opposite magnetic poles attract each other, and similar magnetic poles repel each other, exactly as happens with electric charges.

Figure 1

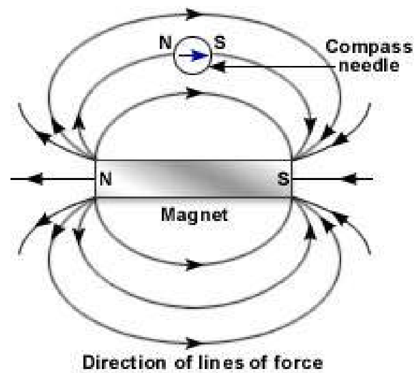


Figure 2

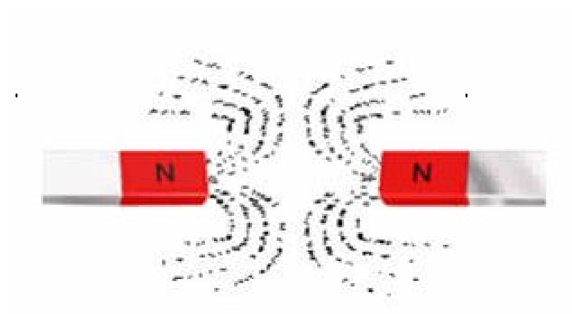


Figure 3

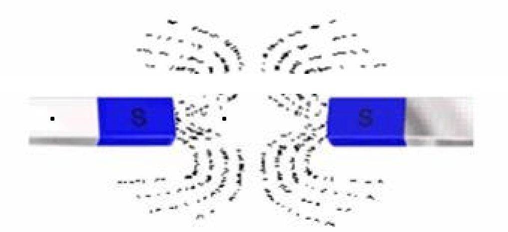
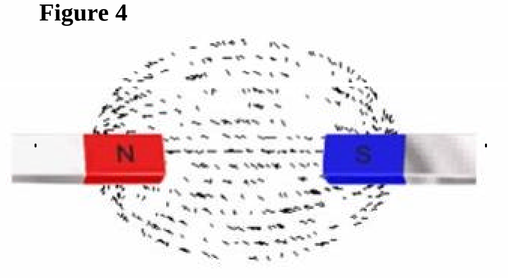


Figure 4



The force with which magnetic poles attract or repel each other depends on the strength of the poles and the distance between them. The properties of lines of force can be enumerated as:

1. They are said to originate from the north pole and end at the south pole. This is only a convention.
2. The lines of forces of a particular magnet do not intersect with each other.
3. Tangent to the line of force gives the direction of the magnetic field acting at that point.
4. A line of force is continuous: starts from the North Pole and ends at the South Pole.
5. There is no line of force within the magnet.

Procedure : In the following experiment you will trace the magnetic lines of force of a bar magnet .The bar magnet is placed on
a surface containing iron filings.

1. Place a plain, thick paper on a table and support it such that it remains flat.
2. Spread fine iron filings on the paper & Place a bar magnet on the paper
4. Tap the paper gently. Write detailed observation regarding the arrangement of iron filings around the magnet
5. Now take 2 bar magnets and place them as show in figure 1, 2 and 3 respectively.
6. Write detailed observation regarding the arrangement of iron filings around the magnets The iron filings line up along the magnetic field lines of the magnet. Note the circular pattern of the field lines.

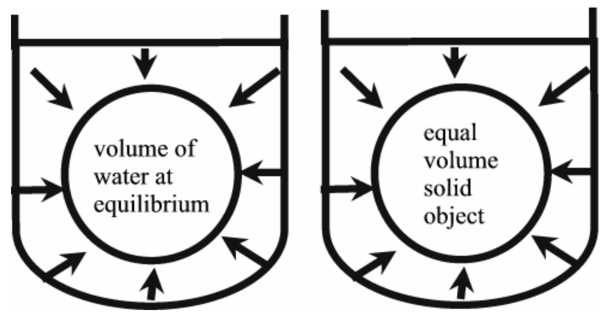
By convention, we say that the field lines emanate from the north pole of the magnet and re-enter the magnet through the South Pole. Note also that the field lines are closer together at the poles than at the center of the magnet. More iron filings are attracted to the poles because the strength of the magnetic field is greater at the poles.

P9M1_Archimedes-principle

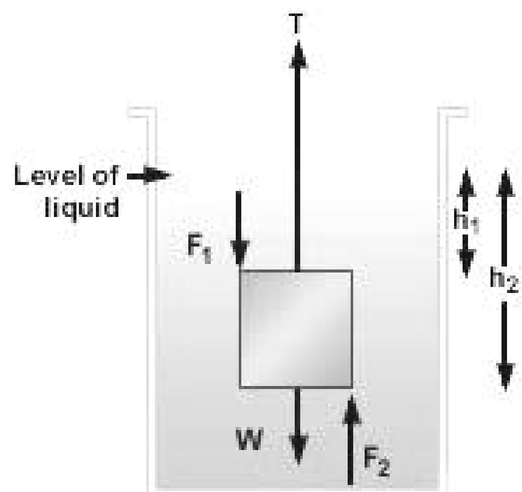
Aim: To determine the relative density of an unknown liquid by Archimedes principle.

Apparatus: Spring balance, solid object, beaker, water etc.

Theory:



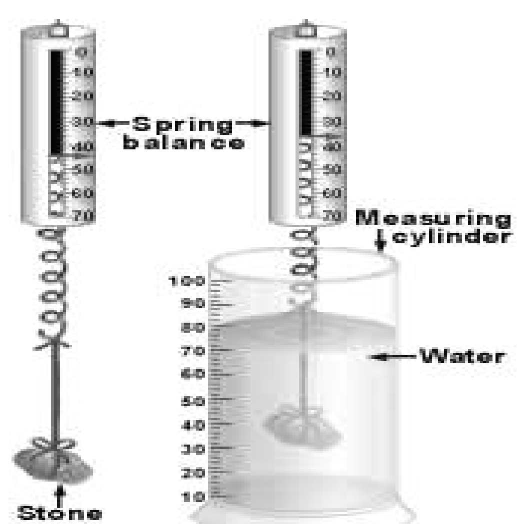
Forces acting on a body immersed in a liquid.
The "water ball" at left is exactly supported by the difference in pressure and the solid object at right experiences exactly the same pressure environment, it follows that the buoyant force on the solid object is equal to the weight of the water displaced



Consider the figure alongside; here a square piece of iron is immersed in liquid. The piece of iron is experiencing forces from all sides and they are:

- The down ward force due to its weight = W
- Downward force acting on the upper surface of the iron piece, due to water pressing on it = F_1
- Upward force due to the tension of the string = T
- Upward force acting on the lower surface of the iron piece due to water pressing on it = F_2

Horizontal forces acting on the other surfaces due to water pressure = H



Take water in a measuring cylinder and note its volume level. Then dip the stone in the water by tying a string around while it is still hanging from the spring balance. You will see that the stone is weighing less!! If you see the water level now, you will see it has risen. Now from the volume of the water displaced, calculate the weight of water

Density of water is 1 gm/cm^3. You will see that the mass of water displaced is exactly equal to the reduction in weight of the stone in water.

Archimedes was the first person to understand this phenomenon more than about 2,200 years ago and hence the phenomenon is named after him. **Archimedes Principle** states that a body immersed in a liquid, wholly or partly, loses its weight. The loss of weight is equal to the weight of the liquid displaced by the body. The Archimedes principle holds good for irregular as well as regular bodies and any liquids. The upward force experienced by the immersed body is also known as up thrust or **buoyancy** .

Since the piece of iron is stationary and is not moving either up or down or side ways, we can safely say that

H=0 and

Total up ward force = Total Downward force

$$T + F_2 = +W \; F_1$$

Application of Archimedes Principle to determine densities of liquids

Density of a substance is given as the mass per unit volume. Quite often, it is easier to quote the relative density of the substance with respect to the density of water. Hence the relative density (R.D.) of a substance is defined as the ratio of the density of the substance with respect to that of water.

$$. = \frac{Density\ of\ substance}{Density\ of\ water}$$

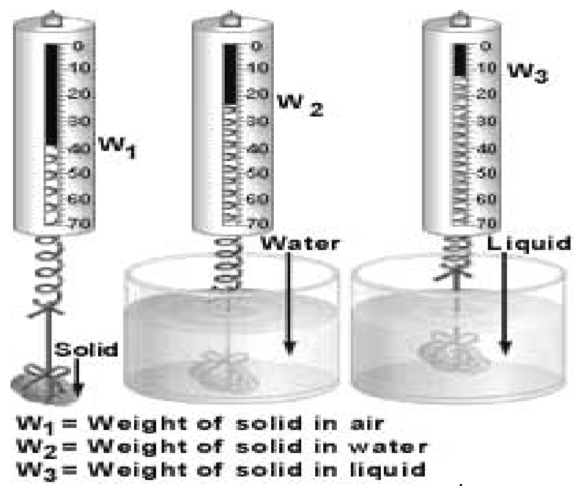
Density of water is 1 gm/cm^3.

To determine the relative density of an unknown liquid by Archimedes method,

Procedure

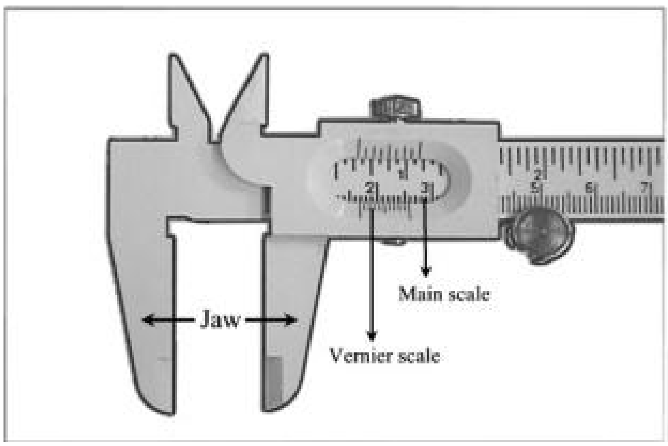
- Weigh a given object in air = W_1
- Weigh the same object in water = W_2
- Weigh the same object in the unknown liquid = W_3

$$R.D. = \frac{W1 - W2}{Volumeofdisplacedliquid} \times \frac{Volumeofwaterdisplaced}{W1 - W3}$$



P9M5_Vernier-Calliper

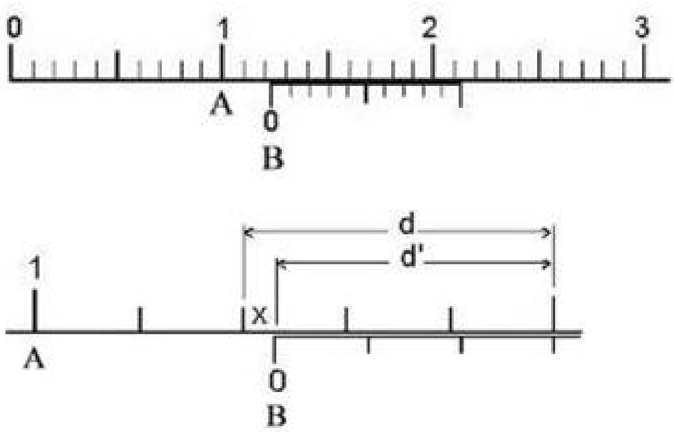
Aim: To measure the diameter of a small spherical body using a Vernier Calliper.
Apparatus: a vernier calliper, a small spherical body.
Theory: Vernier scale is a small, moveable scale placed next to the main scale of a measuring instrument. It is named after its inventor, Pierre Vernier (1580 - 1637). Vernier calliper is a common tool used in laboratories and industries that allows us to make accurate measurements to a precision of a small fraction of the smallest division on the main scale of the instrument. The vernier is a convenient tool to use when measuring the length of an object, the outer diameter (OD) of a round or cylindrical object, the inner diameter (ID) of a pipe, and the depth of a hole . Vernier scales are found on many instruments, for example, spectroscopes, supports for astronomical telescopes etc.
How the vernier works: The vernier consists of a main scale engraved on a fixed ruler and an auxiliary vernier scale engraved on a movable jaw (see Figures 1 and 2). The movable auxiliary scale is free to slide along the length of the fixed ruler. This vernier's main scale is calibrated in centimeters with the smallest division in millimeters. The auxiliary scale has 10 divisions that cover the same distance as 9 divisions on the main scale. Therefore, the length of the auxiliary scale is 9.0 mm.



In the following examples we will assume that the smallest division on the main scale is 1mm so the divisions on the Vernier scale are 0·9mm each. The position of the zero of the Vernier scale tells us the number of cm and mm in our measurement. For example, in figure 1, the reading is a little over1·2cm.

fig1

To find a more precise reading, consider figure 2 (which is a magnified view of part of figure 1)



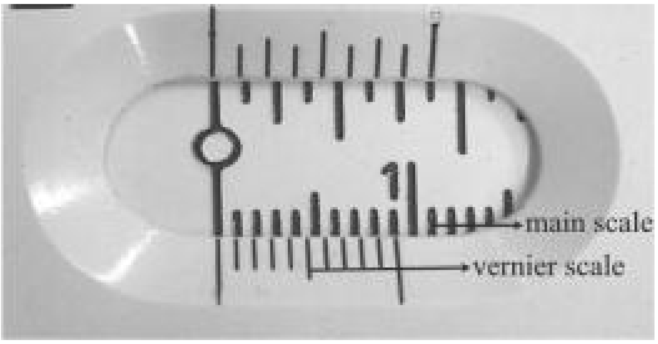
Find the distance, x. To find x, find the mark on the Vernier scale which most nearly coincides with a mark on the main scale.

In figure 3 it is obviously the third mark. Now, it is clear that ....$x = d - d'$

Remembering that each division on the main scale is 1mm and that each division on the Vernier scale is 0·9mm, we have: x = 3mm - 3(0·9)mm = 3(0·1)mm

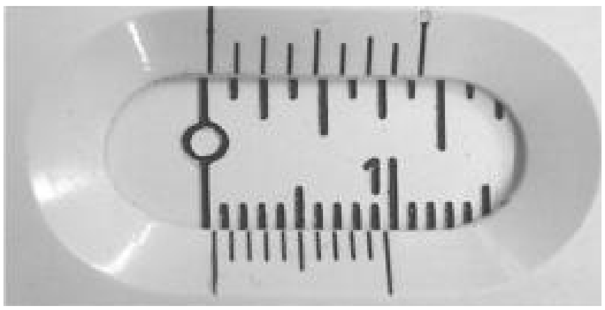
Therefore, the reading in the example is: 1·23cm

Zeroing the vernier:



When the vernier is closed and properly zeroed (compare Figure 5), the first mark (zero) on the main scale is aligned with the first mark on the auxiliary scale. The last mark on the auxiliary scale will then coincide with the 9 mm-mark on the main scale. This is read 0.00 cm.

Improperly zeroed vernier:



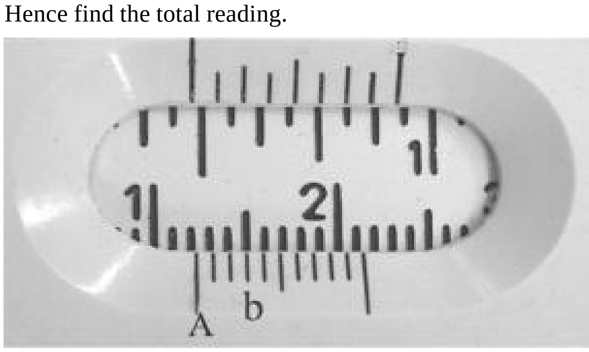
Care must be taken to insure that the vernier caliper is properly zeroed (see above Figure). (With misuse, it is possible that the vernier will not read zero when the jaws are closed, thus leading to systematic errors.) The vernier above is improperly zeroed. To correct this, a zero correction must be made. A correction may be either positive or negative. If the first mark on the auxiliary scale lies to the right of the main scale, then the reading is too large and the error is positive. The zero reading in the Figure is +0.05 cm and should be subtracted from any measurement reading. Similarly, if the first mark on the auxiliary scale lies to the left of the main scale zero-mark, then the error is negative and the correction should be added from the measurement reading.

Reading the vernier calliper:

Least count of vernier calliper

Procedure:-

1. Find the least count of the vernier caliper.
2. Find the zero error of the vernier caliper.
3. To measure the diameter of sphere, hold the sphere between the jaws (without exerting undue pressure on it.). Note the position of the zero mark of the vernier scale on the main scale. Let this be main scale reading A. Note the vernier division b that coincides (or almost coincides if no division exactly coincides) with some division on the main scale. Hence find the total reading.



4. Take at least 2 independent readings for different positions of the sphere.
5. Find the mean diameter of the sphere.

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P9EM2_Study_of_a_Resistor_and_Diode

Aim: To study the electrical property of a resistor.

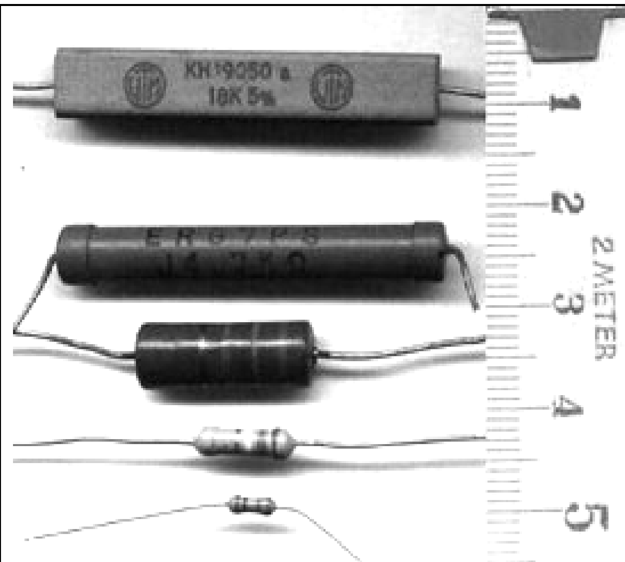
Apparatus: Different resistors, conductor, power supply, ammeter,diode etc.

Part 1

Theory :

A **resistor** is an electrical component designed to have an electrical resistance that is independent of the current flowing through it For a wide variety of materials and conditions, the electrical resistance does not depend on the amount of current flowing or the amount of applied voltage: the two are proportional and the proportionality constant is the electrical resistance. This case is described by Ohm's law.

$$I = \frac{V}{R}$$

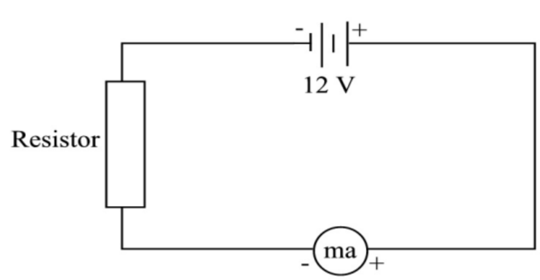


A few resistor types.

Resistance is thus a measure of the component's opposition to the flow of electric charge Any physical object is a kind of resistor. Most metals are conductors, and have low resistance to the flow of electricity. The human body, a piece of plastic, or even a vacuum has a resistance that can be measured. Materials that have very high resistance are called insulators. The resistance of a component change with its physical characteristics like cross sectional area etc. In part 1 of the following experiment you will determine the factor which affects the resistance of a given component.

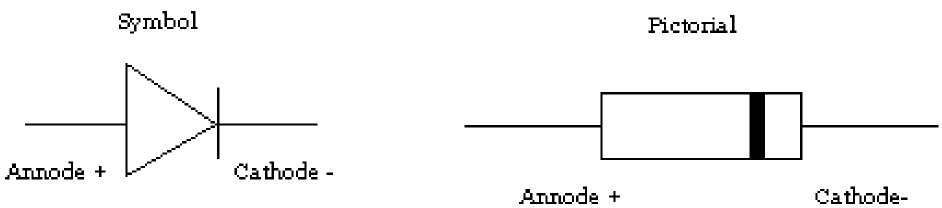
Procedure:

1. You are given a conductor , a power supply, and an ammeter.
2. Connect the circuit as shown in the figure.
3. For the conductor use length L as shown and note the reading in the ammeter A1.
4. Now use the entire length L and note the reading in the ammeter A2.
5. Keep the input voltage fixed throughout.
6. Is A1 different from A2.(**Yes / No**)

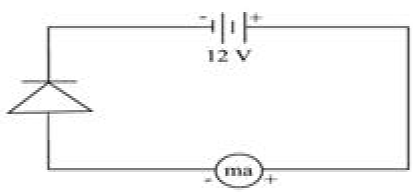


Part 2

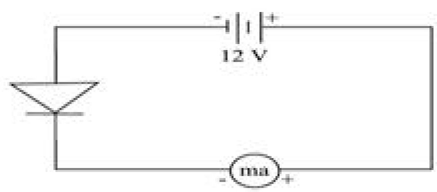
Theory: A Diode an electric component that conducts electric current in only one direction, functioning as a one-way valve. Diodes typically are made from semiconductor materials such as silicon, germanium or selenium and are uses as voltage regulators, signal rectifiers, oscillators and signal modulators/demodulators.
A semiconductor is a material that is neither a good conductor of electricity (like copper) nor a good insulator (like rubber). In a diode , electrodes on opposite ends of the device enable a voltage to be applied.



When a diode is placed in a circuit so that the *Anode,* or positive end, is connected to the positive terminal of the battery, and the *Cathode*, or negative end, is connected to the negative terminal, the diode is considered to have a **forward bias**. This causes current to flow through the diode with little resistance.



Forward bias



Reverse bias

Placing a diode in a circuit so that the cathode end faces the positive terminal of the battery, and the anode end faces the negative terminal, causes the diode to have a **reverse bias.** A current flows in the circuit only when a diode is forward biased.

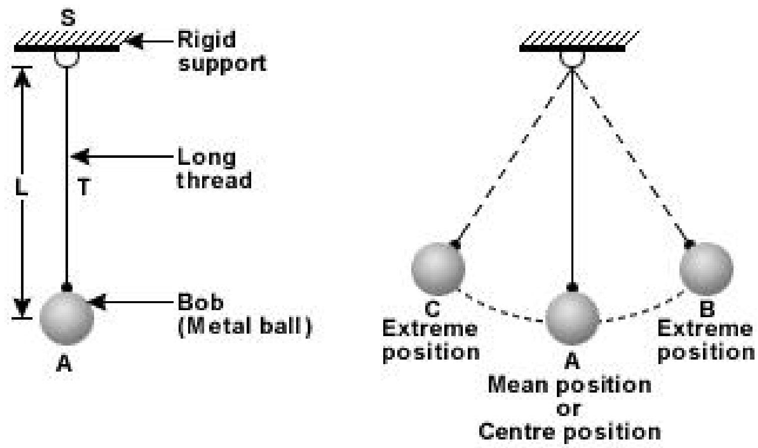
Procedure:

1. Connect a diode to the circuit as shown.
2. See that the diode is forward biased. Note the reading in the ammeter.
3. Now connect the diode such that it is reversed biased. Note the reading in the ammeter

Resistors are used as part of electrical networks and incorporated into microelectronic semiconductor devices. The critical measurement of a resistor is its resistance, which serves as a ratio of voltage to current and is measured in ohms, an SI unit. Superconducting materials at very low temperatures have zero resistance. Insulators (such as air, diamond, or other non-conducting materials) may have extremely high (but not infinite) resistance, but break down and admit a larger flow of current under sufficiently high voltage. In computer equipment, diodes are commonly used to emit light by passing a current through it, as in light emitting diodes (LEDs). Computer chips, both for CPU and memory, are composed of semiconductor materials. Semiconductors make it possible to miniaturize electronic components, such as transistors. Not only does miniaturization mean that the components take up less space, it also means that they are faster and require less energy.

P9M4_Simple-pendulum

Aim: To study the effect of the length of a simple pendulum on its time period.
Apparatus : A retort stand , a metal bob , a stop watch , a string .
Theory: A pendulum is a device consisting of an object suspended from a fixed point that swings back and forth under the influence of gravity. A simple pendulum is made up of a bob made out of a metal ball, attached to a thread that is supported rigidly at one end.
The bob of the pendulum is free to swing. When the pendulum is at rest, it is in its mean position at A. The mean position is also the equilibrium position. At this position, all the forces are balanced and no net force is acting on the pendulum. Thus initially at A, the pendulum is stationary. Now if the bob of the pendulum is taken to one side, at position B and released, the bob will undergo back and forth motion. The motion will trace an arc of a circle whose radius is equal to the length of the pendulum. The bob will move towards position C through A. If there is no frictional force, then the bob will move in the back and forth manner continuously, between the two extreme positions B and C.



(a) Simple pendulum (b) Motion of a simple pendulum

Some parameters associated with a simple pendulum:

1. *Length* of the pendulum: The length of the thread from which the pendulum is hang, up to the centre of the bob is called the length of the pendulum. This is denoted by **L.** It has to be borne in mind that the length of the thread plus the diameter of the bob does not constitute L. In fact L = length of the thread + radius of the bob.
2. Oscillations of the pendulum: One complete to and fro motion is known as the oscillation of the pendulum. One oscillation is the motion taken for the bob to go from position B (initial position) to A (mean position) to C (the other extreme position) and back to B. One oscillation can also be defined as the motion taken for the bob to go from A to B to C (through C) and back to position A.
3. *Time period* of the pendulum: The time taken for one oscillation by the pendulum is called the time period of the pendulum. Time period is also called period of the pendulum. This is denoted by **T.**
4. *Amplitude* of the pendulum: The maximum displacement of the bob from its mean or equilibrium position is known as the amplitude of the pendulum. The straight-line length AB or AC is the amplitude of the pendulum. It has to be borne in mind that the amplitude is the straight-line distance between points A and B or C and not the length of the arc AB or AC.
Energy changes in the pendulum in the pendulum: Since the bob swings from one end to the other, the kinetic and potential energy of the system changes continuously. Experiments show that the time period (T) of a pendulum is given by

$$T = \frac{2\Pi\sqrt{L}}{g}$$

Where L = length of the pendulum g = acceleration due to gravity in m/s^2

Experimentally we can take a simple pendulum and measure the time period by varying the following parameters:
1. Vary the length L of the pendulum.
2. Vary the mass of the bob of the pendulum.
3. Vary the material of the bob.
4. Vary the amplitude of the pendulum.

In this experiment, you are going to keep the mass and the angle of release the same and change the length of the pendulum. This is the independent variable. Then you'll measure the time period, which is the dependent variable.

Procedure:

1. Measure length (L) of the pendulum from the centre of the bob to the point of suspension and note it down.
2. Set up the full length of string and hang the pendulum with the help of a stand
3. Decide what angle you will use to set the pendulum swinging. keep the angl e small.
4. Bring the ball to its rest position and then leave it so that it should have oscillatory motion.
5. Count 10 oscillations and the time required for 10 oscillations as t_1 sec.
6. Repeat the procedure for the same length "L" and find t_2 sec.
7. Similarly take 2 more readings for different lengths (1/3, 1/2).

P9O1_Lateral_Displacement_of_Light

Aim: To study the lateral displacement of light.
Apparatus: Glass slab, pins, Drawing paper, Drawing board, protractor etc.
Theory: Consider a ray of light passing through a rectangular glass block ABCD (fig 1)

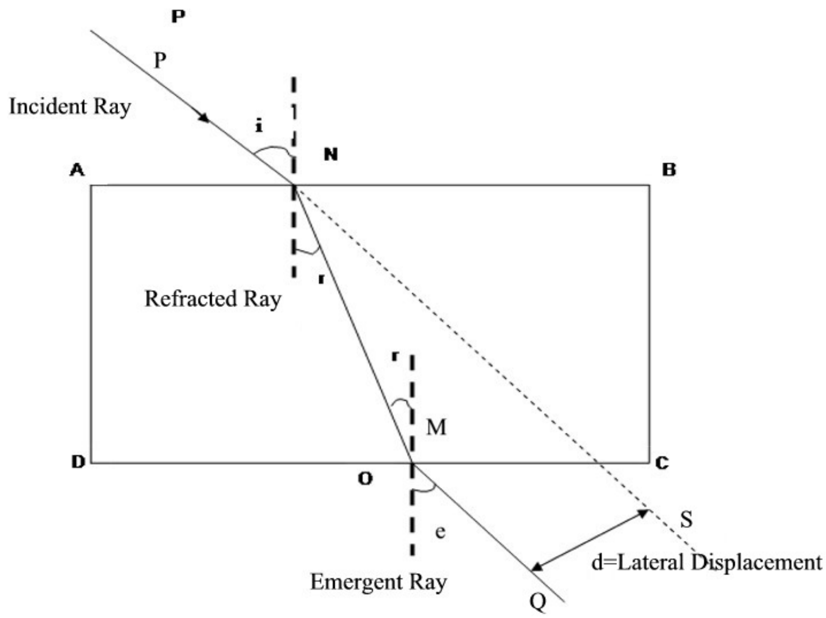


Fig 1 (Position A)

The incident ray PN enters the glass surface AB at N. Glass being a denser medium than air, it bends the ray towards the normal and r is less than *i.* At the opposite face CD, the ray coming out from glass to air at M, bends away from the normal. MQ is called the **emergent ray** and the angle it makes with the normal at M is the **angle of emergent (e)** .Since AB and DC are parallel, it will be found that the angle of incidence is equal to the
Angle of emergence, i=e
The incident ray PN is parallel to the emergent ray MQ. If the glass block were not there, the ray PN would have continued to travel along the dotted line PNS. Due to the glass block, it has been shifted sideways to MQ without any change of direction. This shift is called **lateral displacement.**
In Fig 1, lateral displacement = **d**

Lateral displacement ***is*** *the distance between the paths of the incident and the emergent rays.*
A ray which is incident normally is not refracted. In such a case, **d=0**.
Procedure:

(1) Take a glass slab and position it as shown in fig above.
(2) At a particular angle of incidence 30 ^{o}, 50 ^{o} Measure the angle of incidence **(i)** , angle of emergence **(e)**
(3) Fix the drawing paper on the drawing board. Place the glass slab on it and mark its outline ABCD.
(4) Remove the glass slab. Select a point N on the line AB as shown in the figure. Draw the normal (through the point N) to the line AB. Draw the line PN inclined at a angle OF 30 ^{o} AS shown in the figure.
(5) Fix two pins Such that the pins are vertical and the distance between their bases is about 4 cm. Replace the glass slab properly on the rectangle ABCD drawn on the paper.

(6) Observe the images of the bases of the pins through the glass slab from the side CD. Fix two pins on the side CD of the glass slab so that the bases of these pins are exactly in line with the images of the bases of the pins . (This enables us to determine the path of the ray of light in glass and on emergence in air.)

(7) Remove the pins and mark their positions by small circles Remove the pins. Join the points to get the emergent ray MQ. Produce PN to meet CS.

(8) Measure the lateral displacement **d** of the light ray

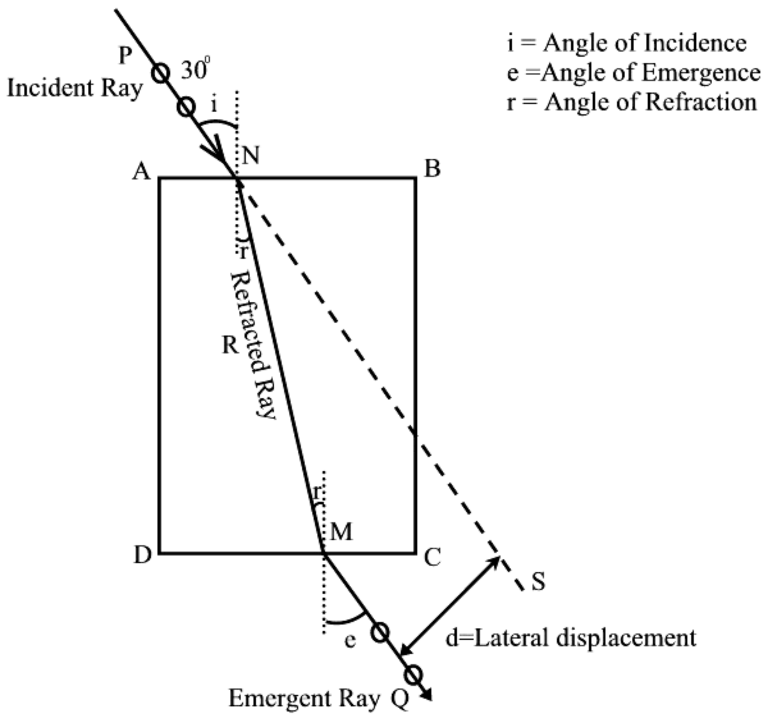


Fig.2 (Position B)

Procedure:

Now place the glass slab at position B and and repeat the above procedure for i=30