GOVERNMENT POLYTECHNIC BARGARH

DEPARTMENT OF MATH & SCIENCE

ENGINNERING PHYSICS
LAB MANUAL

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Date:

EXPERIMENT NO. 1

To find the cross-sectional area of a wire using a screw gauge.

Aim of the Experiment:

To measure the cross-sectional area of a given wire using screw gauge.

Apparatus Required:

1.Given wire
2.Screw gauge
3.Geometry box

Theory:

- In figure 1.1, an image of a typical screw gauge is presented. With the ratchet, the circular scale can be moved over the linear scale. The distance covered on the linear scale with one complete rotation is called Pitch of screw gauge.
- In a micrometre screw, the pitch is usually 1 mm or 0.5 mm. It can be seen that the circular scale also has divisions on it. In general, the number is either 50, 100 or 200.
- So, while rotating, one can estimate the distance travelled on the linear scale by noticing the no. of divisions on the circular scale.
- The smallest distance we can measure by the screw gauge is called the least count of the screw gauge which is given by

$$\text{Least Count} = \frac{\text{Pitch}}{\text{Total no. of divisions on the circular scale}}$$

In general, the screw gauge has a least count of 0.001 cm

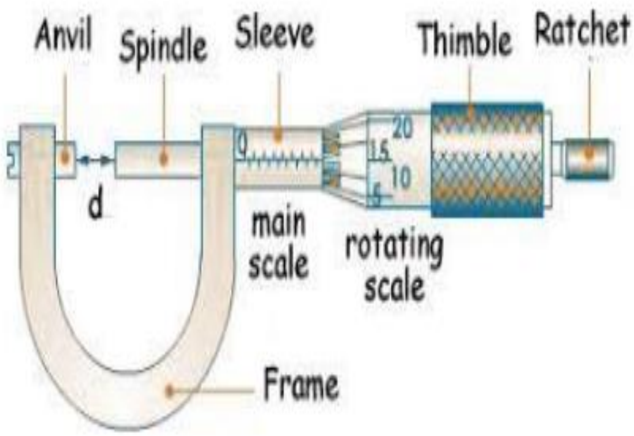


Figure 1.1: Schematic of a typical screw gauge

Procedure:

- Standardize the linear scale. This means, measure the length of one division of the linear scale using the scale in your geometry box/instrument box. Usually, 10 divisions are equal to 1 cm or 0.5 cm. Accordingly, one division is 1 mm or 0.5 mm.
- Rotate the screw through, say, ten complete rotations and observe the distance through which it has receded.
- Then, find the pitch of the screw, i.e., the distance moved by the screw in one complete rotation.
- If there are n divisions on the circular scale, then distance moved by the screw when it is rotated through one division on the circular scale is called the least count of the screw gauge.
- Determine the least count.
- Put the wire in between the anvil/ stud and the spindle. Move the screw forward by rotating the ratchet till the wire is gently gripped between the spindle and the anvil.
- Note the division on the linear scale. Tabulate it as the initial circular scale reading (ICSR).
- Now slightly loosen the screw. Remove the wire. Rotate the screw using the ratchet. Keep track of the no. of complete rotation till the screw/spindle touches the anvil.
- Note the no. of complete rotation (N) and the final circular scale reading (FCSR).
- Find the difference D = (ICSR ~ FCSR)

  D = ICSR – FCSR (if ICSR > FCSR)

  D = (ICSR + No. of total divisions on the circular scale) – FCSR (if ICSR < FCSR)
- Calculate pitch scale reading (PSR) = Pitch x No. of complete rotation
- Calculate circular scale reading (CSR) = D x least count
- Here the circular scale reading is calculated by the difference in initial and final reading for which zero error if any is cancelled.
- These data will be tabulated in the below format in the next page.

Working Formula

$$A = \frac{\pi d^2}{4}$$

A ⇒ Cross Sectional Area of the given wire

d ⇒ Mean or Average Diameter of given wire

TABULATION FOR MEAN DIAMETER (d) OF THE WIRE:

Sl. No.	PITCH	LC	ICSR	N	FCSR	Difference D =I ~ F	PSR= Pitch x N in cm	CSR = D x LC in cm	d = PSR+CSR in cm	Mean d in cm
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

Calculation:

Here Mean d is found to be = ___________ cm

The cross-sectional area of the wire, A = $\frac{\pi d^2}{4}$ = _____________ cm^2

Conclusion:

The cross-sectional area of the given wire was found out to be ______________cm^2 .

Precautions:

1. The screw should always be rotated by ratchet to avoid undue pressure.
2. To avoid back-lash error in the screw, the screw should be moved in the same direction.
3. The reading should be taken repeatedly at different places/orientation of the supplied specimen.

4. View all the reading keeping the eye perpendicular to the scale to avoid error due to parallax

5. While measuring, care should be taken such that no portion of the object under measurement touches the U-shaped frame of the instrument. 6. The given body should be kept lightly between the gaps so that it can be removed conveniently without disturbing the gap.

VIVA QUESTIONS

Q1. Define pitch of the screw.

Q2. Define Least Count of the screw gauge.

Q3. How can you determine the number of complete rotations?

Q4. What do you mean by ICSR?

Q5. How to find Difference?

Date:

EXPERIMENT NO. 2

To find out the thickness and volume of a glass piece using Screw Gauge.

Aim of the Experiment:

To measure the thickness and volume of the given glass piece using screw gauge.

Apparatus Required:

1. Supplied glass piece
2. Screw gauge/micrometre Screw
3. Instrument box
4. Graph paper

Theory:

In the case of regular shaped glass peace (for example circle, rectangle and triangle), the area can be estimated using the measured parameters (e.g., length, breadth, radius or height). However, in the case of irregular lamina, graph paper must be used for the determination of area. Thickness is measured using the screw gauge. To find the thickness of the glass plate, it is gripped between the tip of the screw and the anvil. The PSR and CSR are noted as before.

The thickness of the glass plate is;

$$\text{Thickness}(t) = PSR + CSR$$

PSR= Pitch x N (no. of complete rotation)

CSR= Difference x Least count (L.C)

To find the Volume of glass plate (irregular lamina), find the thickness, t of irregular lamina as before. Then place the lamina over a graph paper and trace its outline on the graph paper. The area A of the lamina is taken from the graph paper.

The volume of the glass plate is calculated from the equation;

The volume of the glass piece = area x thickness

Procedure:

- Measure the thickness of the screw gauge using the method described in the experiment no.1. Only difference is instead of the wire you will be putting the glass piece. Tabulate the observations.
- For measurement of area of the glass plate, put it on a graph paper. Draw its outline on the paper using a sharp pencil. A typical picture is presented in figure 2.1.

- Now remove the piece. First count the biggest square of area (type A) 1cm 1 cm. Note down its number. You can write numbers on the respective squares for a better tracking and ease of counting.
- Then, from the left-over area, count the number of squares with area 0.5 cm 0.5 cm (type B).
- Then, count the smallest squares of area 0.1 cm 0.1 cm (type C).
- Now put the glace piece on another part of the graph paper and repeat the above procedure.
- Tabulate the observations.

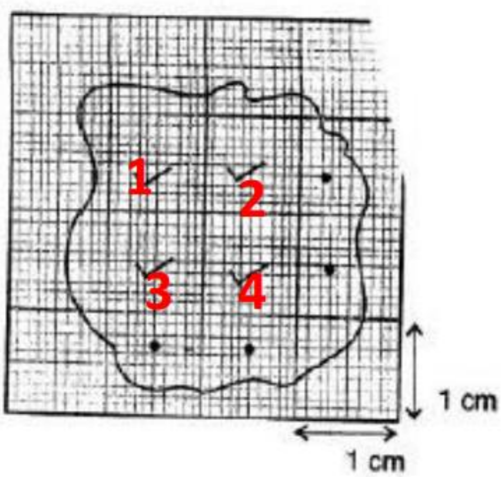


Figure 2.1: The outline of the glass piece on a graph paper.

TABULATION -1 FOR THE MEAN AREA OF THE IRREGULAR LAMINA:

Sl. No	No. of squares of type A	Area comprising the squares of type A In cm^2	No. of squares of type B	Area comprising the squares of type B In cm^2	No. of squares of type C	Area comprising the squares of type C In cm^2	Area of the glass piece in cm^2	Mean area in cm^2
1								
2								
3								
4								
5								

TABULATION -2 FOR MEAN THICKNESS (d) OF THE GLASS PIECE:

Sl. No.	PITCH	LC	ICSR	N	FCSR	Difference D =I ~ F	PSR= Pitch x N in cm	CSR = D x LC in cm	d = PSR+CSR in cm	Mean d in cm
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

Calculation:

From the tabulation 2, the thickness of the glass piece = d= ___________cm

From the tabulation 1, the area of the glass piece = A = _____________cm^2

Hence, the volume of the glass piece = area thickness = A x d = ______________cm^3

Conclusion:

The volume of the given glass piece was found out to be _________cm^3 by using a screw gauge and graph paper.

Precautions:

The precautions remain same as the ones in experiment no. 1 and the outline of the piece on the graph paper must be made carefully.

VIVA QUESTIONS

Q1. Define the pitch of the screw gauge.

Q2. What is the value of the least count in commonly used screw gauge?

Q3. Define the least count of screw gauge.

Q4. What is ratchet?

Q5. What is the formula for Thickness?

Date:

EXPERIMENT NO. 3

To find out the volume of a solid cylinder using Vernier calliper/ slide calliper.

Aim of the Experiment:

To find the volume of a solid cylinder using a Vernier Calliper / Slide calliper.

Apparatus required:

1. Given solid cylinder
2. Slide calliper/Vernier calliper
3. Instrument box

Theory:

The Vernier calliper consists of two scales – main scale and Vernier scale. As the Vernier scale slides over the main scale, it is also known as slide calliper. The main scale and Vernier scale are divided into smaller divisions. The magnitude of the divisions is different from each other. In the figure-3.1 below, a labelled Vernier calliper is presented.

The main scale is graduated in cm and mm. It has two fixed jaws attached. The Vernier scale also has movable jaws which is moved using the thumb screw.

Least Count: The minimum measurement that can be measured using a Vernier calliper is called the least count (LC) of the Vernier calliper.

LC = 1 main scale division — 1 vernier scale division= 1MSD — 1 VSD

Zero Error: When the jaws are closed (touch each other), the zero of main scale (MS) should coincide with the zero of Vernier scale (VS). Then, it is said that there is no zero error. Zero error is of two types.

Positive Zero error: If the zero of the VS is at the right of the zero of the MS, then the vernier calliper is said to have positive zero error.

Negative Zero error: If the zero of the VS is at the left of the zero of the MS, then the vernier calliper is said to have negative zero error.

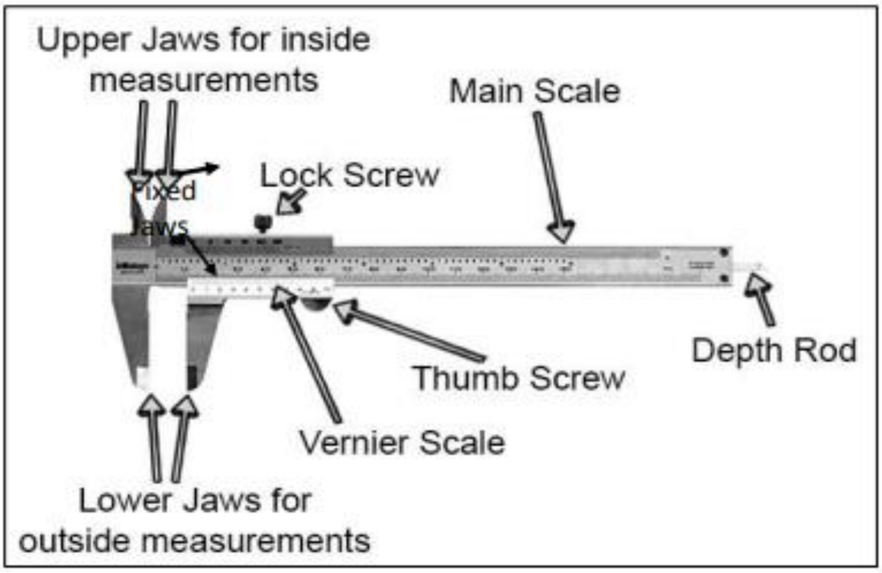


Figure 3.1: A labelled Slide calliper

Procedure:

- Standardise the main scale.
- Keep the jaws of Vernier Callipers closed. Observe the zero mark of the main scale. It must perfectly coincide with that of the Vernier scale. If this is not so, determine the zero error.
- Determine the least count of the instrument.
  Method - 10 MSD = 1 cm (say) $\Rightarrow$1 MSD = 0.1 cm
  Notice that 10 VSD = 9 MSD
  $\Rightarrow$ 1 VSD =$\frac{9}{10}$ MSD = 0.9 x 0.1 cm = 0.09 cm
  Least count = 1 MSD - 1 VSD = (0.1 – 0.09) cm = 0.01 cm
  LC of slide calliper = 0.01 cm
- Keep the solid cylinder length wise to determine height. Keep the jaw parallel to the diameter of the cylinder. Gently tighten the screw so as to clamp the instrument in this position.
- Notice the reading on the main scale with which the zero of the Vernier scale coincides. Note that as main scale reading (MSR). Position your eye directly over the division mark so as to avoid any parallax error.
- If the zero of vernier scale does not exactly coincide with a line on the main scale, then the reading on the left of the zero of vernier scale should be taken as MSR.
- Look for exact coincidence of a vernier scale division with that of any main scale division in the vernier window from left end (zero) to the right. Note its number, carefully. Note the number as vernier coincidence (VC).
- Calculate the vernier scale reading (VSR) = VC x LC
- Determine the height using formula Height = MSR + VSR
- Use same method to determine the diameter of the cylinder.

- Make repeated observations with different orientations/positions of the cylinder and input the observation in tabular form.
- Calculate the mean height and mean diameter.
- Correct it for zero error if any.

Working Formula

$$V = \frac{\pi d^2 h}{4}$$

V= Volume of Solid Cylinder

D= Mean Diameter of Solid Cylinder

h = Mean Height or Mean length of solid cylinder

TABULATION - 1 FOR MEAN HEIGHT OR LENGTH OF THE SOLID CYLINDER:

Sl. No	Least count (LC)	MSR (In cm)	Vernier coincidence (VC)	VSR= VC x LC in cm	Observed height (MSR+VSR) In cm	Mean Height (h) in cm
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

TABULATION - 2 FOR MEAN EXTERNAL DIAMETER OF THE SOLID CYLINDER:

Sl. No	Least count (LC)	MSR (In cm)	Vernier coincidence (VC)	VSR= VC x LC in cm	Observed diameter(D) (MSR+VSR) In cm	Mean diameter (D) in cm
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Calculation:

The observed height or length of the given cylinder is = ________cm

The observed diameter of the given cylinder is = ________cm

Hence, the volume of the given solid cylinder, V = $\frac{\pi d^2 h}{4}$ = _________cm^3

Conclusion:

The volume of the given solid cylinder was found out to be _______ cm^3 .

Precaution:

1. If the vernier scale is not sliding smoothly over the main scale, apply machine oil/grease.
2. Screw the vernier tightly without exerting undue pressure to avoid any damage to it.
3. Keep the eye directly over the division mark to avoid any error due to parallax. Note down each observation with correct significant figures and units.
4. Avoid undue pressure while keeping the object between the jaws. Also, the object should not be held loose.
5. The procedure should be represented at least 10 times in different positions of the cylinder since the cylinder may not be regular.

VIVA QUESTIONS

Q1. What is meant by least count of an instrument?
Q2. What is meant by least count of a vernier callipers?
Q3. What part of the vernier callipers is the vernier scale?
Q4. Which is the instrument you will use to measure the internal and external diameter of a tube?
Q5. What is the unit of volume?

Date:

EXPERIMENT NO. 4

To find out the volume of a hollow cylinder using Vernier calliper/ slide calliper.

Aim of the Experiment:

To find the volume of a hollow cylinder using a Vernier Calliper / Slide calliper.

Apparatus required:

1. Given hollow cylinder
2. Slide calliper/Vernier calliper
3. Instrument box

Theory:

The theory remains same as in expt. No. 3. The theory is to be written again in the lab report of a student.

Procedure:

♣ Measure the height and external diameter of the hollow cylinder with the cylinder held between the lower jaws. Use the same method as described in the experiment 3.

♣ Measure the internal diameter of the hollow cylinder with the cylinder held with the upper jaws.
♣ Take 10 observations with different orientation/position of the hollow cylinder while determining height, internal diameter and external diameter. Tabulate them.

♣ Calculate the mean height, internal diameter and external diameter.

♣ Correct for the zero error if any.

♣ Calculate the volume of the hollow cylinder.

<u>Working Formula</u>

$$V = \frac{\pi\left(D^2 - d^2\right)h}{4}$$

V= Volume of Hollow Cylinder

D= Mean External Diameter of Hollow Cylinder

D= Mean Internal Diameter of Hollow Cylinder

h = Mean Height or Mean length of Hollow cylinder

TABULATION - 1 FOR MEAN HEIGHT OR LENGTH OF THE HOLLOW CYLINDER:

Sl. No	Least count (LC)	MSR (In cm)	Vernier coincidence (VC)	VSR= VC x LC in cm	Observed height (MSR+VSR) In cm	Mean Height (h) in cm
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

TABULATION - 2 FOR MEAN EXTERNAL DIAMETER OF THE HOLLOW CYLINDER:

Sl. No	Least count (LC)	MSR (In cm)	Vernier coincidence (VC)	VSR= VC x LC in cm	Observed diameter(D) (MSR+VSR) In cm	Mean diameter (D) in cm
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

TABULATION - 3 FOR MEAN INTERNAL DIAMETER OF THE HOLLOW CYLINDER:

Sl. No	Least count (LC)	MSR (In cm)	Vernier coincidence (VC)	VSR= VC x LC in cm	Observed diameter(d) (MSR+VSR) In cm	Mean diameter (d) in cm
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Calculation:

The observed height of the hollow cylinder = ________cm

The observed external diameter = ________cm

The observed internal diameter = ________cm

Hence, the volume of the hollow cylinder, V = $\frac{\pi(D^2-d^2)h}{4}$ = __________cm^3

Conclusion:

The volume of the given hollow cylinder was found out to be ________cm^3.

Precautions:

The precautions are the same as the ones in experiment no.3

VIVA QUESTIONS

Q1. What are the uses of vernier callipers?

Q2. What is meant by least count of a vernier callipers?

Q3. What part of the vernier callipers is the vernier scale?

Q4. Which is the instrument you will use to measure the internal and external diameter of a tube?

Q5. What is the unit of volume?

Date:

EXPERIMENT NO. 5

To determine the radius of curvature of convex surface using a Spherometer.

Aim of the Experiment:

To determine the radius of curvature of convex surface using a Spherometer.

Apparatus required:

1. Spherometer
2. The curved piece of glass
3. Base Plate
4. Instrument box

Theory:

The working principle of the spherometer is that of a micrometre screw. It consists of a metallic framework with three legs of equal length (tripod). The tips of the three legs form three corners of an equilateral triangle. The spherometer also has a central leg which can be raised or lowered through a threaded hole in the metal frame using the screw head. The lower tip of the central screw, when lowered touches the centre of the triangle formed by the three legs. The central screw also carries a circular scale. The circular scale is in general divided into 50 or 100 equal parts. A small vertical scale marked in millimetres or halfmillimetres is fixed parallel to the central screw. This scale is called linear scale. This scale is very close to the rim of circular scale but it does not touch it. This scale reads the vertical distance which the central leg moves through the hole. This scale is also known as pitch scale.

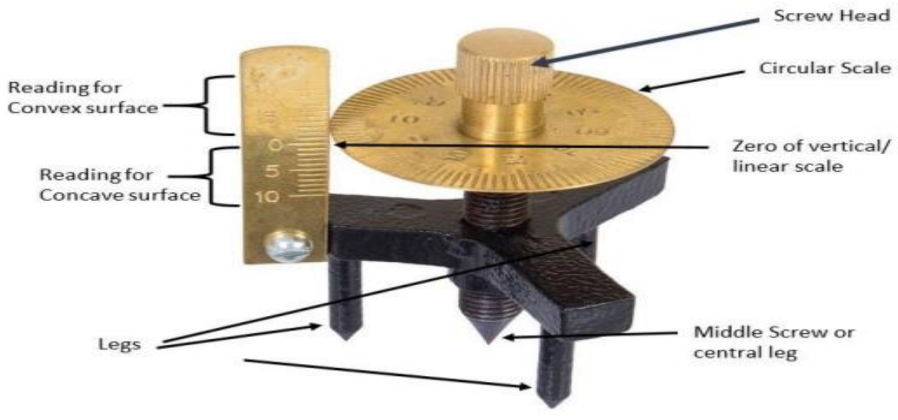


Figure 5.1 : A labelled spherometer

Pitch of the Spherometer:

The distance covered on the linear scale (vertical scale) by 1 complete rotation of the circular scale is called Pitch of spherometer.

Least count of the Spherometer:

Least count of the spherometer is defined the minimum measurement that can be carried out using it. In other words, it is the distance moved by the circular screw, when the circular screw is rotated by one division on the circular scale.

$$\text{Least Count} = \frac{\text{Pitch}}{\text{Total no. of divisions on the circular scale}}$$

⇨ L.C. = _______cm

Formula for radius of curvature:

$$R = \frac{d^2}{6h} + \frac{h}{2}$$

R= Radius of curvature of the spherical surface

d = Mean distance between consecutive legs of the Spherometer

h = Height through which the central leg is raised = Height of the Convex Surface

Procedure:

1. Note the value of one division on the vertical scale/pitch scale.

2. Note the total no. of divisions on the circular scale.

3. Determine the pitch and least count of the spherometer.

4. Place the spherometer on the base plate so that all the three legs touch its surface.

5. Lift the spherometer and put it on a plain paper, press it slightly to get the impression of the three legs. Joint the markings to complete an equilateral triangle. Measure the length of its sides, carefully and note them down in table1. Repeat the procedure with two more orientations. Calculate the average distance between the two legs. Note it as “d”.

6. Then place the spherometer with the central screw raised and the three legs touching the curved surface. Take care to place the legs in such a way that the legs are on a horizontal plane.

7. Rotate the central screw gently till it touches the spherical surface. To be sure that the screw touches the surface, one can observe its image formed due to reflection from the surface beneath it.

8. Note the reading on the circular scale which touches the vertical scale/pitch scale. Note it as initial circular scale reading (ICSR).

9. Remove the curved surface and slowly rotate the circular scale to move the screw downward. Keep counting the no. of complete notations (N). Put it in table 2.

10. Note the reading on circular scale which touches the pitch scale. Note it down as final circular scale reading (FCSR).

11. Find the difference D = I ~ F

i. If ICSR> FCSR, Then, D = ICSR – FCSR

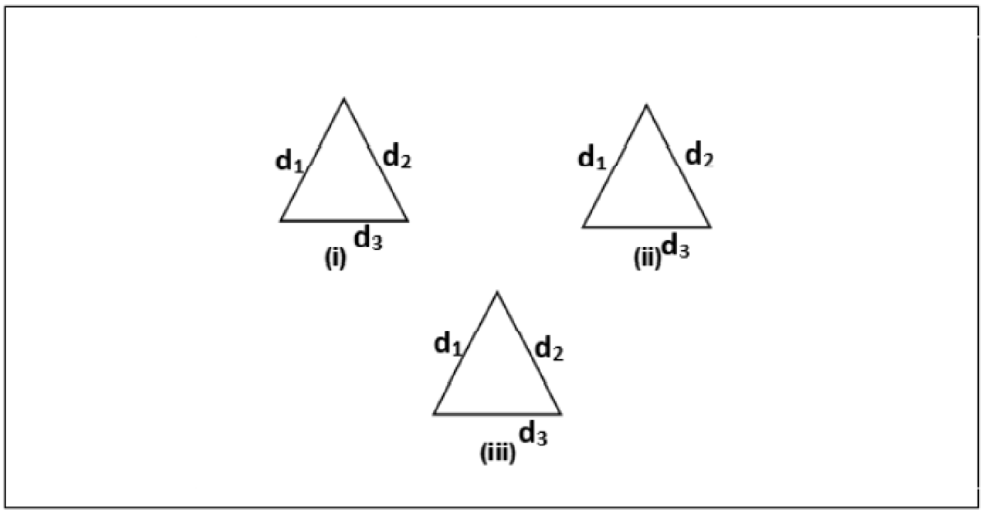
ii. If ICSR< FCSR, Then, D = (ICSR+ total no. divisions on circular scale) – FCSR

12. Calculate Pitch Scale reading (PSR) using, PSR = Pitch X No. of complete rotation

13. Calculate Circular Scale Reading using, CSR = Difference x least count (LC)

14. The height h is the sum of PSR and CSR.

Calculate the radius of curvature.



TABULATION-1: MEAN DISTANCE BETWEEN THE CONSECUTIVE LEGS:

Sl. No.	Figure No.	D_1 in cm	d_2 in cm	D_3 in cm	$d= (d_1+d_2+d_3)/3$ in cm	Mean d in cm
1	I					
2	II					
3	III					

TABULATION -2 FOR MEAN HEIGHT (h) OF THE CONVEX SURFACE:

Sl. No.	PITCH	LC	ICSR	N	FCSR	Difference D =I ~ F	PSR= Pitch x N in cm	CSR = D x LC in cm	h = PSR+CSR in cm	Mean h in cm
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

Calculation:

The distance between the legs = _______cm

The height of convex surface, h = _______ cm

So, R = $\frac{d^2}{6h} + \frac{h}{2}$ = _______________cm

Conclusion:

The radius of curvature of the convex glass piece was estimated to be _____cm.

Precautions:

1. The screw should not be rotated after the screw touches the curved surface.

2. The screw should be rotated in same direction.

3. The spherometer should sit on a horizontal plane of the curved surface.

4. The initial reading is to be taken on a higher surface so that to take the final reading the central leg is always lowered.

VIVA QUESTIONS

Q1. Define radius of curvature.

Q2. Are the radius and radius of curvature of the spherical surface same?

Q3. Why the instrument is named as spherometer?

Q4. What is the radius of curvature of a plane surface?

Q5. State the formula for Radius of Curvature?

Date:

EXPERIMENT NO. 6

To determine the radius of curvature of concave surface using a Spherometer.

Aim of the Experiment:

To determine the radius of curvature of concave surface using a Spherometer.

Apparatus required:

1. Spherometer
2. The concave piece of glass
3. Base Plate
4. Instrument box

Theory:

The theory remains same as that of experiment no. 5. It should be written again in the Lab report by the student.

Procedure:

1. Note the value of one division on the vertical scale/pitch scale.

2. Note the total no. of divisions on the circular scale.

3. Determine the pitch and least count of the spherometer.

4. Place the spherometer on the base plate so that all the three legs touch its surface.

5. Lift the spherometer and put it on a plain paper, press it slightly to get the impression of the three legs. Joint the markings to complete an equilateral triangle. Measure the length of its sides, carefully and note them down in table1. Repeat the procedure with two more orientations. Calculate the average distance between the two legs. Note it as “d”.

6. Then place the spherometer with the central screw raised and the three legs touching the curved surface. Take care to place the legs in such a way that the legs are on a horizontal plane.

7. Rotate the central screw gently till it touches the spherical surface. To be sure that the screw touches the surface, one can observe its image formed due to reflection from the surface beneath it.

8. Note the reading on the circular scale which touches the vertical scale/pitch scale. Note it as initial circular scale reading (ICSR).

9. Remove the curved surface and slowly rotate the circular scale to move the screw downward. Keep counting the no. of complete notations (N). Put it in table 2.

10. Note the reading on circular scale which touches the pitch scale. Note it down as final circular scale reading (FCSR).

11. Find the difference D = I ~ F

i. If ICSR> FCSR, Then, D = ICSR – FCSR

ii. If ICSR< FCSR, Then, D = (ICSR+ total no. divisions on circular scale) – FCSR

12. Calculate Pitch Scale reading (PSR) using, PSR = Pitch X No. of complete rotation

13. Calculate Circular Scale Reading using, CSR = Difference x least count (LC)

14. The height h is the sum of PSR and CSR.

Calculate the radius of curvature.

Formula for radius of curvature:

$$R = \frac{d^2}{6h} + \frac{h}{2}$$

R= Radius of curvature of the spherical surface

d = Mean distance between consecutive legs of the Spherometer

h = Height through which the central leg is raised = Height of the Concave Surface

TABULATION-1: MEAN DISTANCE BETWEEN THE CONSECUTIVE LEGS:

Sl. No.	Figure No.	D_1 in cm	d_2 in cm	D_3 in cm	$d = (d_1+d_2+d_3)/3$ in cm	Mean d in cm
1	I					
2	II					
3	III					

TABULATION -2 FOR MEAN HEIGHT (h) OF THE CONCAVE SURFACE:

Sl. No.	PITCH	LC	ICSR	N	FCSR	Difference D =I ~ F	PSR= Pitch x N in cm	CSR = D x LC in cm	h = PSR+CSR in cm	Mean h in cm
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

Calculation:

The distance between the legs = ________cm

The height of concave surface, h = ________ cm

So, R = $\frac{d^2}{6h} + \frac{h}{2}$ = _________________cm

Conclusion:

The radius of curvature of the concave glass piece was estimated to be ______cm.

Precautions:

same as the ones in experiment no. 6

Date:

EXPERIMENT NO. 7

To determine the angle of Prism.

Aim of the Experiment:

To determine the angle of the given prism.

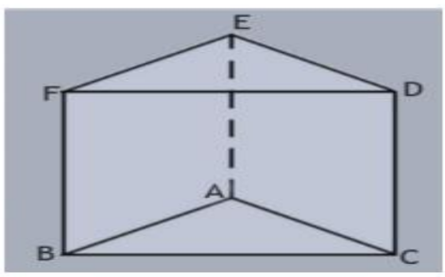
Apparatus required:

1. Drawing Board.
2. White sheet of paper
3. Fixing Pins
4. Needle point steel pins
5. Pencil
6. Scale
7. Protractor
8. A triangular prism.

Theory:

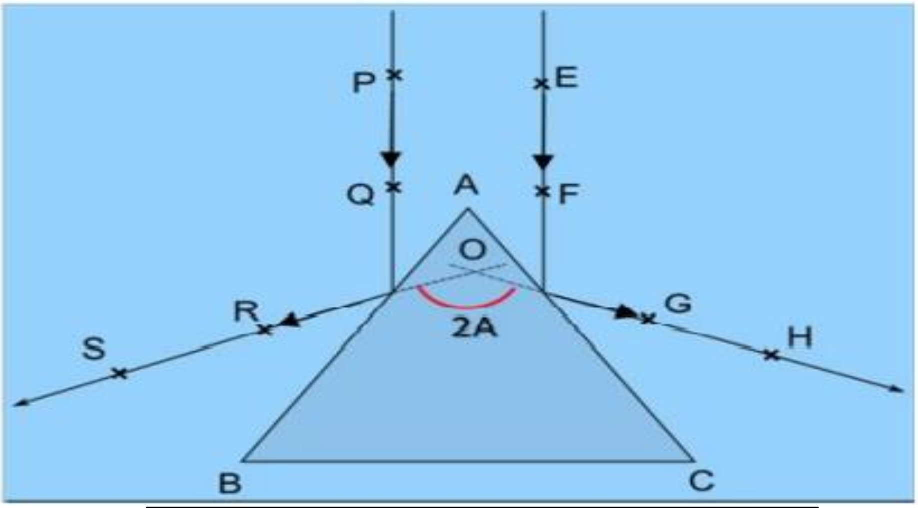
Prism is an optical element with polished and flat surfaces which refract light. The surface should be angled. Two parallel surfaces do not constitute a prism. The conventional geometrical shape of an optical prism is that of a triangular prism with a triangular base and rectangular sides, and in general use of "prism" refers to this type. Prisms can be made from any material that is transparent to the wavelengths for which they are designed. Typical materials include glass, fluorite and plastic.

A prism can be used to disperse white light up into its constituent colours (wavelength). Furthermore, prisms can be used to reflect or refract light, or to split light into components with different polarization.



In the left figure, the angle of prism is marked. In the right-hand figure, the angle A between the two refracting surfaces ABFE and ACDE is called the angle of prism.

When a parallel beam of light is incident on a prism as shown in the below figure, then the angle of deviation is twice of the angle of prism. This principle is used to determine the angle of prism.



Reflection of parallel beam from the prism surface

Procedure:

1. Spread the white sheet of paper on the drawing board. Fix it using fixing pins.

2. Draw two parallel lines on the paper. Place the prism symmetrically on the two lines. Draw its outline triangle. Mark the vertices/corners as A, B, C

3. Put two pins on one of the parallel lines, say at P and Q. Make sure the pins stand straight. See their reflection inside the prism from the side AB and insert two more pins at R and S which lie along the line made by the tips of the images of the pins at P and Q. Avoid parallax error.

4. Now put two pins on the other parallel line, say at E and F. See its reflections from the side AC. Put two pins at G and H so that they lie in the same line as the images of the pins at E and F.

5. Remove the prism and pins. Mark the tips of the pins at P, Q, R, S, E, F, G and H. Join the line RS and GH.

6. RS and GH are the reflected ray. Extend the ray in the backward directions. Let them meet at O. Measure the angle ROG using protractor. Note it down in table 1. That is twice the angle of prism A.

7. Repeat the procedure from 2 to 6, for two more times. 8. Calculate the average 2A and then the angle of prism.

Tabulation- 1: FOR ANGLE OF PRISM A

No. of Observations	**2A in degrees**	**Mean value of 2A in degrees**	**Angle of prism (A) in degrees**
1			
2			
3			

Conclusion:

The angle of prism was found to be __________degree.

Precaution:

1. Ray direction should be marked.
2. The position of the pin must be marked with circle immediately after removing the pins.
3. The experiment table and board should be placed in a firm manner so that there is no disturbance due to vibration.
4. The pins must be fixed straight.
5. Parallax error should be avoided.

VIVA QUESTIONS

Q1. What is a prism? Mention two uses of prism.

Q2. Can we say that glass slab is also a kind of prism?

Q3. Define angle of prism.

Q4. What are the laws of reflection?

Q5. State Snell's law?

Date:

EXPERIMENT NO. 8

Verification of the Ohm's Law

Aim of the Experiment:

To verify Ohm's Law by Ammeter – Voltmeter method.

Apparatus required:

1. A battery
2. Pieces of insulated copper wire
3. Sand paper
4. Ammeter
5. Voltmeter
6. Rheostat
7. Resistor
8. key

Theory:

Statement of Ohm's Law:

The potential difference 'V' across the two ends of a given conductor in an electric circuit is directly proportional to the current 'I' flowing through it provided the temperature is constant.

Mathematically, $V \propto I$, So, $V = IR$

Here, R is the proportionality constant and is known as resistance.

The SI unit of resistance is Ohm. The notation for Ohm is Ω.

The resistance offered by a wire is dependent on the nature of material, the length (l) of the conductor and its cross-sectional area (A).

$R = \frac{\rho l}{A}$

Here, (rho) is the resistivity of the material.

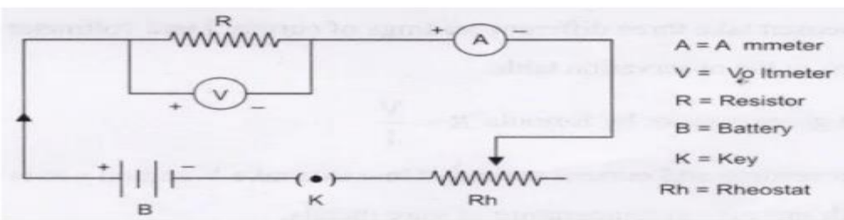


Figure 5: Circuit diagram for the verification of Ohm's Law

• In a circuit ammeter is connected in series.

• The voltmeter is connected in parallel across the points between which potential difference is to be measured.

• A straight-line graph obtained between V and I verify the Ohm's law.

Procedure:

1. Determine the least count of the ammeter and voltmeter by noting down its range and the total no. of divisions on them.

2. Check for zero error. It should be adjusted prior to commencement of experiment.

3. Remove the insulation from the end of the connecting copper wires using sand paper.

4. Connect the ammeter, battery, voltmeter, key and rheostat as per the circuit diagram.

5. Keep the key open.

6. In the circuit, connect the positive terminal of the ammeter to the positive terminal of battery.

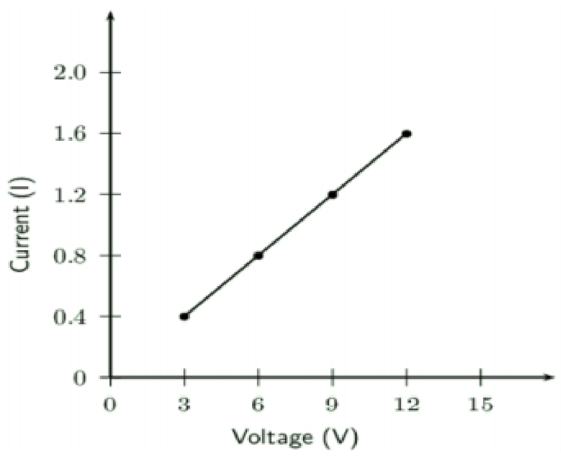
7. Check the rheostat, adjust its slider and see whether the ammeter and voltmeter readings are shown.

8. When there is a constant flow of current in the resistor, note down the current and the corresponding potential difference.

9. Note down the values of potential difference in the voltmeter corresponding to the step-by-step increase of the current and then by decrease of the current by sliding the rheostat.

10. Calculate the resistance by taking the mean of potential Difference.

11. Plot a graph between the voltage and current with V on the X-axis. The slope of the graph gives the inverse of the resistance.



TABULATION FOR V ~ I READING:

Sl. No.	Ammeter Reading (I) in ampere	Voltmeter reading (V) in volts			V/I=R in Ohm	Mean R in Ohm
		Current Increasing	Current Decreasing	Mean		
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

Conclusion:

The ratio of V to I was seen to be constant in Tabulation. The plot of V versus I passed through the origin. Hence, the Ohm's law is verified. The resistance as determined from the graph was ___________ohm.

Precautions:

1. Connections should be tight otherwise some external resistance may introduce in the circuit.

2. The least counts of the ammeter and voltmeter should be estimated carefully.

3. The current should not be flown for a longer time, otherwise, it would increase the temperature and in turn would change the resistance of the resistor.

4. Current beyond 2 Amperes should be avoided.

VIVA QUESTIONS

Q1: What is the nature of the V-I graph?

Q2. What happens to current, when potential difference increases?

Q3. Define the terms current, potential difference.

Q4. What is the role of voltmeter and Ammeter?

Q5. What is resistance?

Date:

EXPERIMENT NO. 9

Tracing of lines of forces due to a bar magnet with north pole pointing geographic north pole of earth

Aim of the Experiment:

To trace lines of force due to a bar magnet with North pole pointing North and locate the neutral points.

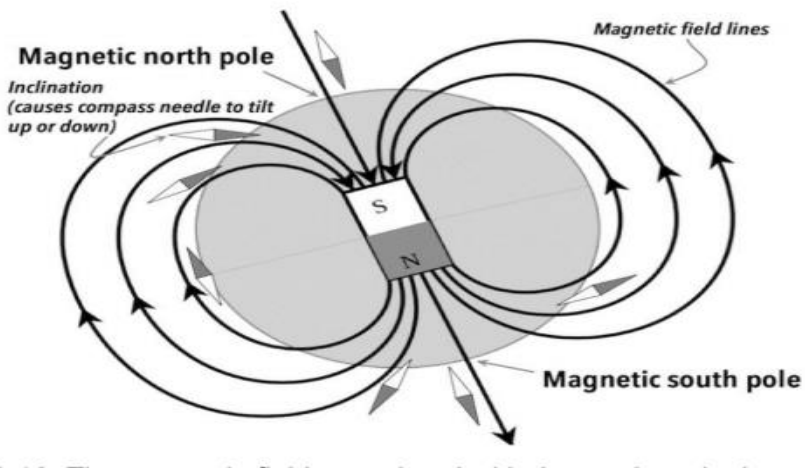
Apparatus required:

1. Drawing board
2. Drawing Sheet
3. Pencil, scale
4. Bar magnet
5. Compass needle
6. Fixing pins

Theory:

A magnet has two poles – one south pole and a north pole. Like poles repel and unlike poles attract each other.

Earth is a giant magnet. Earth's magnetic field is defined by north and south poles representing lines of magnetic force flowing into the Earth in the northern hemisphere and out of Earth in the southern hemisphere. At the north and south poles, the force is vertical. The force is horizontal at the equator.



The south pole of the magnet points to Earth's magnetic north pole and the north pole of a magnet points towards the magnetic South Pole of the earth.

Magnetic lines of forces are the closed imaginary curve starting from the North Pole and the ending in the South Pole in a magnetic field such that the tangent drawn at any point on the curve gives the direction of the resultant magnetic field at that point. The density of magnetic field lines indicates the field strength in an area.

A neutral point of Magnet is a point at which the resultant magnetic field is zero. At neutral point, the field due the bar magnet is equal and opposite of the Earth’s magnetic field. So, if a compass needle is placed at this point, then it will tend to remain in the direction in which it is kept.

Neutral points are located symmetrically with respect to the magnet on the equatorial of the magnet when the North Pole points north.

Neutral points are located symmetrically with respect to the magnet on the axial line of the magnet when its north pole points south.

Procedure:

1. Spread the paper on the drawing board. Fix it well.

2. Keep the compass needle in the middle of the paper. Mark the geographic north and south indicated by the pointing arrow by putting dots next to the needle. Join the two dots to draw a line and extend it.

3. Place the bar magnet in the middle of the paper. Trace its outline Keep the North Pole (marked by a small hole, in general) of the magnet towards the geographic north of Earth and the South Pole towards south.

4. Place the magnetic needle near the north pole of the magnet. Let its arrow rest.

5. Put two dot marks on the paper corresponding to the position of both end of the needle. Place the needle at the subsequent position in such a way that one end of it coincides with the previously marked dot.

6. Mark the other end with dot. Continue this till you reach the South Pole. Connect the dots with smooth curves.

7. Then again place the needle at a different place near theNorth Pole. Continue the procedure 4 to 6.

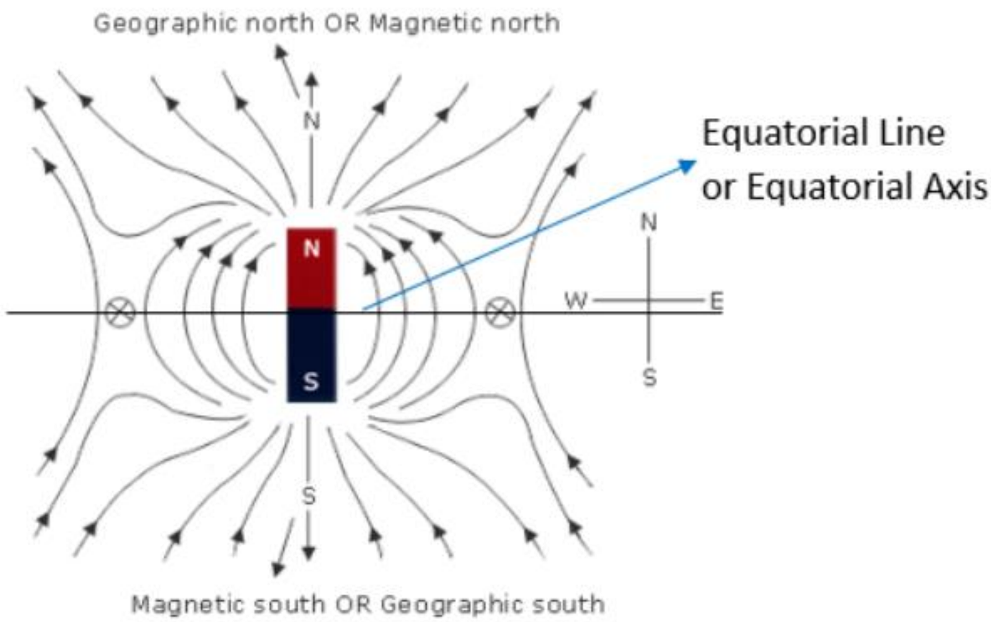
8. Continue the process till a series of curves/lines of force are obtained between the two poles.

9. Draw lines of force on both the sides of the magnet, symmetrically.

10. Place the magnetic compass on the equatorial axis of the magnet. Move it slowly away from the magnet. Check if the compass is experiencing any magnetic force. This can be checked by rotating the compass and seeing if the arrow of compass is pointing to a particular direction or random directions. At neutral point the arrow of the compass rotates with rotation of the compass.

11. Locate the neutral points on both the sides of the magnet. Trace the outline of the compass and put cross insides.

12. The picture looks like this.



Observation:

Both the neutral points on either side should be generally equidistant from the centre of Bar magnet.

Conclusion:

♣ The magnetic lines of forces of a magnet were drawn with its north pole pointing north.

♣ The lines of force do not intersect each other.

♣ The neutral points are located on the equatorial line of the magnet at a distance of ___________________ cm.

Precautions:

1. Don't rely on the painted arrows on the pointers in the compass to tell which pole is north and which is south; they don't all use the same convention. Make sure the pointers can rotate freely.

2. Keep the bar magnet far away while determining the geographic north south/drawing the axial line using the magnetic compass.

3. The table should be away from other magnet, magnetic material or electric circuit.

4. The position of magnet should not get changed.

5. The direction of lines of force should be marked. 6.

The neutral point should be determined properly.

VIVA QUESTIONS

Q1. Does monopole exist?

Q2. Why does the compass needle align itself in a particular direction?

Q3. Can we get a north pole and a south pole by breaking a bar magnet?

Q4. How do the magnetic lines of force look like in a uniform magnetic field?

Q5. Define neutral point in a magnetic field.

Date:

EXPERIMENT NO. 10

Tracing of lines of forces due to a bar magnet with north pole pointing geographic south pole of earth

Aim of the Experiment:

To trace lines of force due to a bar magnet with North pole pointing North and locate the neutral points.

Apparatus required:

1. Drawing board

2. Drawing Sheet

3. Pencil, scale

4. Bar magnet

5. Compass needle

6. Fixing pins

Theory:

For writing theory please refer experiment no. 9.

Procedure:

1. Spread the paper on the drawing board. Fix it well using fixing pins.

2. Keep the compass needle in the middle of the paper. Mark the geographic north and south indicated by the pointing arrow by putting dots next to the needle. Join the two dots to draw a line and extend it.

3. Place the bar magnet in the middle of the paper. Trace its outline. Keep the North Pole (marked by a small hole, in general) of the magnet towards the geographic south of Earth and the South Pole towards north.

4. Place the magnetic needle near the north pole of the magnet. Let its arrow rest.

5. Put two dot marks on the paper corresponding to the position of both end of the needle. Place the needle at the subsequent position in such a way that one and of it coincides with the previously marked dot.

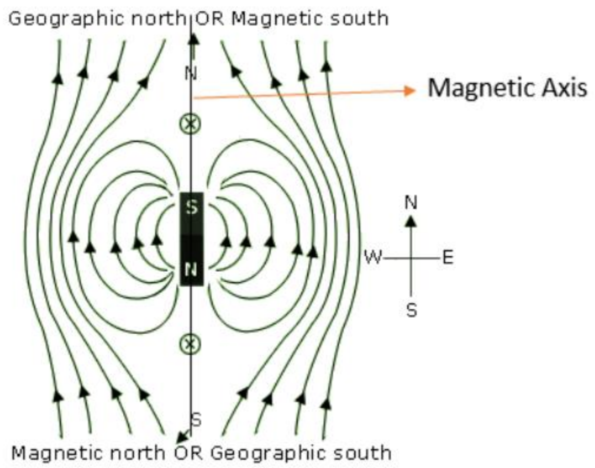
6. Mark the other end with dot. Continue this till you reach the South Pole. Connect the dots with smooth curves.

7. Then again place the needle at a different place near the North Pole. Continue the procedure 4-6.

8. Continue the process till a series of curves/lines of force are obtained between the two poles.

9. Draw lines of force on both the sides of the magnet, symmetrically.

10. The picture looks like this.



Magnetic lines of forces due to bar magnet with north pole pointing geographic south

11. Place the magnetic compass on the axial line of the magnet. Move it slowly away from the magnet. Check if the compass is experiencing any magnetic force. This can be checked by rotating the compass and seeing if the arrow of compass is pointing to a particular direction or a random direction. At neutral point the arrow of the compass rotates with rotation of the compass.

12. Locate the neutral points on both the sides of the magnet. Trace the outline of the compass and put cross inside.

Observation:

Both the neutral points on either side should be generally equidistant from the centre of Bar magnet.

Conclusion:

♣ The magnetic lines of forces of a magnet were drawn with its north pole pointing south.

♣ The lines of force do not intersect each other.

♣ The neutral points are located on the axial line of the magnet at a distance of ____________________ cm.

Precautions:

The precautions are same as the ones in experiment no. 9

VIVA QUESTIONS

Q1. Are the neutral points equidistant from magnetic poles?

Q2. Does the line joining neutral points coincide with the axis of the bar magnet?

Q3. What happened to the magnet if the magnet is slightly rotated?

Q4. Why two magnetic lines of force never intersect each other?