GOVT. POLYTECHNIC KANDHAMAL, PHULBANI

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PR-2A Engg. Physics Lab

Lab Manual

(For 1st & 2nd Semester Diploma students)

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TABLE OF CONTENTS

Experiment No.	Name of the Experiments	Page No.
1	To determine the volume of a Solid cylinder using Vernier callipers.	**2**
2	To determine the volume of a Hollow cylinder using Vernier callipers.	**6**
3	To measure the cross-sectional area of a wire by using Screw gauge	**10**
4	To measure the volume of an irregular lamina by using Screw gauge	**13**
5	To determine the radius of curvature of a convex surface using Spherometer.	**17**
6	To determine the radius of curvature of a concave surface using Spherometer.	**20**
7	To determine the angle of Prism.	**23**
8	To determine the angle of minimum deviation by I~D curve method.	**25**
9	To draw the Magnetic Lines of Force and locate the Neutral points due to a Bar Magnet with North – Pole pointing North (N→N).	**28**
10	To draw the Magnetic Lines of Force and locate the Neutral points due to a Bar Magnet with North – Pole pointing South (N→S).	**30**

Prepared by Jiten Mishra (Lecturer in Physics)

EXPERIMENT -1

AIM OF THE EXPERIMENT: To determine the volume of a Solid cylinder using Vernier callipers.

APPARATUS REQUIRRED:

1. Vernier calliper
2. Solid cylinder
3. Meter scale

THEORY:

The volume (V) of a solid cylinder is

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

Where R is the radius of the solid cylinder

D is the diameter of the solid cylinder

h is the height of the solid cylinder

Length of the cylinder = Main Scale Reading (M.S.R) + Vernier Scale Reading (V.S.R) ± Zero Error

Least Count (LC): it is the minimum measurement that can be done using an instrument.

Least count of a vernier calliper can be calculated by

LC = 1 Main Scale Division (M.S.D) – 1 Vernier Scale division (V.S.D)

We observe that in our instrument,

$$10 \text{ VSD} = 9 \text{ MSD}$$

$$\Rightarrow 1 \text{ VSD} = \frac{9}{10} \text{MSD} = 0.9 \text{ MSD}$$

Then LC = 1 MSD – 1 VSD

= 1 MSD – 0.9 MSD = 0.1 MSD (1MSD = 0.1 cm = 1 mm)

LC = 0.1 MSD = 0.1 mm = 0.01 cm

Zero Error: if the zero of the vernier scale does not coincide with the zero of the main scale, then this is called zero error.

Positive zero Error: If the zero of the vernier scale lies to the right of the zero of the main scale, then that is known as positive zero error

Negative zero Error: If the zero of the vernier scale lies to the left of the zero of the main scale, then that is known as negative zero error

PROCEDURE:

1. The main scale was standardised.
2. Least count of the given instrument was calculated.
3. The zero error was found out by looking into the zero of the main scale and the vernier scale when the jaws were closed.
4. The given solid cylinder was kept in between the two lower jaws lengthwise to determine the length of solid cylinder.
5. Then the position of the zero in the vernier scale was compared with the position of the main scale and main scale reading was noted which is M.S.R
6. Then a particular line of the vernier scale coinciding with a main scale line was observed carefully and that particular division of the vernier scale was noted as vernier coincidence (V.C)
7. THE VERNIER SCALE reading (V.S.R) WAS calculated by multiplying V.C with least count i.e V.S.R = V.C X LC
8. Height of the given cylinder was obtained by adding M.S.R with V.S.R
9. Then the above procedure is repeated at least 10 times to find the length of the cylinder.
10. Then the mean of the height of the cylinder was obtained
11. The same procedure was followed for the diameter of the cylinder and the mean diameter was obtained.
12. Then the volume of the solid cylinder was calculated using the given formula.

OBSERVATION

TABULATION FOR HEIGHT

NO. Of Observation	LC in cm	M.S.R in cm	VC	V.S.R = VC X LC in cm	Observed height = MSR + VSR in cm	Mean height in cm	Zero error in cm	Corrected Height in cm
Take at least 10 readings								

TABULATION FOR DIAMETER

NO. Of Observation	LC in cm	M.S.R in cm	VC	V.S.R = VC X LC in cm	Observed diameter = MSR + VSR in cm	Mean height in cm	Zero error in cm	Corrected diameter in cm
Take at least 10 readings								

CALCULATION:

We observe that

The height of the given cylinder = _________ cm

The diameter of the given cylinder = ________ cm

Now the Volume of the given solid cylinder is calculated by

$$V = \pi R^2 h = \frac{\pi D^2 h}{4} = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ \text{ cm}^3$$

CONCLUSION:

After performing the above experiment and taking necessary readings, the value of the volume of the solid cylinder is found to be ____________ cm^3

EXPERIMENT -2

AIM OF THE EXPERIMENT: To determine the volume of a Hollow cylinder using Vernier callipers.

APPARATUS REQUIRRED:

4. Vernier calliper
5. Hollow cylinder
6. Meter scale

THEORY:

The volume (V) of a hollow cylinder is

$$V = \pi(R_2^2 - R_1^2)h = \frac{\pi\left(D_2^2 - D_1^2\right)h}{4}$$

Where R is the radius of the solid cylinder

D_2 is the outer diameter of the hollow cylinder

D_1 is the inner diameter of the hollow cylinder

h is the height of the solid cylinder

Length of the cylinder = Main Scale Reading (M.S.R) + Vernier Scale Reading (V.S.R) ± Zero Error

Least Count (LC): it is the minimum measurement that can be done using an instrument.

Least count of a vernier calliper can be calculated by

LC = 1 Main Scale Division (M.S.D) – 1 Vernier Scale division (V.S.D)

We observe that in our instrument,

$$10 \text{ VSD} = 9 \text{ MSD}$$

$$\Rightarrow 1 \text{ VSD} = \frac{9}{10} \text{MSD} = 0.9 \text{ MSD}$$

Then LC = 1 MSD – 1 VSD

= 1 MSD – 0.9 MSD = 0.1 MSD (1MSD = 0.1 cm = 1 mm)

LC = 0.1 MSD = 0.1 mm = 0.01 cm

Zero Error: if the zero of the vernier scale does not coincide with the zero of the main scale, then this is called zero error.

Positive zero Error: If the zero of the vernier scale lies to the right of the zero of the main scale, then that is known as positive zero error

Negative zero Error: If the zero of the vernier scale lies to the left of the zero of the main scale, then that is known as negative zero error

PROCEDURE:

1. The main scale was standardised.
2. Least count of the given instrument was calculated.
3. The zero error was found out by looking into the zero of the main scale and the vernier scale when the jaws were closed.
4. The given hollow cylinder was kept in between the two lower jaws lengthwise to determine the length of hollow cylinder.
5. Then the position of the zero in the vernier scale was compared with the position of the main scale and main scale reading was noted which is M.S.R
6. Then a particular line of the vernier scale coinciding with a main scale line was observed carefully and that particular division of the vernier scale was noted as vernier coincidence (V.C)
7. The Vernier Scale reading (V.S.R) WAS calculated by multiplying V.C with least count i.e V.S.R = V.C X LC
8. Height of the given cylinder was obtained by adding M.S.R with V.S.R
9. Then the above procedure is repeated at least 10 times to find the length of the cylinder.
10. Then the mean of the height of the cylinder was obtained
11. The same procedure was followed for the outer and inner diameter of the cylinder and the mean diameter for both the cases were obtained.
12. Then the volume of the hollow cylinder was calculated using the given formula.

OBSERVATION

TABULATION FOR HEIGHT

NO. Of Observation	LC in cm	M.S.R in cm	VC	V.S.R = VC X LC in cm	Observed height = MSR + VSR in cm	Mean height in cm	Zero error in cm	Corrected Height in cm
Take at least 10 readings								

TABULATION FOR OUTER DIAMETER (D_2)

NO. Of Observation	LC in cm	M.S.R in cm	VC	V.S.R = VC X LC in cm	Observed diameter = MSR + VSR in cm	Mean height in cm	Zero error in cm	Corrected diameter in cm
Take at least 10 readings								

TABULATION FOR INNER DIAMETER (D_1)

NO. Of Observation	LC in cm	M.S.R in cm	VC	V.S.R = VC X LC in cm	Observed diameter = MSR + VSR in cm	Mean height in cm	Zero error in cm	Corrected diameter in cm
Take at least 10 readings								

CALCULATION:

We observe that

The height of the given cylinder **h** = ________ cm

The outer diameter of the given cylinder $\mathbf{D_2}$ = _______ cm

The inner diameter of the given cylinder $\mathbf{D_1}$= _______ cm

Now the Volume of the given solid cylinder is calculated by

$$V = \pi(R_2^2 - R_1^2)h = \frac{\pi\left(D_2^2 - D_1^2\right)h}{4} = \_\_\_\_\_\_\_\_\_\_\_\_\ cm^3$$

CONCLUSION:

After performing the above experiment and taking necessary readings, the value of the volume of the hollow cylinder is found to be ____________ cm^3.

EXPERIMENT - 3

AIM OF THE EXPERIMENT: To measure the cross-sectional area of a wire by using Screw gauge

APPARATUS REQUIRRED

1. Screw Gauge
2. A piece of wire
3. Geometry box

THEORY:

The cross-sectional area of a wire is given by

$$\text{Area} = \pi R^2 = \frac{\pi D^2}{4}$$

Where R is the radius of the wire

D is the diameter of the wire.

Diameter of the wire is calculated by the screw gauge using the formula

D = Pitch Scale Reading + Circular Scale Reading - Zero Error

D = P.S.R + C.S.R – ZERO ERROR

P.S.R = Pitch x No. of Complete rotations = p x N

C.S.R = (Difference between ICSR and FCSR) X Least Count = (ICSR ~ FCSR) X Least Count

Hence D = (p X N) + (I~ F) X L.C - Zero Errors

ICSR – Initial Circular scale reading

FCSR– Final Circular scale reading

Pitch: It is the distance covered by the circular scale on the linear scale by one complete rotation

Pitch = 0.5 mm

$$\text{Least Count} = \frac{\text{Pitch}}{\text{Total no. of divisions on the circular scale}} = \frac{0.5}{50} = 0.01 \text{ mm}$$

Zero Error: If the zero of the Circular scale does not coincide with the reference line of the linear scale, then zero error arises.

Zero error = X x L.C

Where X is the no. of circular scale divisions which have either crossed or fall short of main scale

Positive Zero Error: if the zero of the circular scale remains below the reference line or the zero of the linear scale, then it is known as positive zero error. It is to be subtracted from the observed value.

Negative Zero Error: if the zero of the circular scale remains above the reference line or the zero of the linear scale, then it is known as negative zero error. It is to be added to the observed value.

PROCEDURE:

1. The pitch and the least count of the screw gauge were determined.
2. The linear scale and ordinary scale was standardised.
3. When the wire was placed between the two gaps, initial circular scale reading (ICSR) was noted.
4. The wire was removed and the no. of complete rotations was counted while closing the gaps.
5. When the gap is closed, the Final Circular Scale Reading (FCSR) was noted.
6. To get the difference, the following condition was followed.
   i. If I > F, then difference = I – F
   ii. If I < F, then difference = n + I – F

   Where n is the number of divisions on the circular scale

7. The pitch scale reading and circular scale reading were found out and their sum gives diameter of the wire.
8. Then the above procedure is repeated at least 10 times to find the length of the cylinder.
9. Mean diameter of the wire was determined.
10. Then the cross-sectional area of the wire was obtained using the formula.

OBSERVATION:

Tabulation for measuring the diameter

No. of Obs.	Pitch (P) in mm	LC in mm	ICSR (I)	No. Of complete rotations (N)	FCSR (F)	Difference (I ~ F)	PSR = (P * N) in mm	CSR =(Difference * LC) in mm	Diameter = (PSR + CSR) in mm	Mean in mm
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

CALCULATION:

The corrected value of the diameter of the wire is obtained by

Corrected diameter = mean diameter – zero error = ____________ mm

Then the cross-sectional area of the wire is calculated by

$$\text{Area} = \pi R^2 = \frac{\pi D^2}{4}$$

Area = ___________ mm^2

CONCLUSION:

After performing the above experiment and taking necessary readings, the value of the cross-sectional area of the wire is found to be ____________ mm^2.

EXPERIMENT - 4

AIM OF THE EXPERIMENT: To measure the volume of an irregular lamina by using Screw gauge

APPARATUS REQUIRRED

1. Screw Gauge
2. Irregular plane lamina
3. Graph paper

THEORY:

The volume of an irregular lamina is given by

$V = S \times t \text{ cm}^3$

Where S is the area of the irregular lamina

t is the thickness of the irregular lamina.

Thickness of the irregular lamina is calculated by the screw gauge using the formula

t = Pitch Scale Reading + Circular Scale Reading - Zero Error

t = P.S.R + C.S.R – ZERO ERROR

P.S.R = Pitch x No. of Complete rotations = p x N

C.S.R = (Difference between ICSR and FCSR) X Least Count = (ICSR ~ FCSR) X Least Count

Hence D = (p X N) + (I~ F) X L.C - Zero Errors

ICSR means Initial Circular scale reading

FCSR means Final Circular scale reading

Pitch: It is the distance covered by the circular scale on the linear scale by one complete rotation

Pitch = 0.5 mm

$$\text{Least Count} = \frac{\text{Pitch}}{\text{Total no. of divisions on the circular scale}} = \frac{0.5}{50} = 0.01 \text{ mm}$$

Zero Error: If the zero of the Circular scale does not coincide with the reference line of the linear scale, then zero error arises.

Zero error = X x L.C

Where X is the no. of circular scale divisions which have either crossed or fall short of main scale

Positive Zero Error: if the zero of the circular scale remains below the reference line or the zero of the linear scale, then it is known as positive zero error. It is to be subtracted from the observed value.

Negative Zero Error: if the zero of the circular scale remains above the reference line or the zero of the linear scale, then it is known as negative zero error. It is to be added to the observed value.

PROCEDURE:

1. The pitch and the least count of the screw gauge were determined.
2. The linear scale and ordinary scale was standardised.
3. When the irregular lamina was placed between the two gaps, initial circular scale reading (ICSR) was noted.
4. The lamina was removed and the no. of complete rotations was counted while closing the gaps.
5. When the gap is closed, the Final Circular Scale Reading (FCSR) was noted.
6. To get the difference, the following condition was followed.
   i. If I > F, then difference = I – F
   ii. If I < F, then difference = n + I – F

   Where n is the number of divisions on the circular scale

7. The pitch scale reading and circular scale reading were found out and their sum gives diameter of the wire.
8. Then the above procedure is repeated at least 10 times to find the thickness of the irregular lamina.
9. Mean thickness of the lamina was determined.
10. Then the given lamina was placed at three different places on the graph paper and its outline is drawn at each location with the help of a pencil.
11. The outlines were numbered as figure 1, figure 2 and figure 3.

12. The total number of big square divisions (area 1cm^2) and small square divisions (area 0.01 cm^2) enclosed inside the outline boundary were counted.
13. Then the total area of the lamina and the mean area were calculated as per the tabulation.
14. The volume of the irregular lamina was calculated using the formula.

OBSERVATION:

Table 1: Tabulation for measuring the thickness (t)

No. of Obs.	Pitch (P) in mm	LC in mm	ICSR (I)	No. Of complete rotations (N)	FCSR (F)	Difference (I ~ F)	PSR = (P * N) in mm	CSR =(Difference * LC) in mm	Diameter = (PSR + CSR) in mm	Mean in mm
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

Table 2: Tabulation for area of the irregular lamina (S)

No. of figs	Area of each big square division (A_1) In cm^2	No. of big square divisions (N_1)	Area of each medium square division (A_2) In cm^2	No. of medium square divisions (N_2)	Area of each small square division (A_3) In cm^2	No. of small square divisions (N_3)	Area of Lamina $S = (N_1 A_1 + N_2 A_2 + N_3 A_3)$ In cm^2	Mean area in cm^2
1.	1		0.25		0.01			
2.	1		0.25		0.01			
3.	1		0.25		0.01			

CALCULATION:

The corrected value of the thickness of the wire is obtained by

Corrected thickness = mean thickness – zero error = ____________ mm = _____________ cm

Then the volume of the irregular lamina is calculated by

V = S x t cm^3 = ______________ cm^3

CONCLUSION:

After performing the above experiment and taking necessary readings, the value of the volume of the irregular lamina is found to be ____________ cm^3.

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EXPERIMENT - 5

AIM OF THE EXPERIMENT: To determine the radius of curvature of a convex surface using Spherometer.

APPARATUS REQUIRRED:

1. Spherometer
2. Watch glass (Convex)
3. Base Plate
4. Instrument Box

THEORY:

The radius of curvature R of a curved surface is the radius of the sphere of which the curved surface is a part.

The radius of curvature can be determined by

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

Where R is the Radius of Curvature.

d is the distance between any two fixed legs of the Spherometer.

h is the height or depth as observed through the fourth movable leg of the Spherometer w.r.t the curved surface.

Height (h) of the convex surface is calculated by the Spherometer using the formula:

h = Pitch Scale Reading (P.S.R) + Circular Scale Reading (C.S.R)

P.S.R = Pitch x No. of Complete rotations = p x N

C.S.R = (Difference between ICSR and FCSR) X Least Count = (ICSR ~ FCSR) X Least Count

Hence h = (p X N) + {(I~ F) X L.C}

ICSR – Initial Circular scale reading

FCSR– Final Circular scale reading

Pitch: It is the distance covered by the circular scale on the linear scale by one complete rotation. Pitch = 1 mm

$$\text{Least Count} = \frac{\text{Pitch}}{\text{Total no. of Circular Scale Divisions}} = \frac{1}{100} = 0.01\ \text{mm}$$

PROCEDURE:

1. The pitch and the least count of the Spherometer were determined.
2. The watch glass with the convex side towards up was placed on a base plate.
3. The Spherometer was placed on the convex surface in such a way that the central leg just touched the convex surface.
4. At this time the value of ICSR was noted down from the circular scale.
5. The watch glass was removed and the Spherometer was placed on the base plate.
6. While the central leg was slowly rotated in downward direction to touch the base plate, the no. of complete rotations was counted.
7. The value of FCSR was noted down when the central leg just touched the base plate.
8. To get the difference, the following condition was followed.

   i. If ICSR > FCSR, then difference = ICSR – FCSR

   ii. If ICSR < FCSR, then difference = n + ICSR – FCSR

Where n is the number of divisions on the circular scale.

9. The pitch scale reading and circular scale reading were found out and their sum gives height of the convex surface.
10. Then the above procedure was repeated at least 10 times to find the mean height of the convex surface
11. The Spherometer with the central leg raised up was placed on a plain paper and was pressed gently to get the impression of the three legs on the paper. This step was repeated thrice.
12. The distance between the legs was noted from the three figures and the mean distance (d) was obtained.

OBSERVATION:

Table – 1 (Tabulation for height of the Convex Surface: h)

No. of Obs.	Pitch (P) in mm	LC in mm	ICSR (I)	No. Of complete rotations (N)	FCSR (F)	Difference (I ~ F)	PSR = (P * N) in mm	CSR =(Difference * LC) in mm	Height = (PSR + CSR) in mm	Mean in mm
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

Table – 2 (Tabulation for distance between legs: d)

No. of figures	d_1 in mm	d_2 in mm	d_3 in mm	$d = (d_1+d_2+d_3)/3$ in mm	Mean d in mm
1					
2					
3					

CALCULATION:

The Radius of Curvature of the convex glass surface is found to be

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

CONCLUSION:

After performing the above experiment and taking necessary readings, the value of the Radius of curvature of the convex surface is found to be __________mm.

EXPERIMENT - 6

AIM OF THE EXPERIMENT: To determine the radius of curvature of a concave surface using Spherometer.

APPARATUS REQUIRRED:

5. Spherometer
6. Watch glass (Concave)
7. Base Plate
8. Instrument Box

THEORY:

The radius of curvature R of a curved surface is the radius of the sphere of which the curved surface is a part.

The radius of curvature can be determined by

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

Where R is the Radius of Curvature.

d is the distance between any two fixed legs of the Spherometer.

h is the height or depth as observed through the fourth movable leg of the Spherometer w.r.t the curved surface.

Height (h) of the concave surface is calculated by the Spherometer using the formula:

h = Pitch Scale Reading (P.S.R) + Circular Scale Reading (C.S.R)

P.S.R = Pitch x No. of Complete rotations = p x N

C.S.R = (Difference between ICSR and FCSR) X Least Count = (ICSR ~ FCSR) X Least Count

Hence h = (p X N) + {(I~ F) X L.C}

ICSR – Initial Circular scale reading

FCSR– Final Circular scale reading

Pitch: It is the distance covered by the circular scale on the linear scale by one complete rotation. Pitch = 1 mm

$$\text{Least Count} = \frac{\text{Pitch}}{\text{Total no. of Circular Scale Divisions}} = \frac{1}{100} = 0.01\text{ mm}$$

PROCEDURE:

1. The pitch and the least count of the Spherometer were determined.
2. The Spherometer was placed on the base plate in such a way that the central leg just touched the base plate.
3. At this time the value of ICSR was noted down from the circular scale.
4. The watch glass with the concave side towards up was placed on a base plate.
5. The Spherometer was placed on the concave surface.
6. While the central leg was slowly rotated in downward direction to touch the concave surface, the no. of complete rotations was counted.
7. The value of FCSR was noted down when the central leg just touched the concave surface.
8. To get the difference, the following condition was followed.

   i. If ICSR > FCSR, then difference = ICSR – FCSR

   ii. If ICSR < FCSR, then difference = n + ICSR – FCSR

   Where n is the number of divisions on the circular scale.
9. The pitch scale reading and circular scale reading were found out and their sum gives height of the concave surface.
10. Then the above procedure was repeated at least 10 times to find the mean height of the concave surface
11. The Spherometer with the central leg raised up was placed on a plain paper and was pressed gently to get the impression of the three legs on the paper. This step was repeated thrice.
12. The distance between the legs was noted from the three figures and the mean distance (d) was obtained.

OBSERVATION:

Table – 1 (Tabulation for height of the Convex Surface: h)

No. of Obs.	Pitch (P) in mm	LC in mm	ICSR (I)	No. Of complete rotations (N)	FCSR (F)	Difference (I ~ F)	PSR = (P * N) in mm	CSR =(Difference * LC) in mm	Height = (PSR + CSR) in mm	Mean in mm
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

Table – 2 (Tabulation for distance between legs: d)

No. of figures	d_1 in mm	d_2 in mm	d_3 in mm	$d = (d_1+d_2+d_3)/3$ in mm	Mean d in mm
1					
2					
3					

CALCULATION:

The Radius of Curvature of the concave glass surface is found to be

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

CONCLUSION:

After performing the above experiment and taking necessary readings, the value of the Radius of curvature of the concave surface is found to be __________mm.

EXPERIMENT - 7

AIM OF THE EXPERIMENT: To determine the angle of Prism.

APPARATUS REQUIRRED:

1. Drawing Board
2. Glass Prism
3. Fixing pins
4. Four hair pins
5. White Paper Sheet
6. Instrument Box

THEORY:

A prism is a transparent optical element with flat polished surfaces that refracts light. When white light passes through a prism, it splits into 7 colours.

Angle of Prism is defined as the angle between the two transparent plane faces.

PROCEDURE:

1. White paper sheet on the drawing board was fixed using fixing pins.
2. The outline of the prism was drawn on the white paper.
3. Two parallel straight lines were drawn and the prism was put as shown in the figure.
4. PQ was taken as the incident ray by putting two pins and its reflected ray on the face AB was found out as RS.
5. Then on the other straight line P_1Q_1 was taken as the incident ray by putting two pins P_1 and Q_1 and its reflected ray on the face AC was found out as R_1S_1.
6. The reflected rays RS and R_1S_1 were produced backwards to meet at O. The angle is two times angle of prism.
7. The above procedure was repeated for three times.
8. The value of angle of prism was calculated from the above readings.

OBSERVATION:

Table – 1 (Tabulation for measurement of Angle of Prism: A)

No. of Observations	2 A in degrees	Mean Value of 2 A in degrees	A in degrees
1			
2			
3			

CALCULATION:

The observed value of the angle of prism is found to be A = _______________

The actual value of the angle of prism is 60° .

$$\text{Percentage Error} = \frac{|\text{Actual Value - Observed Value}|}{\text{Actual Value}} \times 100 = \text{\_\_\_\_\_\_\_\_\_\_\_\_}\%$$

CONCLUSION:

After performing the above experiment and taking necessary readings, the value of the angle of the prism is found to be _________ with ________% experimental error.

EXPERIMENT - 8

AIM OF THE EXPERIMENT: To determine the angle of minimum deviation by I~D curve method.

APPARATUS REQUIRRED:

1. Drawing Board
2. Glass Prism
3. Fixing pins
4. Four hair pins
5. White Paper Sheet
6. Instrument Box

THEORY:

A prism is a transparent optical element with flat polished surfaces that refracts light. When white light passes through a prism, it splits into 7 colours.

If I is the angle of incidence and r is the angle of refraction, then refractive index is given by

$$\mu = \frac{\sin i}{\sin r}$$

Angle of deviation: the angle between the incident ray and the emergent ray is called angle of deviation.

Angle of minimum deviation: the angle between the incident ray and the emergent ray, when angle of incidence is equal to angle of emergence, is called angle of minimum deviation. It is represented as D_m.

According to Snell's law,

$$\mu = \frac{\sin i}{\sin r} = \frac{\sin\left(\frac{A + D_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

PROCEDURE:

1. The white paper sheet was fixed on the drawing board using fixing pins.
2. A straight line on the middle of the paper covering the entire length of the paper was drawn.
3. Outlines of prism at least six times with little gap between two figures along this line as in the given figure was drawn.
4. Six inclined lines to the six figures making angle starting from 30^0 with an interval of 5^0 were taken. These lines were served as incident rays and the incident angles are (90 – angle taken).
5. The prism was placed on one figure and two hair pins were fixed on the inclined line as the incident ray.
6. Two more pins on the other side of the prism were fixed in such a way that the feet of those two pins and the image of the feet of the pins fixed on the incident ray must appear to lie in a straight line. The straight line joining these two pins was the emergent ray.
7. The prism was removed from the position, the incident and the emergent rays were produced to intersect each other.
8. The angle of deviation was measured.
9. The above procedure was repeated for at least _____ no. of times.
10. A graph between angle of incidence (i) along X- axis and angle of deviation (D) along Y-axis was plotted.
11. From the graph, angle of minimum deviation was determined.

OBSERVATION:

Table – 1 (Tabulation for determination of Angle of Deviation: D)

No. of figures	Base Angle θ in degrees	Angle of Incidence (i = 90 - θ) in degrees	Angle of deviation (D) in degrees
1			
2			
3			
4			
5			
6			
7			

The angle of minimum deviation (D_m) from the graph was found to be ________.

CALCULATION:

The angle of minimum deviation (D_m) = __________

$$\mu = \frac{\sin i}{\sin r} = \frac{\sin\left(\frac{A + D_m}{2}\right)}{\sin\left(\frac{A}{2}\right)} = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_$$

The actual value of refractive index of prism is 1.5.

$$\text{Percentage Error} = \frac{|\text{Actual Value - Observed Value}|}{\text{Actual Value}} \times 100 = \_\_\_\_\_\_\_\_\_\_\_\_ \%$$

CONCLUSION:

After performing the above experiment and taking necessary readings, the value of the angle of minimum deviation for prism is found to be _________ and the refractive index of the prism is found to be _______with ________% experimental error.

EXPERIMENT - 9

AIM OF THE EXPERIMENT: To draw the Magnetic Lines of Force and locate the Neutral points due to a Bar Magnet with North – Pole pointing North (N→N).

APPARATUS REQUIRRED:

1. A Bar Magnet
2. A Compass Needle
3. A Drawing Board
4. Fixing Pins
5. White Paper Sheet
6. Instrument Box

THEORY:

Line of Force: line of force is a closed imaginary curve starting from the North Pole and ending in the South Pole in magnetic field such that the tangent drawn at any point on the curve gives the direction of resultant magnetic field at that point.

Two lines of force never intersect each other.

Neutral Point: it is a point in the magnetic field where the field due to bar magnet is equal and opposite to the horizontal intensity of earth's magnetic field. So if a compass needle is placed at this point then it will tend to remain in any direction in which it is kept.

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

PROCEDURE:

1. A white paper sheet was stretched over drawing board and it was fixed with non-magnetic fixing pins.
2. The geographic north and south was determined using the magnetic compass.
3. The bar magnet was placed on the white paper sheet in such a way that its North Pole was pointing towards North and its outline was drawn.
4. The magnetic needle was placed near one pole of the magnet (North Pole).
5. Two dot marks were put on the paper corresponding to the position of both ends of needle when it was a rest.
6. The magnetic needle was placed at the subsequent position so that one end of it matched with the farther dot already plotted.
7. The other was marked with a dot.
8. This process was continued till a series of dot marks were obtained between the two poles of magnet.
9. All the dots were joined with a smooth curve to get a line of force.
10. The above procedure was followed to draw several lines of force symmetrically on both sides of the magnet.
11. The neutral points were located on the equatorial axis.

OBSERVATION:

1. Lines of Force never intersect each other.
2. The neutral points were located on the equatorial axis of the magnet.

CONCLUSION:

After performing the above experiment, I found that Lines of Force never intersect each other and neutral points were located on the equatorial axis of the magnet at a distance _______________ cm from the centre of the magnet.

EXPERIMENT - 10

AIM OF THE EXPERIMENT: To draw the Magnetic Lines of Force and locate the Neutral points due to a Bar Magnet with North – Pole pointing South (N→S).

APPARATUS REQUIRRED:

1. A Bar Magnet
2. A Compass Needle
3. A Drawing Board
4. Fixing Pins
5. White Paper Sheet
6. Instrument Box

THEORY:

Line of Force: line of force is a closed imaginary curve starting from the North Pole and ending in the South Pole in magnetic field such that the tangent drawn at any point on the curve gives the direction of resultant magnetic field at that point.

Two lines of force never intersect each other.

Neutral Point: it is a point in the magnetic field where the field due to bar magnet is equal and opposite to the horizontal intensity of earth's magnetic field. So if a compass needle is placed at this point then it will tend to remain in any direction in which it is kept.

Neutral points are located symmetrically with respect to the magnet on axial position when North Pole of the magnet points South.

PROCEDURE:

1. A white paper sheet was stretched over drawing board and it was fixed with non-magnetic fixing pins.
2. The geographic north and south was determined using the magnetic compass.
3. The bar magnet was placed on the white paper sheet in such a way that its North Pole was pointing towards South and its outline was drawn.
4. The magnetic needle was placed near one pole of the magnet (North Pole).
5. Two dot marks were put on the paper corresponding to the position of both ends of needle when it was a rest.
6. The magnetic needle was placed at the subsequent position so that one end of it matched with the farther dot already plotted.
7. The other was marked with a dot.
8. This process was continued till a series of dot marks were obtained between the two poles of magnet.
9. All the dots were joined with a smooth curve to get a line of force.
10. The above procedure was followed to draw several lines of force symmetrically on both sides of the magnet.
11. The neutral points were located on the axial line of the magnet.

OBSERVATION:

1. Lines of Force never intersect each other.
2. The neutral points were located on the axial line of the magnet.

CONCLUSION:

After performing the above experiment, I found that Lines of Force never intersect each other and neutral points were located on the axial line of the magnet at a distance _______________ cm from the centre of the magnet.