(Experiment – 01)

Aim :- To determine the internal diameter and depth of a cylinderical container (like tin can, calorimeter) using a vernier callipers and find its capacity. Verify the result using a graduated cylinder.

Theory

What Is Least Count?

The least count is defined as the smallest change in the measured quantity, which can be resolved on an instrument's scale.

How to Calculate Least Count?

The least count of vernier caliper = Least count of vernier caliper =

$$\frac{frac\ magnitude\ of\ the\ smallest\ division\ on\ the\ main\ scale}{total\ number\ of\ small\ divisions\ on\ the\ vernier\ scale}$$

The formula used to calculate the volume of beaker/calorimeter = internal area of cross-section × depth

$$V = (\frac{D}{2})^2 . d$$

Where,

- D is the internal diameter of the beaker/calorimeter
- d is the depth of the beaker/calorimeter

Procedure

(I) Observe the divisions on the vernier scale are smaller than those on the main scale. The difference between one main scale division and one vernier division is called vernier constant or least count of the vernier callipers.

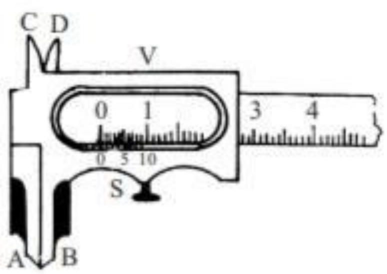
(II) Observe the number of vernier divisions (n) which match against one less number of divisions of main scale (n – 1).

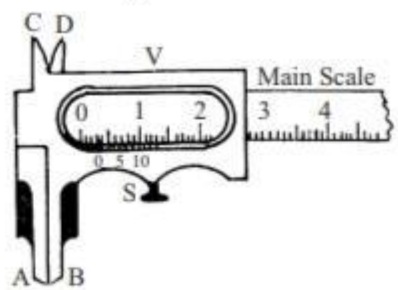
(iii) Calculate the least count as under

$$1 \text{ division of vernier scale} = \frac{n-1}{n} \text{ division of main scale}$$

$$\text{Least count} = 1 \text{ main scale division} - 1 \text{ vernier scale division}$$

$$= 1 \text{ main scale division} - \frac{n-1}{n} \text{ main scale division}$$





(b) To find the zero error of the vernier scale

(iv) With the jaws of the callipers closed, if the zero marks of the main scale does not coincide with the zero mark of the vernier scale, the instrument has a zero error. If the zero mark of the vernier scale is on the left of the main scale's zero mark then the zero error is negative as show 1.and when it is on the right of the main scale's zero mark error is positive figure 2

(figure 1.). (figure 2)

(v) If there is zero error, observe which vernier scale (v.s.) division best coincides with any main scale (ms) division with jaws of the callipers closed. The value of the zero error is the product of the best coinciding vernier division and least count of the vernier callipers when zero error is positive. On the other hand when zero error is negative, the coinciding vernier division is to be seen from the end of the vernier scale, backwards.

(vi) While observing which vernier scale division coincides with a main scale division, it may happen that none coincides. For example, 5th may be. a little ahead and 6th may be a little before a main scale division. Observe, which one is closest to a main scale division.

(c) To find the zero correction of the vernier scale

(vii) It is the negative of the zero error.

Zero correction = - (zero error)

Zero correction is added algebraically in the observed diameter to get the corrected diameter.

(d) Measuring internal diameter

(viii) To measure the internal diameter of the calorimeter, place the vernier callipers with the upper jaws inside the calorimeter as shown in the diagram (Fig. 1) . The upper jaws of the vernier callipers should firmly touch the ends of a diameter of the calorimeter, but without deforming the calorimeter.

(ix) Note the main scale reading immediately before the zero mark of the vernier and also note the division of the vernier which coincides with any of the main scale divisions

(X) Since the calorimeter may not be of precisely circular shape, take one more observation along a diameter perpendicular to previous one

(xi) Repeat the pair of observations at least three times and record them.

(e) Measuring depth

Next, let the end of the vernier callipers stand on its end on a glass slab, push down its depth gauge (the central moving strip), so that it also firmly touches the glass slab. Then note the zero error of its depth gauge.

(xiii) Next, set the vernier callipers with its end resting on the upper edge of the Calorimeter and its depth gauge touching the bottom inside. Thus note the

Observed depth of the calorimeter. Calculated corrected depth by applying

Zero correction.

(f) Verification

(xiv) Next, in order to verify the capacity of calorimeter measured by vernier callipers, fill it completely with water. Pour this water in to an empty graduated cylinder and observe the volume of this water. Both values should be in agreement within experimental error.

Observations

Table for diameter of the beaker

S.No	Main scale Reading M (cm)	Vernier scale Reading		Total Value D = M+V (cm)
		No of Coinciding Divisions (b)	Value b X L.C = V (cm)	
01	4·5	6	0·01X6 = 0·06	4·56
02	4·5	6	0·01X6 = 0·06	4·56
03	4·5	6	0·01X6 = 0·06	4·56
04	4·5	8	0·0X1X8 = 0·08	4·58

Table for depth of the beaker

S.No	Main scale Reading M (cm)	Vernier scale Reading		Total Value D = M+V (cm)
		No of Coinciding Divisions	Value b X L.C = V (cm)	
01	7·1	9	9X0·01 = 0·09	7·19
02	7·2	3	3X0·01 = 0·03	7·23
03	7·1	9	9X0·01 = 0·09	7·19
04	7·1	9	9X0·01 = 0·09	7·19

Mean value of observed diameter

$$\frac{4.56+4.56+4.56+4.56}{4}$$
$$\frac{18.26}{4}$$
$$D = 4.565 = 4.56 \text{ cm}$$

Mean value of the height

$$\frac{7{\cdot}19+7{\cdot}23+719+7.19}{4}$$
$$= \frac{28.8}{4}$$
$$= 7.2 \text{ cm}$$

Volume of the beaker

$$= \frac{1}{4}\pi r^2 h$$
$$= \frac{1}{4}\pi.13 \times 4.56^2 \times 7.3$$
$$= \frac{1}{4} \times 47.1017$$
$$= 117.53.\ \text{cm}^s$$

(Experiment -02)

Aim:- Determine the diameter of a given wire using a screw gauge.

Theory

(i) Pitch: The pitch of the screw is the distance through which the screw moves along the main scale in one complete rotation of the cap on which is engraved the circular scale.

(ii) Least Count: The least count of the screw gauge is the distance through which the screw moves when the cap is rotated through one division on the circular scale.

(iii) Zero error and correction: When the zero mark of the circular scale and the main scale do not coincide on bringing the studs in contact the instrument has zero error. The zero of the circular scale may be in advance or behind the zero of the main scale by a certain number of divisions on circular scale. If the zero of the circular scale is ahead of the zero of main scale the zero error is negative (Fig. 2.3a). On the other hand if the zero of the circular scale is behind the zero of the pitch scale, the zero error is positive

(iv) Back-lash error: Owing to ill fitting or wear between the screws and the nut, there is generally some space for the play of the screw, the screw may not move along the its axis for appreciable rotation of the head (or cap, on which circular scale is marked). The error so introduced is called back-lash errors. To eliminate it you must advance the screw, holding it by the ratched cap, when making final adjustment for finding zero error or the diameter of the wire.

Material Required

Given wire, screw gauge

Procedure

(I) Measuring pitch: To measure the pitch give several rotation to its cap and observe the distance through which screw moves. Calculate the pitch using the following formula

(ii) Measuring least count: To measure the least count note the number of divisions on the circular scale and calculate

(iii) Measuring zero error: With the studs in contact observe the numbers of divisions by which zero of the circular scale deviates from the zero of the main scale. This number multiplied by the least count gives the required

(iv) Calculate the zero correction: It is negative of zero error. -

Zero correction =- zero error Zero correction is added algebraically in the observed diameter of wire to get the corrected reading

(v) Measuring diameter: To measure the diameter of the wire move the screw back to make a gap between the studs. Insert the wire between the studs. Turn the screw forward by holding it from the ratchet cap and wire should be held gently between the two studs.

(vi) Read the neacrest division on the circular scale in line with the main scale and also find the complete rotations of the cap with the help of the main scale. Calculate the observed diameter: Observed diameter = pitch x number of complete rotation +L.C. x circular scale reading

Source of If the instrument be screwed up tightly when finding zero error or taking reading of diameter of wire (perhaps on account of defective on hard ratchet cap) it may compress the wire out of shape.

Observation :-

(1) For the least count –

Pitch of the screw (s) = 0.1 cm

Total no of divisions on head

Scale (cm) = 100

Least count –

$$
\begin{aligned}
\text{least count } &= \frac{S}{n} \\
&= \frac{0.1}{100} \\
&= 0.001 \text{ cm}
\end{aligned}
$$

(2) for the zero error -

sign of zero error = Negative

No of mark coinciding with base line of main scale (p) – 48

Zero error = e = (100-48) X 0.001

= 5.2X 0.001 = -0.052 Cm

Table for diameter

S.No	Main Scale Reading M (cm)	Head Scale Reading: No of Head scale Mark Conciding with Base line (P)	Reading H = PXL.C (cm)	Total Reading D = M+H (cm)
1.	0.0	11	11X0.001 = 0.011	0.011
2.	0.0	10	10X0.001=0.010	0.010
3.	0.0	5	5X0.001 = 0.005	0.005
4.	0.0	9	9X0.001 = 0.009	0.009

Calculation

Mean observed diameter

$$
\begin{aligned}
= p^{1} \prime = & \frac{0.011 + 0.010 + 0.005 + 0.009}{4} \\
& = \frac{0.035}{4} = 0.00875 \text{ cm} \\
& = 0.008 \text{ cm}
\end{aligned}
$$

Correct diameter

$D = p^1 - e$

= 0.008 – (- 0.052)

= 0.008 + 0.52

= 0.060 Cm

Result

The diameter of given wire

= 0.060 cm

(Experiment – 03)

Aim :- Determine the radius of curvature of a concave mirror using a spherometer.

Theory

When a spherometer is placed on a curved surface such .That all its legs are touching it, the middle leg will be a A Little higher or lower than the plane of the outer legs by A small amount / which is related to R. the radius of Curvature of the surface

$GH = h$

$GOE = 2R$

$AH = a$, the distance between the central leg and the outer leg.

From geometry

$AH \times HB = GH \times HE$

$a \times \mathrm{a} = h\,(2\,R - h)$

$a^2 = 2\,Rh - h^2$

$2RH = a^2 + h^2$

$$R = \frac{a^2}{2h} + \frac{h^2}{2h}$$

$$\therefore R = \frac{a^2}{2h} + \frac{h}{2}$$

H is the centre of equilateral triangle formed by the outer legs *A*, *B*, *C*, (Fig.3.2). We have

$$cos\ 30^0 = \frac{AM}{AH}$$

$$\Rightarrow \frac{\sqrt{3}}{2} = \frac{l/2}{a} = \frac{l}{2a}$$

$$a = \frac{l}{\sqrt{3}}$$

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

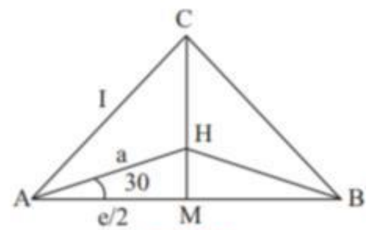


Fig. 3.2:

Materials required

Spherometer, plane glass slab, concave mirror, half metre rod.

(1) Examine the spherometer, noting carefully that the legs and the vertical scale are not shaky and that the central screw is not very loose.

(ii) Find the pitch of the screw by determining the vertical distance covered in 4 or 5 rotations. Pitch Distance moved No. of complete rotations

$$\text{Pitch} = \frac{\text{Distance moved}}{\text{No. of complete rotations}}$$

(iii) Find the least count by dividing the pitch by number of divisions on the circular scale

$$\text{Least count} = \frac{\text{Pitch of the screw}}{\text{No. of divisions on circular scale}}$$

(iv) Set the given concave mirror on a horizontal surface firmly and place the spherometer on it and adjust the central leg till it touches the surface. All the four legs touch the surface of the concave mirror.

(v) In order to eliminate back-lash error, proceed slowly as the central leg reach close to the mirror surface. Stop when central leg touches the mirror surface and the entire spherometer just rotates,

(iv) Hanging on the central leg. Read the coincident division on the circular scale and also the main scale reading on the vertical scale. Thus find the total reading.

(vii) Now place the instrument on the surface of the plane glass slab and find how many complete turns have to be made to bring the tip of the central leg to the plane of the outer leg. Also read the coincident division on the circular scale. Thus find the total reading on the glass slab.

The difference between the above two readings gives h.

(viii) Press the spherometer gently on the notebook so as to get pricks of the feet which are pointed. Measure the distance between each pair of outer pricks And find their mean. This gives

Observations

1.Distance between the two legs of the spherometer in ABC (Triangle) , by legs of spherometer

AB = 4 , BC = 4.3 , AC = 3.9

Mean value of 1 =

$$\frac{AB+BC+AC}{3} = 4.06$$

2.Least count of spherometer

1 pitch scale division = 1 mm

No of full rotations given of the screw distance moved by the screw = 5 mm

Pitch

$$\frac{5 \text{ mm}}{5} = 1 \text{ mm}$$

No of division on circular (disc) scale

Hence least count

$$= \frac{1 \text{ mm}}{100}$$
$$= 0.001cm$$

(Experiment – 04)

Aim:- To find the time period of a simple pendulum for small amplitudes and draw the graph of length of pendulum against square of the time period. Use the graph to find the length of the second's pendulum.

Theory :-

A simple pendulum is a small heavy bob' I hanging by a light and inextensible String S (fig 4.1). In 'equilibrium position string is vertical. While oscillating. The amplitude of oscillation is the maximum angle that thread makes with the Vertical (or sometimes the maximum horizontal displacement of the bob). Its Time period Tie, time taken for one oscillation depends on its length ie distance from point of suspension to CG of bob B

$$T \propto \sqrt{l}$$

$$\text{or} \qquad T^2 \propto l$$

increases if amplitude is large, but for small amplitudes it is constant. Second's pendulum is one which takes one second to move from one end of the swing to other. Thus its time period is 2.

Material Required

A spherical bob; stop watch (with least count of 0.1 second or less), tall Laboratory stand with clamp, split cork, fine thread, two small wooden blocks, metre scale.

Procedure

(I) Measure diameter of the bob with help of the metre scale and the two Wooden blocks. Then tie one end of thread in the hook of the bob

(ii) Pass the other end of the thread between two pieces of the split cork and Clamp it in the clamp of the stand (Fig 4.1). The point P, where the thread comes out of the cork is thus a sharp point of suspension, whose position does not change as the pendulum swings. To ensure this, check up that two pieces of the split-cork have sharp lower edges at P

(iii) Make a length of about 125 cm of this pendulum for the first set of readings Measure the length from foot of the hook H to point of suspension P (fig 4.2). Add to it half the diameter of the, bob to obtain 1, the length of the pendulum. Length PH must be measured with bob suspended, as the three May have some elastic extension by the weight of the bob

(iv) Adjust position of stand to bring this pendulum close to edge of the table (Fig 4.1). On a white strip of paper stuck at the vertical end face of the Table, mark a vertical line. The thread coincides with this line in its vertical position, when you see it from the front.

(v) Pull the bob to one side and release so that it oscillates with an amplitudes of less than 4” (Fig 431 If height of P above table is about 60 cm, then maximum displacement of thread from central mark is not more than about 4 cm

(vi) With the help of stop watch, measure time of 20 oscillation. You should' start the watch when thread crosses the central mark in a given direction and count "zero". At the count 'twenty' when thread crosses the central mark in the same direction, stop the watch. Take three consistent readings, lest there is an error in counting. Then calculate time of one oscillation T.

(vii) Repeat steps (3) to (6) making shorter lengths of the pendulum upto about 20 cm.

(viii) For each length calculate 7 and plot a graph between 7 versus /(Fig 4.4) from this graph find the value of I for 7 = 4 s^2

Procedure

(1) Vernier constant of vernier calipers(v.c)=0.01cm

Zero error of vernier caliper

(I) 0 cm (ii) 0 cm (iii) 0 cm

Mean zero error (e) = 0 cm

Mean zero correction (c) = - e = 0 Cm

Observed diameter of the BOB

(I) 1.82 cm (ii) 1.82 cm (iii) 1.82 cm.

Mean observed diameter of = 1.82 cm

Mean correct diameter , d =date = 1.82 cm

Mean radius of the BOB r = 0.9 cm

Length of the BOB (h) = 0.9 cm

(2) Least count of step clock 1watch = 0.5 seconds

-

Observation table

S.No. of obs.	Length of Thread Pendulum		Time for 20 vibrations				Time period $T = \frac{t}{20}$	T^2
	l' (cm)	$l = l' + r$ (cm)	t_1 (s)	t_2 (s)	t_3 (s)	Mean t (s)	(s)	(s^2)
1	69.1	70.0	35	34	34	34	1.7	2.89
2.	79.1	80.0	36	36	36	36	1.8	3.24
3	89	90.0	38	39	40	39	1.95	3.802
4	99.1	100.0	41	41	42	41	2.05	4.2025

(Experiment – 05)

Aim:- To find the weight of a given body using law of parallelogram of vectors.

Theory

According to Newton's Third Law of motion, tension in a string supporting a body is equal to the weight of the body.

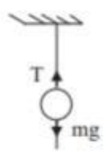


Fig. 5.1

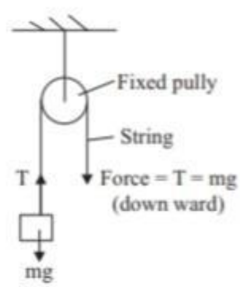


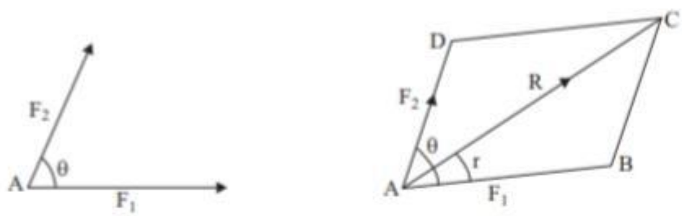
Fig. 5.2

(The weight due to a body of mass m = mg (Fig. 5.1). Therefore in the string is:)

(ii) A fixed pulley only changes the direction of force and not its value (Fig.

(iii) Forces are vectors and they cannot be added arithmetically. Resultant force is a single force that produces the same effect as a combination of two or more forces. A body is said to be in equilibrium if the resultant force on it is zero.

(iv) Law of parallelogram of vectors: If two vectors acting simultaneously on a particle be represented in magnitude and direction by the two adjacent sides of a parallelogram drawn from a point, then their resultant is completely represented in magnitude and direction by the diagonal of that parallelogram drawn from that point.



The diagonal AC will represent ***R*** the resultant force.

$$R = F_1 + F_2$$

$$|R| = F_1^2 + F_2^2 + 2F_1F_2Cos\theta$$

Also $$\tan\alpha = \frac{F_2 Sin\theta}{F_1 + F_2 Cos\theta}$$

Where a is the angle which the direction of the resultant, R, makes with the direction of F,

If F, or F, change in magnitude or direction R will also change

Material Required :-

Parallelogram law of forces apparatus (Gravesand's apparatus), plumb line, slotted weights, thin strong thread, white drawing, paper sheet, drawing pins, mirror strip, pencil, set square/ protractor, a body whose weight is to be determined.

Procedure :-

(I) Set up the Gravesand's apparatus with its-board vertical arid stable on a rigid base. Check this with the help of a plumb line

(ii) Oil the axle of pulley so as to make them move freely.

(iii) Fix the white drawing sheet on the board with the help of pins.

(iv) Cut alm long thread. Tie the hooks of the slotted weights at its ends. (v) Pass the thread over the two pulleys. The hangers must hang freely and They should not touch the board or pulley or ground. (vi) Cut 50 cm long thread. Tie the body whose weight is to be determined One end of the string.

(vii) Knot the other end to the centre of Im thread at A.

(viii) Adjust the three weights such that the junction A stays in equilibrium slightly

Below the middle of the paper. The three forces are:

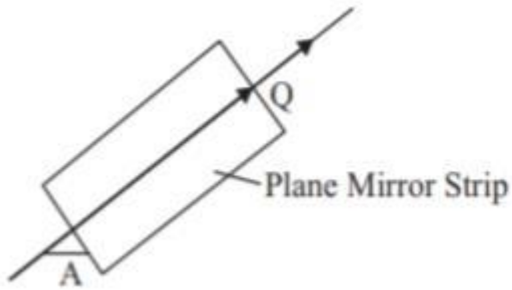
F, due to slotted weights P

F, due to slotted weights Q.

R due to the weight of the body.

F = P (slotted weight + Weight of hanger) F,= Q(slotted weight + weight of hanger)

Perhaps with a given set of weights P and Q and body of unknown weight you find that central junction A can stay anywhere within a circle. Try to locate the centre of this area and bring the junction A there.



(ix) To mark the direction of the forces, place the plane mirror strip lengthwise under each thread in turn. Mark two points one on either ends of mirror strip by placing your eye in such a position that the image of the thread in strip is covered by the thread itself. The points should be marked only west are the at rest

(X) Note the value of the weights P and Q. Do not forget to add the the hanger along with each. Find weight of hanger by spring balance.

(xi) Remove the sheet of paper. Join the marked points to show the direction of forces (Fig. 5.6).

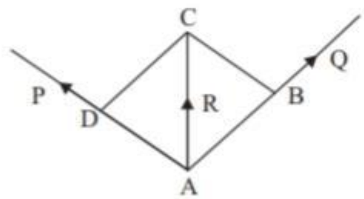
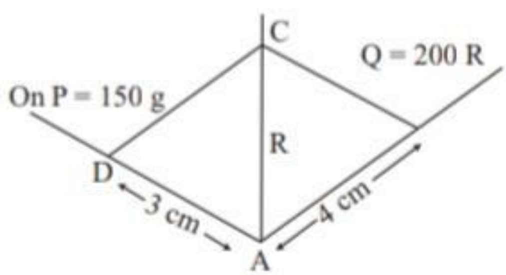


Fig. 5.6

(xii) Choose a suitable scale to indicate the forces, so as to get a large parallelogram.D such that AD to represent forces



Due to n the weights and hanger. Here, n grown weight is represented by 1cm. The number n should be so chosen that the lengths AB and AD are accommodated in the drawing sheets. An example will make these points clearer. In an experiment P = 150g and Q=200g and their directions were recorded as shown in Fig. 5.7. Choose a scale 1cm = 50g

$\therefore AD \frac{150}{50} = 3$ cm

and $AB = \frac{200}{50} = 4$ cm

completing the parallelogram we measure and find that

AC is 4.4 cm.

$\therefore R = 4.4 \times 50 = 220.0\ g$

or 220 g.

The diagonal AC gives the value of resultant and hence in our case the unknown weight of the body.

(xiii) Repeat the experiment twice again by changing weights in the hangers. Find the average value of the unknown weight.

Culculation

$$\text{mean weight} \quad R = \frac{0.080 + 0.020t0.0825}{3}$$

$$= \frac{0.2425}{3}$$

$$= 0.0808 \text{ kg}$$

Result-

The unknown weight of given body = 0.0808kg

Precautions:-

1.The board should be stable and vertical.

2.The pulleys should be frictionless The hangers Table

(Experiment – 06)

Aim:- To find the focal length of a convex mirror using a convex lens.

Theory:- You know that a convex mirror always forms virtual image of a real object and hence the value of v (i.e. the position of the image) cannot be obtained directly. Therefore, convex lens is used to enable us to form a real image due to the combination.

Let an object 0 be placed between fand 2 ƒ of a convex lens L and its image be

Formed at I, which we locate by removing parallax between the image pin and the image of O (Fig. 15.1). Now keeping the position of O and L fixed we place the convex mirror between L and I at such a position so that the image of O is formed just above it (Fig. 15.2). This happens when the rays retrace their path, i.e. when the rays falls on the mirror normally. Obviously this means that MI is the radius of curvature of

Since, $R = 2f$

$$\therefore f = \frac{MI}{2}$$

Material Required

Convex mirror, convex lens (having focal length greater than tha mirror but not greater than twice of that of the mirror), optical with four uprights, knitting needle, metre-rod, spirit level.

Procedure

Calculate the probable focal length of the convex lens by focussing the image of a distant subject (example: a tree) on a clear screen and calculating the length between the image and the lens.

Fix the object needle, the mirror, and the lens on the optical bench as shown in the above figure. Then adjust their height in a way that the needle's tip, the pole of the mirror, and the lens's optical centre lie at the same horizontal alignment.

Place the object pin between 2F and F. Tune the mirror and the needle in such a way that there is no significant parallax between the object needle's tip and its inverted image produced at O.

4. Measure the positions of the lens (L), the mirror (M), and the object (O).

5. Take out the mirror and place another needle, C, on the same side of the mirror. Tune the needle C in such a way as to remove the parallax between the needle C and the image of object O. Note down the position of C.

6. Repeat procedures 3 to 5 to note down at least five various locations of the lens and the object.

7. Calculate the index correction between the imaging needle and the mirror as described previously.

Observations ;:- Approximate focal length of convex is 20cm

Observations table :-

S.No	**Position of the object needle**	**Position of convex lines L (cm)**	**Position of convex mirror p (cm)**	**Position of needle c (cm)**	**R= P – C**
01	15 cm	60 cm	70 cm	40 cm	70 -110 = - 40
02	13 cm	60 cm	73 cm	112.5 cm	73 – 112.5 =-39.5
03	12 cm	60 cm	74 cm	114.5 cm	74 – 114.5 = 40.5

Calculations

$$R = \frac{(-40+39.5+40.5)}{2}$$

$$R = \frac{40}{2} = 20 \text{ cm}$$

Result

The focal length of convex mirror is 20 cm

(Experiment -08)

Aim :- To determine the internal resistance of a primary cell using a potentiometer.

Theory

The potentiometer is a device used to measure the internal resistance of a cell and is used to compare the e.m.f. of two cells and the potential difference across a resistor. The relation between potential difference, emf, and internal resistance of a cell is given by

$$I = \frac{E}{R + r} \quad \text{or} \quad E = I(R + r)$$

Hence V = IR = E – Ir

This indicates the value of V is less than E by an mount equal to the fall of potential inside the cell due to its internal resistance.

From the above equation

$$\frac{r}{R} = \frac{E - V}{V}$$

The internal resistance of the cell is given by

$$r = R\frac{E - V}{V}$$

Materials required :-

1 galvanometer

2.A battery

3. potentiometer

4.rheostat of low resistance

5.A fractional resistance box

6.ammeter

7. numbers keys (one-way)

8.Connecting wires

9.A jockey

10 .1 high resistance box

11. Sandpaper

12. Leclanche cell

13.set square

14.voltmeter

Prodecure

1.The connections should be according to the diagram shown above.

2.Using sandpaper clean the ends of the connecting wires and make sure that the connections are tight.

3.The plugs in the resistance box should be tight.

4.The e.m.f of the cell and battery is more than that of the cell. If it is not then the null point won't be obtained.

5.Rheostat resistance can be made minimum by taking maximum current from the battery.

6.To check if the circuit connections are correct, the galvanometer deflections should be in the opposite direction. This is done by inserting the key K1 and making note of ammeter reading.

7.To obtain the null point on the fourth wire, the rheostat should be adjusted without inserting the key K2.

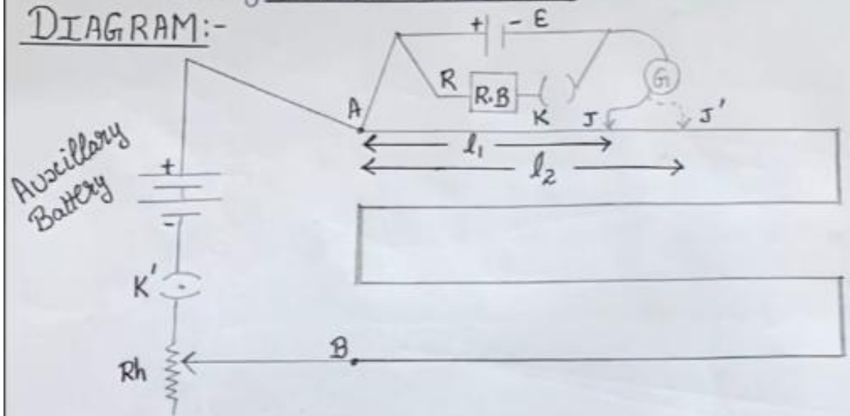
8.Take the small resistance between 1-5 ohm from resistance box R connected in parallel with the cell.

9.Slide the jockey and obtain the null point

Observations

Using POTENTIOMETER.

DIAGRAM:-



FORMULA USED:-

$$r = \left(\frac{E}{V} - 1\right) R$$
$$= \left(\frac{l_2}{l_1} - 1\right) R$$

OBSERVATION TABLE:-

S.No	R(Ω)	When key K is open l_2(cm)	When key K is Closed l_1 (cm)	$r = \left(\frac{l_2}{l_1} - 1\right)R$
1	1	706	86	7.2
2	1.5	690	125	6.8
3	2	610	123	7.9

CALCULATION:- Mean value of r = 7.3 Ω

RESULT:- Internal resistance of given primary Cell is 7.3 Ω

(Experiment – 08)

Aim :- To determine the specific heat capacity of a given solid by the method of mixtures**.**

Theory

The calorimeter is a device used to measure the heat flow of a chemical or physical reaction. Calorimetry is the process of measuring this heat. It consists of a metal container to hold water above the combustion chamber and a thermometer to measure the temperature change. Hypsometer is an instrument used to determine the boiling point of water at a given altitude.

Materials Required

(i) A hypsometer
(ii) Calorimeter
(iii) Stirrer
(iv) A lid and outer jacket
(v) Solid in small pieces
(vi) Balance
(vii) Weight box
(viii) Two half-degree thermometers
(ix) Coldwater
(x) Clamp stand

Procedure :-

(1) Put thermometers A and B in a beaker containing water and note their reading. Let thermometer A be a standard to find the correction that is to be applied to thermometer B.

(2) Put the thermometer B into the copper tube of a hypsometer containing the powder of the given solid. Before placing the hypsometer on the burner, add a sufficient amount of water.

(3) Record the weight of the calorimeter with a stirrer and lid over it.

(4) Add water (temperature between 5 to 8℃) to the calorimeter at half-length and weigh it again.

(5) Heat the hypsometer till the temperature of the solid is steady.

(6) Note the temperature of water in calorimetry. Now slowly stir and add the solid powder from the hypsometer to the calorimeter and record the final temperature of the mixture.

(7) Remove thermometer A from the calorimeter.

(.8) Note the weight of the calorimeter with the contents and lid.

Observations-

Mass of given salid (mg) = 83.7 g

Mass of empty calorimeter with stirrer (mc) = 45.5g mass of calorimeter with stiveer & water

M = Mw+me = 122.5

Mass of water (mw) = M-mc = 779

Specific heat of water Cw = 10 cal-g”. “G””

Specific heat of copper calorimeter C_2 = 0-1 Calg” “

Temperature of water in calorimeter T-32.5°C

Temperature of hat salid To = 97 C

Final temperature of the mixture Tr = 30°C

Result :-

Specific heat of given salid by method of mixture is 0.0god cal/g'c

(Experiment – 09)

Aim :- To determine the specific resistance of the material of two given wires using a metre bridge.

Theory

Metre bridge apparatus is also known as a slide wire bridge. It is fixed on the wooden block and consists of a long wire with a uniform cross-sectional area. It has two gaps formed using thick metal strips to make the Wheatstone's bridge.

Then according to Wheatstone's principle, we have:

$$\frac{X}{R} = \frac{l}{(100-l)}$$

The unknown resistance can be calculated as:

$$X = R\frac{l}{(100-l)}$$

Then the specific resistance of the material of the is calculated as:

$$\rho = \frac{\pi r^2 X}{L}$$

Materials Required

1.metre bridge

2. Leclanche cell (battery eliminator)

3. galvanometer

4. resistance box

5. jockey

6.one-way key

7. resistance wire

8. screw gauge

9.metre scale

10.set square

11.Connecting wires

12.A piece of sandpaper

Procedure

1.The arrangement of the apparatus should be as shown in the circuit diagram.

2.The wire whose resistance is to be determined should be connected in the right gap between C and B without any formation of loops.

3.The resistance box should be connected in the left gap between A and B.

4.All the other connections should be as shown in the circuit diagram.

5.Plug the key K in place of 2-ohm resistance in the resistance box.

6.The jockey should be first touched gently to the left end and then to the right end of the bridge.

7.The deflections in the galvanometer should be in opposite directions and if it is in one direction then the circuit connections are not correct. Note the galvanometer deflection.

8.Let D be the null point where the jockey is touching the wire. The movement of the jokey should be gentle from left to the right of the galvanometer.

9.Take a 12 value from the resistance box should be taken such that when the jockey is nearly in the middle of the wire, there shouldn't be any deflection.

10.Note the position of D to know the length of AD = l.

11.Four sets of observations should be taken by changing the value of 12.

12.Record the observations in a tabular form.

13.Stretch the resistance wire to find its length using a metre scale.

14.Using screw gauge measure the diameter of the wire at four different places keeping it in a mutually perpendicular direction.

15.Record the observations in the table.

Observation table

S.No	R Ω	l cm	(100−l) cm	$S = \frac{R(100-l)}{l}$
1	1	51	49	$S_1 =$ 0.9
2	1.2	52	48	$S_2 =$ 1.1
3	1.3	54	46	$S_3 =$ 1.1

Calculations

$$\frac{0.9 + 1.1 + 1.1}{3} = 1.03 \approx 1\,\Omega$$

Result

The resistance of given wire is **1 Ω**

(Experiment – 10)

Aim :- To compare the e.m.f.'s of two given primary cells by using a potentiometer.

Apparatus/Material Required

- Potentiometer
- Daniel Cell
- Leclanche Cell
- low resistance Rheostat
- Ammeter
- Voltmeter
- Galvanometer
- A one-way key
- A two-way key
- Set Square
- Jockey
- Resistance Box
- Connecting wires
- Piece of sandpaper

Theory:

Using a voltmeter, it is possible to measure only the potential difference between the two terminals of a cell, but using a potentiometer, we can determine the value of emf of a given cell. Where E_1 and E_2 are EMFs of two cells, l_1 and l_2 are the balancing lengths when E_1 and E_2 are connected to the circuit respectively, and ϕ is the potential gradient along the potentiometer wire.

$$E_1 / E_2 = \phi l_1 / \phi l_2 = l_1 / l_2$$

Procedure :-

1.Connect the circuit as shown in the figure.

2. With the help of sandpaper, remove the insulation from the ends of connecting copper wire.

3.Measure the EMF € of the battery and the EMFs (E_1 and E_2) of the cell and see if $E_1 > E$ and $E_2 > E$.

4.Connect the positive pole of the battery to the zero ends (P) of the potentiometer and the negative pole through the one-way key, low resistance rheostat, and the ammeter to the other end of the potentiometer (Q).

5.Connect the positive poles of the cells to the terminal at the zero ends (P) and the negative poles to the terminals a and b of the two-way key.

6.Connect the common terminal c of the two-way key through a galvanometer (G) and a resistance box to the jockey J.

7.Take maximum current from the battery by making the rheostat resistance zero.

8.Insert the plugin, the one-way key through the resistance box and the galvanometer to the jockey J.

9.Take out the 2000 Ω plug from the resistance box.

10. Note down the direction of the deflection in the galvanometer by pressing the jockey at zero ends.

11. Now, press the jockey at the other end of the potentiometer wire. If the deflection is in the opposite direction to that in the first case, the connections are correct.

12. Push the jockey smoothly over the potentiometer up to a point where the galvanometer shows no deflection.

13.Put the 2000 Ω plug back into the resistance box and obtain the null point position accurately with the help of the set square.

14. Note the length l_1 of the wire for the cell E_1.

15. Note the current as indicated by the ammeter.

16.Disconnect the cell E1 from the plug

17.Connect E2 by inserting the plug into the gap of the two-way key.

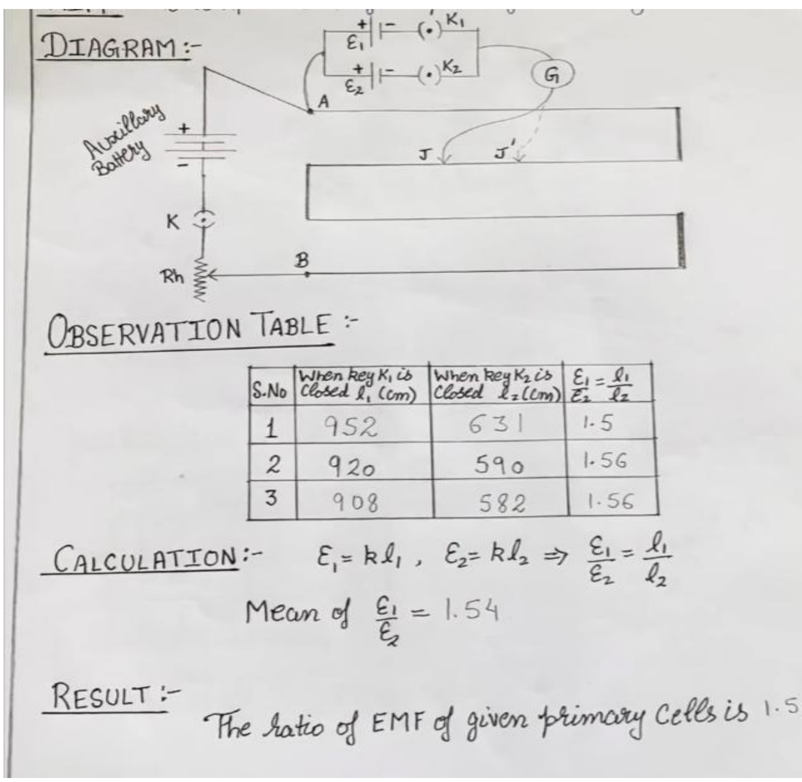
18.Take out a 2000 ohms plug from the resistance box and slide the jockey along the potentiometer wire and obtain no deflection position.

19.Put 2000 ohms plug back in the RB and obtain null for E2.

20. Note the length L2 of wire in this position for the cell E2.

21. By increasing the current and adjusting the rheostat, we get three sets of observations

Observation



OBSERVATION TABLE :-

S.No	When key K_1 is Closed l_1 (cm)	When key K_2 is Closed l_2 (cm)	$\frac{\mathcal{E}_1}{\mathcal{E}_2} = \frac{l_1}{l_2}$
1	952	631	1.5
2	920	590	1.56
3	908	582	1.56

CALCULATION :- $\mathcal{E}_1 = kl_1$, $\mathcal{E}_2 = kl_2 \Rightarrow \frac{\mathcal{E}_1}{\mathcal{E}_2} = \frac{l_1}{l_2}$

Mean of $\frac{\mathcal{E}_1}{\mathcal{E}_2} = 1.54$

RESULT :- The ratio of EMF of given primary Cells is 1.5