EXP-1

AIM

To determine the frequency of alternating current using a sonometer and an electromagnet.

APPARATUS AND MATERIAL REQUIRED

A sonometer with a soft iron wire stretched over it, an electromagnet or a strong magnet, a step-down transformer, slotted 1/2 kg weights hanger, a digital balance, two sharp edge wedges and a weight box

PRINCIPLE

The frequency n of the fundamental mode of vibration of a stretched string, fixed at two ends, is given by

$$n = \frac{1}{2l}\sqrt{\frac{T}{m}}$$

If an alternating current is passed in the coil of the electromagnet, the magnetisation produced in the core is proportional to instantaneous value of the current. If the electromagnet is held close to the middle of the sonometer wire, the wire will be attracted twice during each cycle towards the electromagnet. The attractive force experienced by the wire will be proportional to the magnetisation produced in the core of the electromagnet. Since in each cycle, the wire will be pulled twice and hence at resonance, it will vibrate with a frequency which is twice the frequency of alternating current. Hence, if f is the frequency of the alternating current, then

$$f = \frac{n}{2} = \frac{1}{4l}\sqrt{\frac{T}{m}}$$

PROCEDURE

1. Set up the sonometer and stretch the wire by placing a load of kg on the hanger.
2.Place the magnet under the wire
3. Switch on the alternating current supply and adjust the length of vibrating portion . Make this adjustment until the amplitude of the vibrating string is maximum.
4. Measure the vibrating length and note the tension in the string.
5. Increase the load in steps of kg and each time find the vibrating length.
6. Switch off the ac supply. Untie the wire of the sonometer from its peg and find its mass in a physical balance. Hence find the mass per unit length, m for the wire.

OBSERVATIONS1. Length of the wire = ... m **2.** Mass of the wire =...kg **3**. Mass per unit length, m =...kg/m
4. Acceleration due to gravity, g = ...ms^{-2}

S.NO.	LOAD(M) INCLUDING MASS OF HANGER	TENSION, T = mg (N)	RESONANT LENGTH (l) in (m)	$n = \frac{1}{2l}\sqrt{\frac{T}{m}}$
1				
2				

RESULT:
Frequency of a.c. supply f=n/2=….

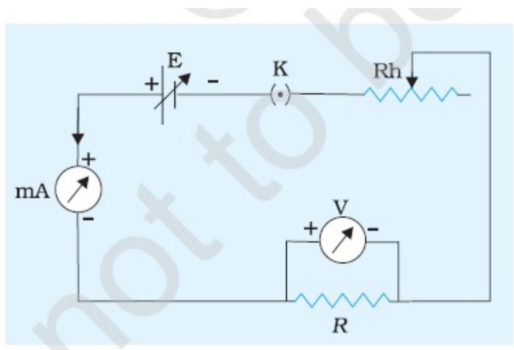
PRECAUTIONS 1. Pulley should be as frictionless as possible. 2. Edges of the wedge should be sharp.

EXP-2

AIM
To determine resistance per unit length of a given wire by plotting a graph of potential difference versus current

APPARATUS AND MATERIAL REQUIRED
A wire of unknown resistance ,battery eliminator, voltmeter,milliammeter (0 – 500 mA), rheostat, plug key, Connecting wires and a piece of sand paper.

PRINCIPLE
Ohm's law states that the electric current flowing through a conductor is directly proportional to the potential difference across its ends, provided the physical state of the conductor remains unchanged.i.e., V =IR
A linear relationship is obtained between *V* and *I*, i.e. the graph between *V* and *I* will be a straight line passing through the origin . The slope of the graph is 1/*R* (Equation of straight line passing through origin is $y = mx$ where *m* is the slope of graph).



PROCEDURE
1.Connect various components - resistance, rheostat, battery, key,voltmeter and ammeter as shown in Fig.
2.Note the range and least count of the given voltmeter and milliammeter.
3.Insert the key K and slide the rheostat contact to one of its extreme ends, so that current passing through the resistance wire is minimum.
4. Note the milliammeter and voltmeter readings.
5.Remove the key K and allow the wire to cool, if heated. Again insert the key. Shift the rheostat contact slightly to increase the applied voltage. Note the milliammeter and voltmeter reading.

OBSERVATIONS
1. Range of ammeter = ... mA to ...mA
2. Least count of ammeter = ... mA
3. Range of voltmeter = ... V to ...V
4. Least count of voltmeter = ...V
5. Least count of metre scale = ... m
6. Length of the given wire, *l* = ...m

S.NO	VOLTMETER READING (V) Volt	CURRENT (I) mA

CALCULATIONS
1.. The resistance of the given wire is equal to the reciprocal of the slope.
From the graph R =
3. Resistance per unit length of given wire $=\frac{R}{l} = \cdots \ldots\ ohm/m$

RESULT
1. The potential difference across the given wire varies linearly with the current.
2. The resistance per unit length of the wire is = …….ohm/m

PRECAUTIONS
1. The voltmeter should be connected in parallel and the ammeter in series with the circuit. It should be ensured that current enters at the positive terminal and leaves at the negative terminal.
2. The key should be inserted only while taking observations, asexcessive flow of current causes unnecessary heating of the wire.

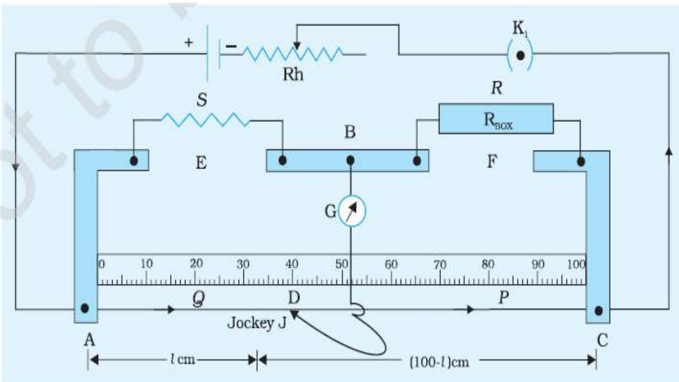
EXP-3

AIM

To determine the resistance of a given wire using a metre bridge and hence determine the resistivity of the material.

APPARATUS AND MATERIAL REQUIRED

Metre bridge, a wire , a resistance box, a rheostat,galvanometer, a jockey, one-way key, a cell or battery eliminator,
thick connecting wires, sand paper, screw gauge.



PRINCIPLE

A metre bridge works on the principle of Wheatstone's bridge

When bridge is balanced then $\boldsymbol{S = R\frac{l}{100-l}}$

Resistivity is $\rho = \frac{RA}{l}$

PROCEDURE

1. Set up the circuit as shown in Fig. with unknown resistance wire of known length in gap E.
2. Next, introduce some resistance *R* in the circuit from the resistance box. Bring the jockey J in contact with terminal A first and then with terminal C. Note the direction in which pointer of the galvanometer gets deflected in each case. Make sure that jockey remains in contact with thewire for a fraction of a second.
3. Repeat step 2 for four different values of resistance *R.*

OBSERVATIONS

1-Length of the wire , l = ……………m
2-Radius of the wire, r = …………m

S.No.	Resistance (R)	Balancing length(l)	100-l	Unknown resistance(s)
1				
2				
3				

CALCULATIONS

Average S =
Area of the wire = $\pi r^2 =$
Resistivity $\rho = \frac{RA}{l}$=……….

RESULT

Unknown resistance S =
Resistivity $\rho =$

PRECAUTIONS AND SOURCES OF ERROR

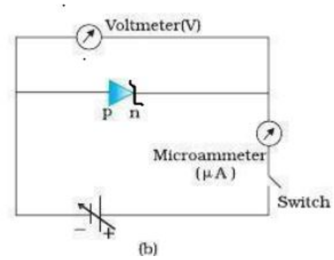
1. All the connections and plugs should be tight.
2. Jockey should be moved gently over the metre bridge wire.
3. The plug in the key (K_1) should be inserted only at the time of taking observations.
4. Null points should be in the middle of the wire (30 cm to 70 cm).
5. The length *L* of the wire should not include the lengths below the terminals when placed in gap E or F.

EXP-4

AIM:
To draw characteristics of zener diode and to determine its reverse breakdown voltage

APPARATUS REQUIRED:
Zener diode apparatus containing Zenerdiode,voltmeter,ammeter and rheostat.

THEORY:
A Zener Diode is a heavily doped pnjunntion diode opertaes in the reverse breakdown region.
After reaching a certain voltage, called the breakdown voltage, the current increases widely even for a small change in voltage. However, there is no appreciable change in voltage. So, when we plot the graph, we should get a curve very near to x-axis and almost parallel to it for quite sometime. After the Zener potential Vz there will be a sudden change and the graph will become exponential.



PROCEDURE:
1.Draw a neat circuit diagram as shown in figure. Connect all the components by leads and ensure that the Zener diode is reverse biased.
2.Switch on the power supply and gradually increase the potential difference applied across the Zener diode and note the reading of potential difference from voltmeter also note corresponding value of reverse current in milliammeter.
3.Continue increasing the potential difference till you get a sudden increase in the reverse current in microammeter.
4.Record all the observations.
5.Plot the graph between V and I as shown.
6.Mark on the graph the value of Breakdown Voltage or Zener Voltage Vz as shown. Take the value of V, corresponding to I, where it suddenly increases. This value of V, is called Zener voltage or Breakdown voltage Vz.

OBSERVATIONS:

VOLTAGE(V)	CURRENT(mA)

RESULT:
The characteristic curve of the given Zener is plotted as shown in the graph.
The reverse breakdown voltage of the given Zener Diode is ……………V

PRECAUTIONS AND SOURCES OF ERROR

1- The Zener diode should be connected in reverse bias.
2- Zero error if any in the voltmeter or milliammeter should kept nil.

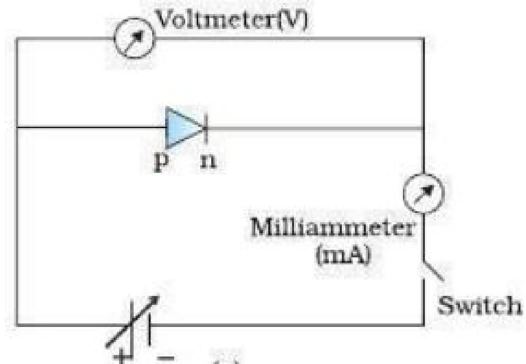
EXP-5

AIM:
To draw I-V characteristics curve of a P-N junction in forward bias and reverse bias.

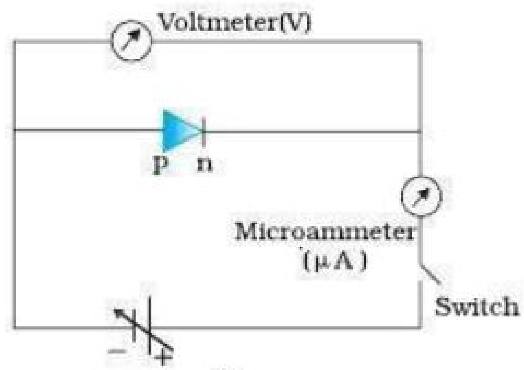
MATERIALS REQUIRED
Diode Characteristics Kit , Power Supply, Ammeter (0-20mA), Voltmeter (0-20V), Connecting Leads.

THEORY:
A P-N junction is known as Semiconductor diode or Crystal diode. It is the combination of P-type & N-type Semiconductor. Which offers Nearly zero resistance to current on forward biasing & nearly infinite Resistance to the flow of current when in reverse biased.

PROCEDURE
(1) Connect the ckt. as shown in fig. (a) for forward bias (b) for reverse bias
(2)Switch on the power supply.
(3)Vary the value of input dc supply in steps.
(4)Note down the ammeter & voltmeter readings for each step.
(5)Plot the graph of Voltage Vs Current



(a)



(b)

OBSERVATIONS:
1. Range of ammeter = 0 ... mA to ...mA
2. Least count of ammeter = ... mA
3. Range of voltmeter = 0 ... V to ...V
4. Least count of voltmeter = ...V

FORWARD-BIAS

S.NO.	VOLTAGE(V)	CURRENT(mA)

REVERSE-BIAS

S.NO.	VOLTAGE(V)	CURRENT(μA)

RESULT:
The graph has been plotted between voltage and current.

PRECAUTIONS AND SOURCES OF ERROR
1. All the connections and plugs should be tight.
2. Switch on the circuit after connecting all the leads.

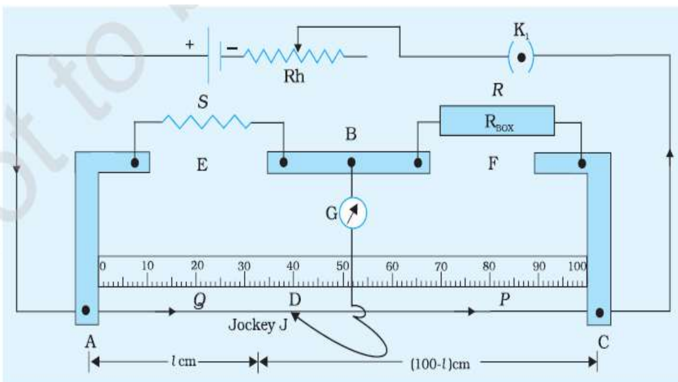
EXP-6

AIM

To verify the law of series combination using a metre bridge

APPARATUS AND MATERIAL REQUIRED

Metre bridge, a wire , a resistance box, a rheostat,galvanometer, a jockey, one-way key, a cell or battery eliminator,
thick connecting wires, sand paper, screw gauge.



PRINCIPLE

A metre bridge works on the principle of Wheatstone's bridge

When bridge is balanced then $S = R\frac{l}{100-l}$

Equivalent resistance in series is given by $R = R_1 + R_2$

PROCEDURE

1. Set up the circuit as shown in Fig. with unknown resistance wire of known length in gap E.
2. Next, introduce some resistance *R* in the circuit from the resistance box. Bring the jockey J in contact with terminal A first and then with terminal C. Note the direction in which pointer of the galvanometer gets deflected in each case. Make sure that jockey remains in contact with thewire for a fraction of a second.
3. Repeat step 2 for four different values of resistance *R.*
*4.*Then find the resistance of other wire.

OBSERVATIONS

1-For Wire A

S.No.	**Resistance (R)**	**Balancing length(l)**	**100-l**	**Unknown resistance(s)**
1				
2				

2-For Wire B

S.No.	**Resistance (R)**	**Balancing length(l)**	**100-l**	**Unknown resistance(s)**
1				
2				

CALCULATIONS

Average Resistance of wire A =

Average Resistance of wire B =

Theoretical value of equivalent resistance is =

Practical value of equivalent resistance is =

Percentage error = $\frac{Practical\ valu\quad Theoretica\ \ value}{Theoretical\ value} \times 100 =$

RESULT

Theoretical value is nearly equal to practical value hence Law of series combination is verified

PRECAUTIONS AND SOURCES OF ERROR

1. All the connections and plugs should be tight.
2. Jockey should be moved gently over the metre bridge wire.

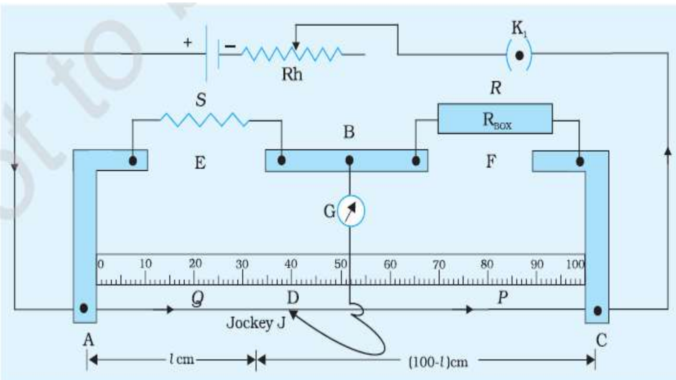
EXP-7

AIM

To verify the law of Parallel combination using a metre bridge

APPARATUS AND MATERIAL REQUIRED

Metre bridge, a wire , a resistance box, a rheostat,galvanometer, a jockey, one-way key, a cell or battery eliminator,
thick connecting wires, sand paper, screw gauge.



PRINCIPLE

A metre bridge works on the principle of Wheatstone's bridge

When bridge is balanced then $\boldsymbol{S = R\frac{l}{100-l}}$

Equivalent resistance in series is given by $\boldsymbol{R = \frac{R_1R_2}{R_1+R_2}}$

PROCEDURE

1. Set up the circuit as shown in Fig. with unknown resistance wire of known length in gap E.
2. Next, introduce some resistance *R* in the circuit from the resistance box. Bring the jockey J in contact with terminal A first and then with terminal C. Note the direction in which pointer of the galvanometer gets deflected in each case. Make sure that jockey remains in contact with thewire for a fraction of a second.
3. Repeat step 2 for four different values of resistance *R.*
*4.*Then find the resistance of other wire.

OBSERVATIONS

1-For Wire A

S.No.	Resistance (R)	Balancing length(l)	100-l	Unknown resistance(s)
1				
2				

2-For Wire B

S.No.	Resistance (R)	Balancing length(l)	100-l	Unknown resistance(s)
1				
2				

CALCULATIONS

Average Resistance of wire A =

Average Resistance of wire B =

Theoretical value of equivalent resistance is =

Practical value of equivalent resistance is =

Percentage error = $\frac{Practical\ value - Theoretical\ value}{Theoretical\ value} \times 100 =$

RESULT

Theoretical value is nearly equal to practical value hence Law of Parallel combination is verified.

PRECAUTIONS AND SOURCES OF ERROR

1. All the connections and plugs should be tight.
2. Jockey should be moved gently over the metre bridge wire.
3. The plug in the key (K_1) should be inserted only at the time of taking observations.

EXP-8

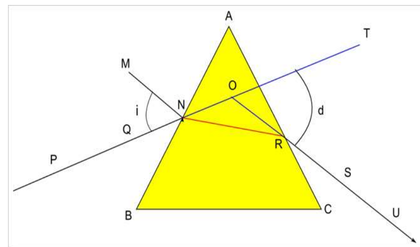
AIM: a) To determine angle of minimum deviation for a given prism by plotting graph between angle of incidence and angle of deviation.
b) To determine refractive index of material of prism.
Requirements: Drawing board, a white sheet of paper, prism, drawing pins, pencil, half meter scale, office pins, graph paper and a protractor.
Theory: For angle of deviation

$$\delta = (i - r) + (e - r') = i + e - A$$

At the position of the prism for minimum deviation δm, the light ray passes through the prism symmetrically, i.e. parallel to the base so that when δ = Dm, i = e which implies r = r′.

The refractive index of the material of the prism is given by $n_{21} = \frac{sin\left(\frac{A+Dm}{2}\right)}{sin\left(\frac{A}{2}\right)}$

Procedure: Fix the drawing sheet on the drawing board using drawing pins,keep the prism on the paper and trace the prism.The trace will give us a triangle ABC.



AB reflecting surface , AC refracting surface and BC is the base of the prism.Draw a normal line MN to the reflecting surface at N.Drawa incident line PQ making some angle (>30degrees) with the normal line MN.Now place the prism on its trace along ABC.Fix two pins on the incident ray at two points P and Q .Now observing through the face AC two pins S and U are fixed so that these two pins at S and U will be in the line with P and Q.Remove the prism join the points S and U with a st line which meets the face AC at R.Extend the incident ray PQ forward and emergent ray SU backwards till the meet at O.Measure the $\angle TOR = d$.
Repeat the experiment in the above said procedure for various angles of incidences i.e 35,40,45,50,55 ……. and measure the respective angles of deviations d1,d2,d3,d4,d5….. record these values in the table.

OBSERVATION

S.N.	ANGLE OF INCIDENCE	ANGLE OF DEVIATION
1	35	
2	40	
3	45	
4	55	
5	60	

Angle of Prism = ……..

RESULT :

Angle of minimum deviation, Dm = ……………….

Refractive index of material of prism ,$n_{21} = \frac{sin\left(\frac{A+Dm}{2}\right)}{sin\left(\frac{A}{2}\right)}$ =………………………….

PRECAUTIONS:
(i) Pins should be fixed perfectly vertical
(ii)while fixing the pins in line with the refractive or reflective images of incident rays care should be taken for the parallax error.

EXP-9

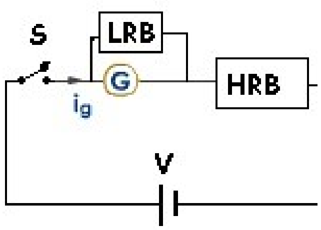
AIM: TO DETERMINE RESISTANCE OF GALVANOMETER BY HALF DEFLECTION METHOD AND TO FIND ITS FIGURE OF MERIT

MATERIAL REQUIRED: A moving coil galvanometer, a battery or a battery eliminator (0 - 6 V), one resistance box (R-BOX 1) of range 0-10kΩ, one resistance box(R-BOX 2) of range 0-200Ω, 2 one way keys, voltmeter, connecting wires and a piece of sand paper.

THEORY: Galvanometer is a sensitive device used to detect very low current. Its working is based on the principle that a coil placed in a uniform magnetic field experiences a torque when an electric current is set up in it. The deflection of the coil is determined by a pointer attached to it, moving on the scale. When a coil carrying current I is placed in a radial magnetic field, the coil experiences a deflection θ which is related to I as **I=kθ**

where k is a constant of proportionality and is termed as figure of merit of the galvanometer.

Resistance of galvanometer is given by $R_G = \frac{RS}{R-S}$



PROCEDURE:

1. Clean the connecting wires with sand paper and make neat and tight connections as per the circuit diagram

2. From the high resistance box (R-BOX 1) (1-10 kΩ), remove keys and then close the key K1. Adjust the resistance R from this resistance box to get full scale deflection on the galvanometer dial. Record the values of resistance, R and deflectionθ.

3. Insert the key K2 and keep R fixed. Adjust the value of shunt resistance S to get the deflection in the galvanometer which is exactly half of θ. Note down S. Remove plug K2 after noting down the value of shunt resistance, S.

4. Take five sets of observations by repeating steps 2 and 3 so that θ is even number of divisions and record the observations for R, S, θ and 2 in tabular form.

5. Calculate the galvanometer resistance G and figure of merit k of galvanometer using Equations.

OBSERVATIONS

Emf of the battery E =.....V

Number of divisions on full scale of galvanometer = ...

S.NO.	R	DEFLECTION, θ	HALF DEFLECTION, θ/2	SHUNT(S)	$R_G = \frac{RS}{R-S}$
1					
2					
3					

Figure of merit $k = \frac{E}{\theta(R+R_G)}$

RESULT:

1. Resistance of galvanometer by half deflection method, G = ... Ω
2. Figure of merit of galvanometer, k = ...ampere/division

PRECAUTIONS AND SOURCES OF ERROR

1. All the connections and plugs should be tight.
2. Galvanometer should not be connected directly with the battery.

EXP-10

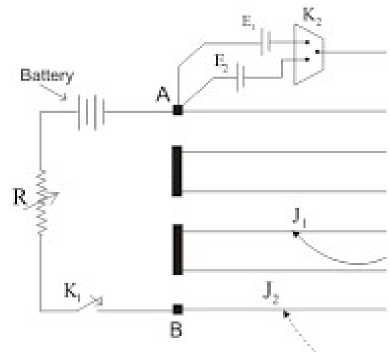
AIM: To compare EMF's of 2 given primary cells using potentiometer.

Requirements: Potentiometer, battery, two one way key, rheostat of low resistance, galvanometer, high resistance box, fractional resistance box, ammeter, voltmeter, a cell, jockey, connecting wires etc.

Theory: The internal resistance of a cell is given by $\frac{E_1}{E_2} = \frac{l_1}{l_2}$

E_1emf of primary cell 1, l_1 is the balancing length for cell 1
E_2emf of primary cell 2 ,l_2 is the balancing length for cell 2

Procedure:



1. The connections are made as shown in the circuit diagram. The circuit is checked for opposite side deflections.
2. Using DPDT switch the Leclanche cell is included in the secondary circuit. The jockey is pressed on the potentiometer wire.
3. The point (J) where the galvanometer wire shows full scale deflection is noted.
4. The balancing lengthl$_1$ is measured.
5. Using DPDT switch the Daniel cell is included in the secondary circuit.
6. The above steps are repeated and the balancing length l2 is measured.
7. By varying the rheostat values l1, l2 are measured and the readings are tabulated.
8. The ratio of emf of the given two primary calls are calculated using the formula

Observations:

S.NO	CELL E_1 BALANCE POINT l_1	CELL E_2 BALANCE POINT l_2	$\frac{E_1}{E_2} = \frac{l_1}{l_2}$
1			
2			
3			

RESULT:

Mean: $\frac{E_1}{E_2} =$

PRECAUTIONS AND SOURCES OF ERROR

1. All the connections and plugs should be tight.
2. Don't slide the jockey over the wire.

EXP-11

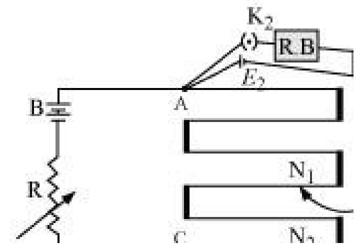
AIM: To determine the internal resistance of a given primary cell using potentiometer

Requirements: Potentiometer, battery, two one way key, rheostat of low resistance, galvanometer, high resistance box, fractional resistance box, ammeter, voltmeter, a cell, jockey, connecting wires etc.

Theory: The internal resistance of a cell is given by

$r = \frac{l_1 - l_2}{l_2} R$

Procedure:



1. Connect different electrical components as shown in the circuit.
2.Make all the connections tight.
2.With Keys K1 close and k2 open find the balancing length l_1.
3.Now close Key K_2 and remove some resistance from R.B. find the balancing length l_2.
4.Now find the internal resistance of the cell using the formula

$$r = \frac{l_1 - l_2}{l_2} R$$

observations:

S.NO.	SHUNT RESISTANCE,R	BALANCING LENGTH IN OPEN CIRCUIT , l_1	BALANCING LENGTH IN CLOSED CIRCUIT , l_2	INTERNAL RESISTANCE, $r = \frac{l_1 - l_2}{l_2} R$
1				
2				
3				

Calculations:

Mean internal resistance = …

Result:

The internal resistance of the given cell r =

PRECAUTIONS AND SOURCES OF ERROR

1. All the connections and plugs should be tight.
2. Don’t slide the jockey over the wire.

EXP-12

AIM: To study characteristics of a common emitter N-P-N Transistor and to find current gain

Requirements: n-p-n transistor apparatus

Theory: An NPN transistor can be considered as two diodes with a shared anode region.In typical operation, the emitterbase junction is forward biased and the base collector junction is reverse biased. The electrons in the base are called minority carriers because the base is doped p-type which would make holes the majority carrier in the base.The base region of the transistor must be made thin, so that carriers can diffuse across it in much less time than the semiconductor's minority carrier life-time, to minimize the percentage of carriers that recombine before reaching the collector base junction.

Procedure:

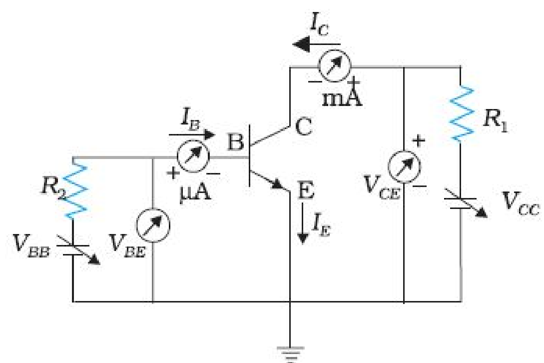
1-Connect the circuit as shown in the figure

2-Fix V_{ce} and find the values of I_B and V_{BE}

3-Then fix I_B and find the values of V_{CE} and I_C

4-Plot the input characteristics i.e., between I_B and V_{BE}

5-Plot the output characteristics i.e., between V_{CE} and I_C.



OBSERVATIONS:

1. Range of ammeter = 0 ... mA to ...mA
2. Least count of ammeter = ... mA
3. Range of voltmeter = 0 ... V to ...V
4. Least count of voltmeter = ...V

1-Input Characteristics(V_{CE} = …….)

V_{BE}(V)	I_B

2-Output Characteristics(I_B = …….)

V_{CE}(V)	I_C

RESULT: Input and output characteristics are as plotted in the graph.

Current gain $\beta_{ac} = \frac{\Delta I_C}{\Delta I_B} =$

PRECAUTIONS AND SOURCES OF ERROR

1. Do not plug in the power supply while making connections.
2. Zero error if any in the voltmeter or milliammeter should kept nil.

EXP-13

AIM: To find focal length of a convex lens by plotting graph between 1/u and 1/v

REQUIREMENTS: An optical bench with three uprights (central upright fixed, two outer uprights with lateral movement), a convex lens with lens holder, two optical needles, (one thin, one thick) and a meter scale.

THEORY: The relation between u, v and f for a convex lens is $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

PROCEDURE:

1- Place the optical bench on a rigid table or on a platform, and using the spirit level, make it horizontal with the help of leveling screws provided at the base of the bench.

2- . Clamp the convex lens on an upright and mount it vertically almost near to the middle of the optical bench such that its principal axis is parallel to the optical bench. In this position, the lens would lie in a plane perpendicular to the optical bench.

3- Place the object needle on one side and image needle on another side and correct the parallax.

4- Note the object distance and image distance.

OBSERVATIONS:

(A) Determination of Bench Correction

Length of the knitting needle l =............ cm.

Observed separation between the lens and object-pin O on optical benched scale when they are separated by l, i.e. l_1 = ... cm.

Observed separation between the lens and the image-pin when they are separated by l, i.e. l_2 = ...cm.

Bench correction for object distance $x = (l - l_1)$ cm. Bench correction for image distance $y = (l - l_2)$ cm.

(B) Rough focal length of the mirror

f_1 = ... cm, ... cm, ...cm.

Mean value of rough focal length = ... cm.

(C) Observations for u and v

Sl. No.	Position of			Object distance		Image distance		1/u	1/v
	Lens O cm	Object Needle A cm	Image Needle A' cm	Observed Value OA cm	Corrected value OA' cm	Observed value OA' cm	Corrected value OA' cm	m^{-1}	m^{-1}
1.									
2.									
3.									
4.									
5.									
6.									

CALCULATIONS:

The graph between 1/u and 1/v is shown in Fig. 14.3. x-coordinate of point C,

OC = = ... m^{-1} $f = \frac{1}{OC} m = a$

y-coordinate of point D, OD = ... m^{-1}

$f = \frac{1}{OD} m = b$

Mean $f = \frac{a+b}{2}$ m

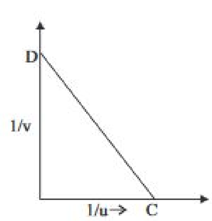


Fig. 14.3

RESULT:

(i) Graph between $\frac{1}{u}$ and $\frac{1}{v}$ is a straight line with a slope = –1 (because $a \approx b$)

(ii) Focal length of the given convex lens f = ... cm.

PRECAUTIONS AND SOURCES OF ERROR:

1-Make sure to correct parallax before taking any reading

2-optical bench should be placed in horizontal level.

3-Lens has some thickness which has been ignored in this experiment

EXP-14

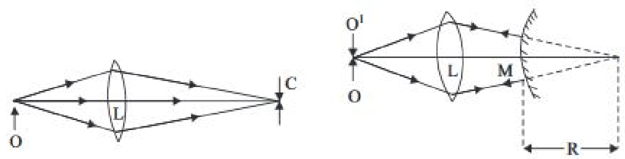
AIM: To find focal length of a convex mirror using convex lens

REQUIREMENTS: An optical bench with three uprights (central upright fixed, two outer uprights with lateral movement), a convex lens with lens holder,a convex mirror , two optical needles, and a meter scale.

THEORY: Half the distance of radius of curvature will be the focal length of convex mirror

PROCEDURE:

1- Place the optical bench on a rigid table or on a platform, and using the spirit level, make it horizontal with the help of leveling screws provided at the base of the bench.
2- . Clamp the convex lens on an upright and mount it vertically almost near to the middle of the optical bench such that its principal axis is parallel to the optical bench. In this position, the lens would lie in a plane perpendicular to the optical bench.
3- Place the object needle on one side and convex mirror on another side of convex lens and correct the parallax.



4- Now remove the convex mirror and place the image needle in place of it .Again correct the parallax
5- Measure the distance between the marked position of convex mirror and the image needle .This will be the radius of curvature of the convex mirror and its half will be the focal length. i.e., $f = \frac{MI}{2}$

OBSERVATIONS:

(i) Approximate focal length of the convex lens f_1

= (i) .... cm, (ii) .... cm, (iii) .... cm

Mean value of f_1 = ... cm

(ii) Real length of the knitting needle l = ... cm.

Observed length of the knitting needle between convex mirror M and image needle I, l_1 = ... cm.

Index correction $x = (l - l_1)$= .... cm.

(iii) Measurement of Radius of curvature of the mirror.

S.No.	Position of upright at				Observed radium R_1 (cm)	Corrected $R = R_1 + x$ (cm)
	O (cm)	L (cm)	M (cm)	I (cm)		
1.						
2.						
3.						
4.						
5.						

Mean R = ... cm

RESULT:

Mean focal length of the convex mirror $f = \frac{R}{2}$ =............ cm

PRECAUTIONS AND SOURCES OF ERROR:

1-Make sure to correct parallax before taking any reading
2-optical bench should be placed in horizontal level.

EXP-15

Aim

To find the refractive index of a liquid by using convex lens and plane mirror.

Apparatus

A convex lens, a plane mirror, clean transparent liquid in a beaker, an optical needle, (a thick knitting needle passed through a rubber cork), an iron stand with base and clamp arrangement, plumb line, plane glass slab, a spherometer, half metre scale etc.

Theory

If f_1 and f_2 be the focal length of glass convex lens and liquid lens and F be the focal length of their combination then,

$$\frac{1}{F}=\frac{1}{f_1}+\frac{1}{f_2} \quad \text{or} \quad \frac{1}{f_2}=\frac{1}{F}-\frac{1}{f_1}$$

Liquid lens formed is a planoeconcave lens with $R_1 = R$ (radius of curvature of convex lens surface), $R_2 = \infty$

From lens maker's formula

$$\frac{1}{f_2}=(n-1)\left[\frac{1}{R_1}-\frac{1}{R_2}\right]$$

We have,

$$\frac{1}{f_2}=\frac{(n-1)}{R} \quad \text{or} \quad n=1+\frac{R}{f_2}$$

Putting value of f_2, n can be calculated.

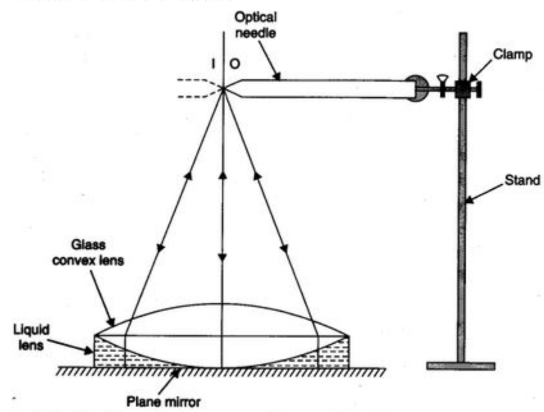


Fig. Focal length of glass convex lens and liquid lens combination.

Procedure

(a) For focal length of convex lens

1. Take any one convex lens and find its rough focal length.
2. Take a plane mirror and place it on the horizontal base of the iron stand.
3. Place the convex lens on the plane mirror.
4. Screw tight the optical needle in the clamp of the stand and hold it horizontally above the lens at distance equal to its rough focal length.
5. Bring the tip of the needle at the vertical principal axis of the lens, so that tip of the needle appears touching the tip of its image.
6. Move the needle up and down and remove parallax between tips of the needle and its image.
7. Measure distance between tip and upper surface of the lens by using a plumb line and half metre scale.
8. Also measure distance between tip and the surface of its plane mirror.

(b) For focal length of the combination

1. Take a few drops of transparent liquid on the plane mirror and put the convex lens over it with its same face above as before (A piano concave liquid lens is formed between plane mirror and convex lens).
2. Repeat steps 6, 7 and 8.
3. Record your observations as given below.

Observations

1. Rough focal length of convex lens =……… cm.
2. **Table for distance of needle tip from lens and mirror**

Arrangement	*Distance of needle tip*			*Focal length x (cm)*
	From lens surface x_1 (cm)	*From plane mirror x_2 (cm)*	*Mean $x = \frac{x_1 + x_2}{2}$ (cm)*	
(1)	*(2a)*	*(2b)*	*(2c)*	*(3)*
Without liquid				f_1 = ...
With liquid				F = ...

Radius of curvature

R = ... cm.

Calculations

$$\frac{1}{f_2} = \frac{1}{F} - \frac{1}{f_1},$$

$$n = 1 + \frac{R}{f_2}$$

Precautions

1. The liquid taken should be transparent.
2. Only few drops of liquid should be taken so that its layer is not thick.
3. The parallax should be removed tip to tip.