1.RESISTANCE PER UNIT LENGTH

20/01/2020

AIM:

Determination of resistance per unit length.

PRINCIPLE:

Ohm's Law: The electric current flowing through a conductor is directly proportional to the potential difference across the ends of the conductor when temperature and other physical conditions remains constant.

FORMULA:

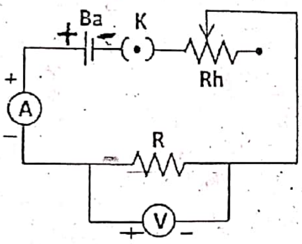
1) Resistance of the wire, $R = \frac{1}{m}$ ....Ω

   Where R- resistance of the wire, m- slope of the graph of current versus potential difference.

2) Resistance per unit length $= \frac{R}{L}$...........Ωm^{-1}.

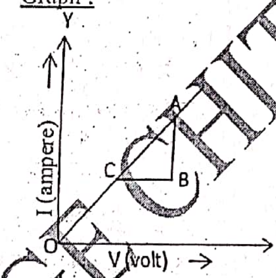
   where L- length of the experimental wire.

CIRCUIT DIAGRAM:



Ba - Battery
K - Key
Rh - Rheostat
V - Voltmeter
A - Ammeter
R - Resistance wire

Graph :



OBSERVATION:

Length of the wire, L =..........m

TABULAR

Trial No.	V in volt	I in Ampere
1.		
2.		
3.		
4.		
5.		

CALCULATION:

1. Resistance of the wire, $R = \frac{1}{m} = \frac{CB}{AB}$ = ...Ω
2. Resistance per unit length= $\frac{R}{L}$...........Ωm^{-1}.

RESULT:

Resistance per unit length of given wire =..............Ωm^{-1}

2. RESISTIVITY OF THE MATERIAL OF THE WIRE

AIM:

Determination of resistance of a given wire using metre bridge and hence to find resistivity of the material of the wire .

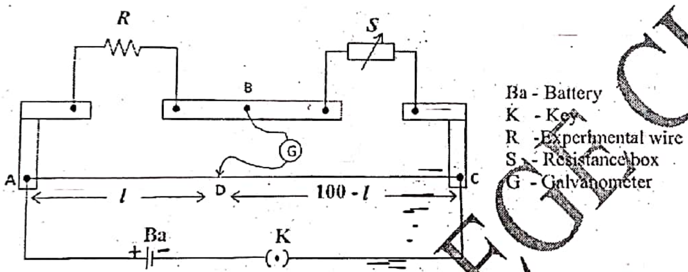
PRINCIPLE:

1. Wheatstone's bridge is balanced when current through the galvanometer is zero.
2. If P, Q, R & S represent the resistances of four arms of Wheatstone's bridge, then $\frac{P}{Q} = \frac{R}{S}$

FORMULA:

1) Resistance of the wire, $R = \frac{Sl}{(100-l)}$ ....Ω
   where S – Standard resistance , l – the balancing length in cm
2) Resistivity of the material of the wire, $\rho = \frac{\pi r^2 R}{L}$...........Ωm
   where R- resistance of the wire, L- length of the experiment wire.
   r- radius of the wire .

DIAGRAM:



OBSERVATION:

1. Radius of the experimental wire(given), r =...........m
2. Length of the experimental wire, L = ...m.

TABULAR

Trial No.	Resistance S in Ω	Balancing length l in cm	$(100 - l)$ in cm	$R = \frac{Sl}{(100-l)}$ in Ω
1.				
2.				
3.				

Mean R =.................. Ω

CALCULATION:

1. $R = \frac{Sl}{(100-l)}$ ....Ω
2. $\rho = \frac{\pi r^2 R}{L}$...........Ωm.

RESULT:

Resistivity of the material of the wire, ρ =...............Ωm

3(A).SERIES COMBINATION

AIM:

a)Verification of the law of combination of resistances in series using metre bridge.

PRINCIPLE

1. Wheatstone's bridge is balanced when current through the galvanometer is zero.
2. If P, Q, R and S represent the resistances of four arms of Wheatstone's bridge, then $\frac{P}{Q} = \frac{R}{S}$

FORMULA:

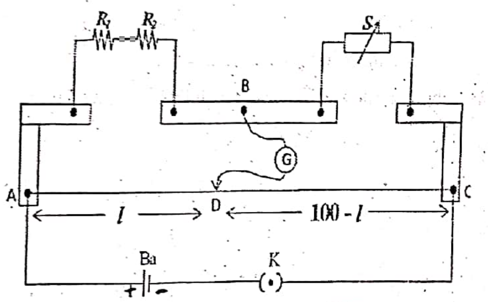
1) Resistance of the wire, $R_s = \frac{Sl}{(100-l)}$ ....Ω

where S – Standard resistance , l- the balancing length in cm

2) Equivalent resistance in series, $R_s = R_1 + R_2$........Ω

Where R_1 & R_2 – Individual resistances

DIAGRAM:



Ba - Battery
K - Key
R_1 & R_2 – Individual resistors
S - Resistance box
G - Galvanometer

OBSERVATION:

1) Resistance, R_1 = ...Ω
2) Resistance, R_2 = ...Ω

TABULAR COLUMN:

Trial No.	Resistance S in Ω	Balancing length l in cm	$(100 - l)$ in cm	$R_s = \frac{Sl}{(100-l)}$ in Ω
4.				
5.				
6.				

CALCULATION:

1. $R_s = \frac{Sl}{(100-l)}$ ....Ω
2. R_s(Theoretically) = $R_1 + R_2$............Ω

RESULT:

- The experimental value of resistance R_s = ...Ω
- Theoretical value of resistance R_s = ...Ω
- Theoretical value of resistance (R_s) is equal or nearly equal to experimental value of resistance (R_s). Hence the law combination of resistance in series is verified.

3.(B) PARALLEL COMBINATION

AIM:

b) Verification of the law of combination of resistances in parallel using metre bridge.

PRINCIPLE

1. Wheatstone's bridge is balanced when current through the galvanometer is zero. If P, Q, R & S represent the resistances of four arms of Wheatstone's bridge, then $\frac{P}{Q} = \frac{R}{S}$

FARMULA:

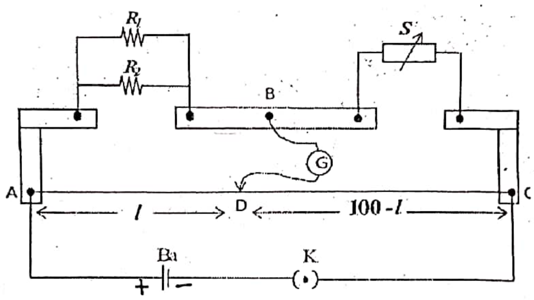
1) Resistance of the wire, $R_p = \frac{Sl}{(100-l)}$ ....Ω

where S – Standard resistance , l- the balancing length in cm

2) Equivalent resistance in parallel, $R_p = \frac{R_1 R_2}{R_1 + R_2}$......$\Omega$

$Where\ R_1$ & R_2 – Individual resistances

DIAGRAM:



Ba - Battery
K - Key
R_1 & R_2 – Individual resistors
S - Resistance box
G - Galvanometer

OBSERVATION:

1) Resistance, R_1 = ...Ω
2) Resistance, R_2 = ...Ω

TABULAR COLUMN:

Trial No.	Resistance S in Ω	Balancing length l in cm	$(100 - l)$ in cm	$R_p = \frac{sl}{(100-l)}$ in Ω

CALCULATION:

1. $R_p = \frac{Sl}{(100-l)}$ ....Ω
2. $R_p = \frac{R_1 R_2}{R_1 + R_2}$......$\Omega$

RESULT:

- The experimental value of resistance R_p = ...Ω
- Theoretical value of resistance R_p = ...Ω
- Theoretical value of resistance (R_p) is equal or nearly equal to experimental value of resistance (R_p). Hence the law combination of resistance in parallel is verified.

4. FIGURE OF MERIT OF GALVANOMETER

AIM:

Determination of the resistance and current sensitivity (Figure of merit) of a galvanometer by half – deflection method.

PRINCIPLE:

Deflection in a galvanometer is directly proportional to the current through the galvanometer.

$$I = K\theta$$

Where K is called figure of merit of the galvanometer.

FORMULA:

Figure of merit of the galvanometere, $K = \frac{E}{(R+G)\theta}$ ... ... A / div

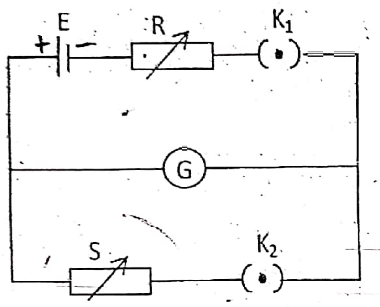
Where E – emf of the cell.

G – Galvanometer resistance

R – resistance in series with the galvanometer.

θ – deflection in the galvanometer.

CIRCUIT DIAGRAM:



E – Cell

K_1 & K_2 - Keys

G – Galvanometer

R & S – Resistance boxes

OBSERVATION:

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

TABULAR COLUMN:

Trial No.	Resistance R in Ω	Deflection θ in Div.	S for $\frac{\theta}{2}$ in Ω	$G = \frac{RS}{R-S}$ in Ω	$K = \frac{E}{(R+G)\theta}$ in A / Div
01	4000	24	50		
02	5000	20	50		
03	6000		50		

Average G=..................Ω

Average K=.................A / Div

CALCULATION:

$$K = \frac{E}{(R+G)\theta} \text{ ... ... A / div}$$

RESULT:

The resistance of the galvanometer =.............Ω

The figure of merit of the pointer galvanometer =............... A /-div

5. CONVERSION OF A GALVANOMETER TO VOLTMETER

AIM:

To convert the given galvanometer into a voltmeter.

PRINCIPLE:

Galvanometer can be converted into voltmeter by connecting suitable high resistance in series with it, so that very small current flows through the galvanometer.

FORMULA:

1) Current required for full scale deflection

$$I_g = NK \ldots\ldots A$$

Where N – Number of divisions on either side of zero of the galvanometer

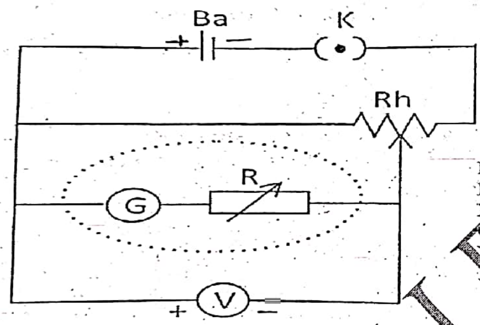
K – Figure of merit of the galvanometer.

2) High resistance to be connected in series with the galvanometer,

$$R = \frac{V}{I_g} - G \ldots\ldots \Omega$$

Where G - Galvanometer resistance. V - Maximum voltage to be measured.

CIRCUIT DIAGRAM:



Ba - Battery
K - Key
Rh - Rheostat
G - Galvanometer
V - Voltmeter
R - Resistance box

OBSERVATION:

1. Resistance of the galvanometer, G (given) =……………..Ω
2. Figure of merit of the galvanometer, K (given) =……….A / div.
3. Number of divisions on either side of zero of the galvanometer scale,
   N =………………….. div.
4. Current required for producing full scale deflection of N divisions,
   $I_g = NK$ = ……………….A
5. Maximum voltage to be measured, V (say 3 V) = ……………V

CALCULATION:

$$R = \frac{V}{I_g} - G \ldots\ldots \Omega$$

RESULT:

The value of the calculated series resistance, R =…………..Ω

The value of the observed series resistance, R' =……………. Ω

6. FREQUENCY OF A.C

AIM:

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

PRINCIPLE:

1. In each cycle of A.C., the sonometer string is pulled and released twice.
2. At resonance, the frequency of alternating current is equal to half of the frequency of fundamental mode of vibration of the stretched string.

FORMULA:

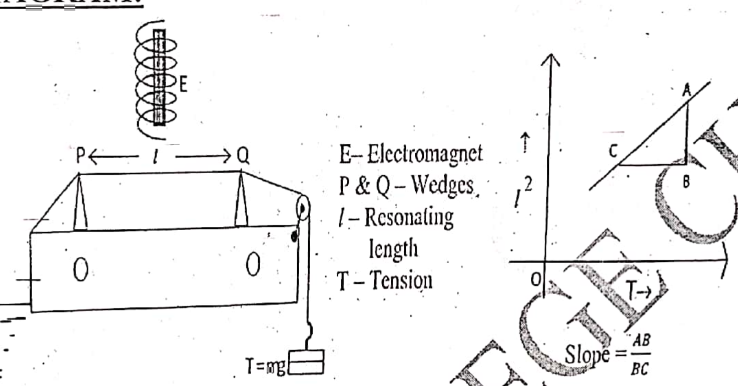
Frequency of alternating current,

$$f = \frac{1}{4\sqrt{m \times slope}} \text{........Hz}$$

Where m - Mass per unit lenght of the string.

Slope- Slope of the graph of l^2 versus T.

DIAGRAM:



OBSERVATION:

1. Mass per unit length of the wire, m (given) = ...kgm^{-1}
2. Acceleration due to gravity, g = 9.8 ms^{-2}

TABULAR COLUMN:

Trial No.	Mass attached to the string (M) in kg	Tension T = Mg in N	Resonating length l in m	l^2 in m^2
1				
2				
3				
4				
5				

CALCULATION:

$$f = \frac{1}{4\sqrt{m \times slope}} \text{........}Hz$$

RESULT:

The frequency of alternating current, f =.............Hz.

7. FOCAL LENGTH OF CONCAVE MIRROR

AIM:

Determination of the focal length of a concave mirror by u – v method.

PRINCIPLE:

1. Focal length is the distance between the pole and principle focus of the mirror.
2. The object distance must be greater than the focal length of the concave mirror to get a real and inverted image.

FORMULA:

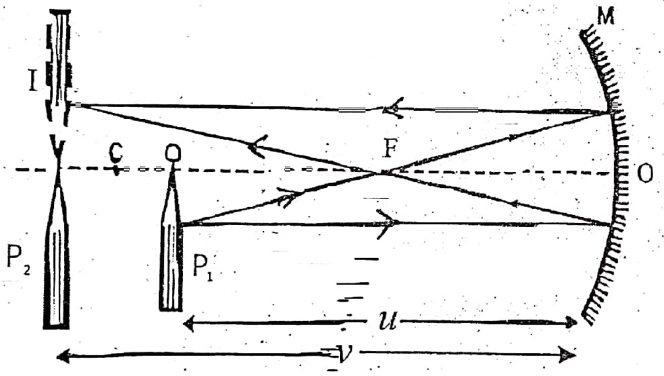
Focal length of concave mirror

$$f = \frac{uv}{u+v} \text{........cm}$$

Where, u - distance of the object from the mirror

v – distance of the image form the mirror

DIAGRAM:



OBSERVATION:

TABULAR COLUMN:

Trial No.	Object distance u in cm	Image distance v in cm	$f = \frac{uv}{u+v}$ in cm
1			
2			
3			

mean f =...............cm

CALCULATION:

$$f = \frac{uv}{u+v} \text{.......}cm$$

RESULT:

The focal length of the concave mirror, f = ...cm or

f =..........$\times 10^{-2}\ m$

8. FOCAL LENGTH OF CONVEX LENS

AIM:

Determination of the focal length of a convex lens by plotting a graph of u versus v.

PRINCIPLE:

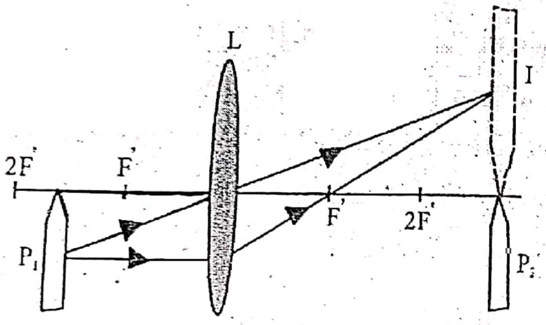
1. The object distance must be greater than the focal length of the convex lens to get a real and inverted image.
2. When object distance is equal to twice the focal length of the convex lens, then the image distance will be equal to twice the focal length.

FORMULA:

Focal length of convex lens, $f = \frac{OA+OB}{4}$........cm

Where OA – image distance OB – object distance

DIAGRAM:



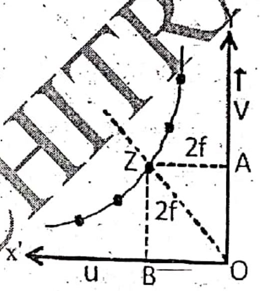
P_1 - Object pin

P_2 - Image pin

I - Image

L - Convex mirror

Graph :



OBSERVATION:

TABULAR COLUMN:

Trial No.	Object distance **u** in cm	Image distance **V** in cm
1		
2		
3		
4		
5		

CALCULATION:

$$f = \frac{OA+OB}{4}\text{........cm}$$

RESULT:

The focal length of the convex lens, $f = ...\ cm$ *or*

$f = ...\times 10^{-2}\ m$

9. FOCAL LENGTH OF CONVEX MIRROR

AIM:

Determination of the focal length of a convex mirror using a convex lens.

PRINCIPLE:

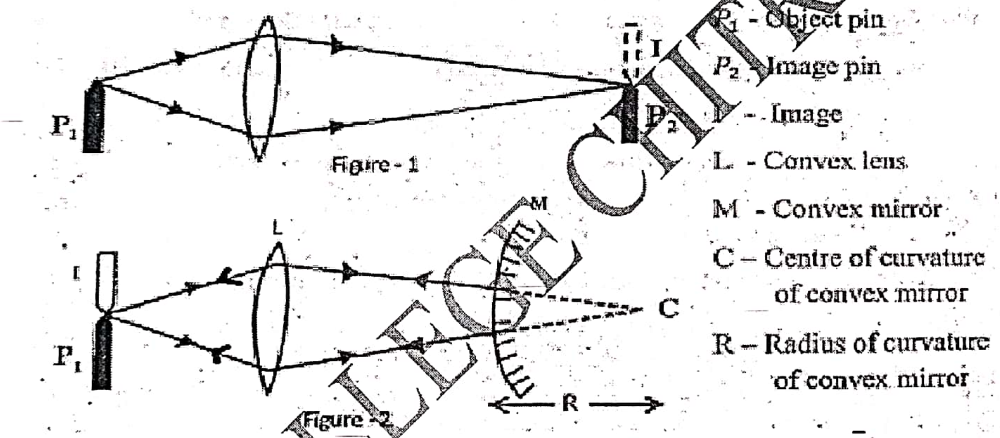
1. The object distance must be greater than the focal length of the convex lens to get a real and inverted image.
2. The reflected ray from a convex mirror appears to be coming from its center of curvature for normal incidence.

FORMULA:

Focal length of convex mirror, $f = \frac{R}{2}$........cm

Where R = radius of curvature of the convex mirror

DIAGRAM:



OBSERVATION:

TABULAR COLUMN:

Trial No.	Position C of the image in cm	Position M of the convex mirror in cm	Radius of curvature R=(C – M) in cm	Focal length $f = \frac{R}{2}$ in cm
1				
2				
3				

CALCULATION:

$f = \frac{R}{2}$........cm

RESULT:

The focal length of the convex mirror, $f =$ .... cm or

$f =$ ....$\times 10^{-2}\ m$

10. (A) REFRACTIVE INDEX OF WATER

AIM:

Determination of the refractive index of water using a concave mirror.

PRINCIPLE:

1. The rays of light from the object incident normally on the concave mirror, retrace their paths so that image of the object forms by the side of the object.
2. The bottom of the concave mirror containing water, appears to be raised up because of refraction of light through water.

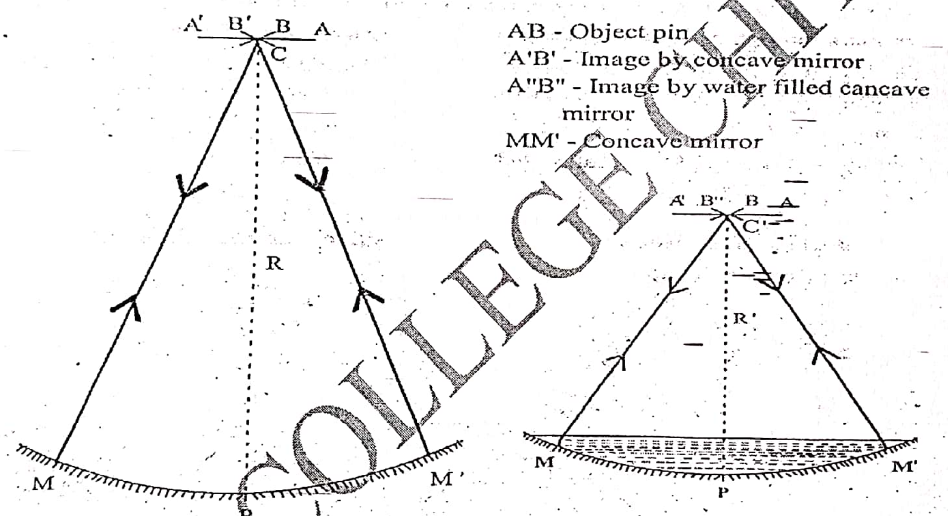
FORMULA:

Refractive index of water with respect to air, $n_w = \frac{R}{R'}$

Where R = Radius of curvature of the concave mirror

R' - apparent radius of curvature of concave mirror with water.

DIAGRAM:



OBSERVATION:

1. Radius of curvature of concave mirror, R= ....cm
2. Radius of curvature of concave mirror with water, R' =.........cm

CALCULATION:

$$n_w = \frac{R}{R'}$$

RESULT:

The refractive index of water, n_w =........

10. (B) REFRACTIVE INDEX OF WATER

AIM:

Determination of the refractive index of water using a canvex lens and plane mirror.

PRINCIPLE:

1. The rays of light from the object incident normally on the plane mirror, retrace their paths so that image of the object forms by the side of the object.
2. It is based on the relation between radii of curvature of equiconvex lens and effective focal length of the glass and water lenses.

FORMULA:

1. Focal length of the lens formed by water,

$$f_w = \frac{ff'}{f-f'} \text{ ....cm}$$

Where f – focal length of convex lens.

f' – focal length of combination of glass lens and water lens.

2. Refractive index of water,

$$n_w = 1 + \frac{R}{f_w}$$

Where R – radius of curvature of equiconvex lens,

f_w – magnitude of focal length of the lens formed by water.

DIAGRAM:

AB - Object pin
A' B' - Image by convex lens
A'' B'' - Image by combination of water lens & convex lens
MM' - Plane mirror

OBSERVATION:

1. Radius of curvature of equiconvex lens (given) R= ....cm
2. Focal length of convex lens, f =.........cm
3. Focal length of lens combination, f' =.........cm

CALCULATION:

1. $f_w = \frac{ff'}{f-f'}$ ....cm

2. $n_w = 1 + \frac{R}{f_w}$

RESULT:

The refractive index of water n_w =......

11. SEMICONDUCTOR DIODE

AIM:

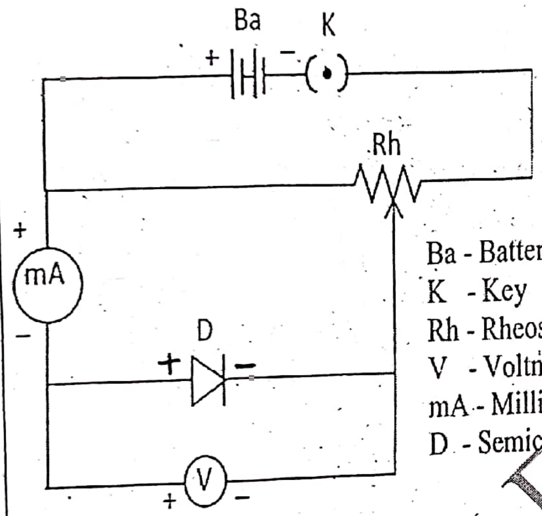
To draw the current (I) verses voltage (V) characteristic curve of a p-n junction diode in forward bias and hence find cut-in voltage.

PRINCIPLE:

When the diode is forward biased it offers very low resistance.

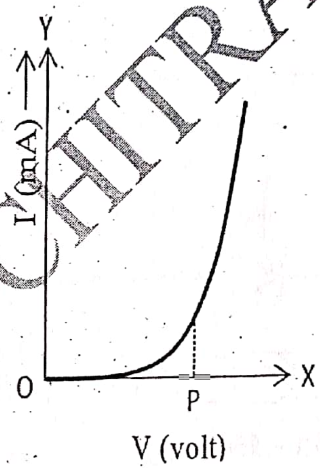
Cut-in voltage is the characteristic voltage at which diode current increases exponentially even for a small increase in bias voltage, when diode is in forward bias.

CIRCUIT DIAGRAM:



Ba - Battery
K - Key
Rh - Rheostat
V - Voltmeter
mA - Milliammeter
D - Semiconductor Diode

Graph :



OP → cut-in voltage

OBSERVATION:

TABULAR COLUMN:

Voltage V in V							
Current I in mA							

RESULT:

Cut – in voltage of the given diode =..........V

Scanned with CamScanner

12. ZENER DIODE

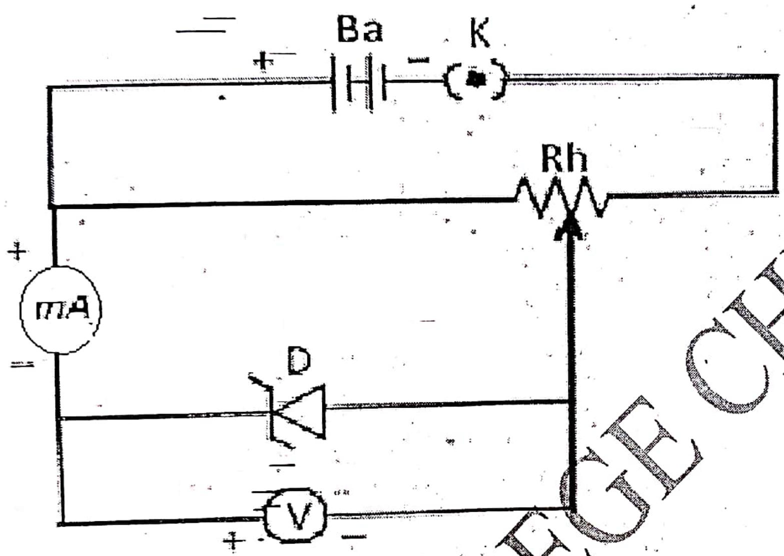
AIM:

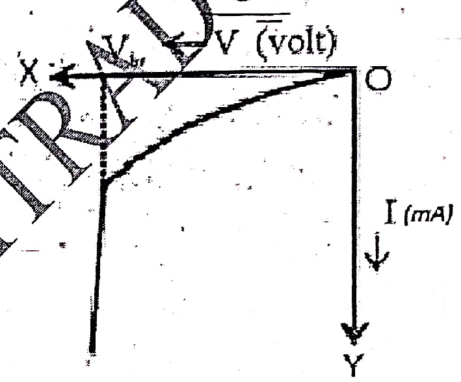
To draw the current (I) verses voltage (V) characteristic curve of zener diode in reverse bias and hence to determine its breakdown voltage.

PRINCIPLE:

When the zener diode is reverse biased, at a particular negative voltage, the reverse current increases suddenly and sharply so that the voltage across diode remains constant. This voltage is called breakdown voltage or zener voltage.

CIRCUIT DIAGRAM:





Ba - Battery
K - Key
Rh - Rheostat
V - Voltmeter
μA - Microammeter
D - Zener Diode

OBSERVATION:

TABULAR COLUMN:

Voltage V in V							
Current I in mA							

RESULT:

The breakdown voltage of the Zener diode, V_{br} =..........V