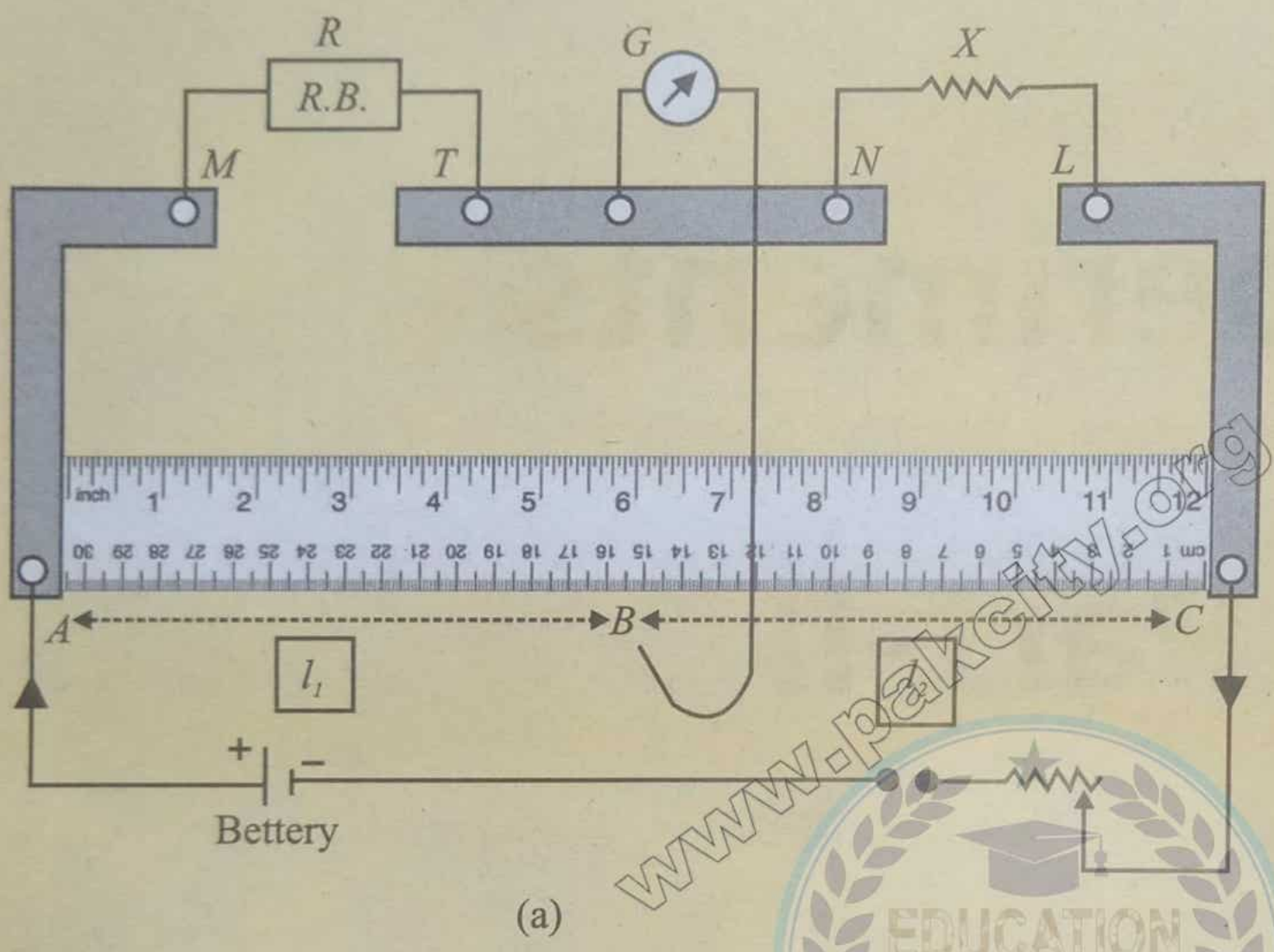
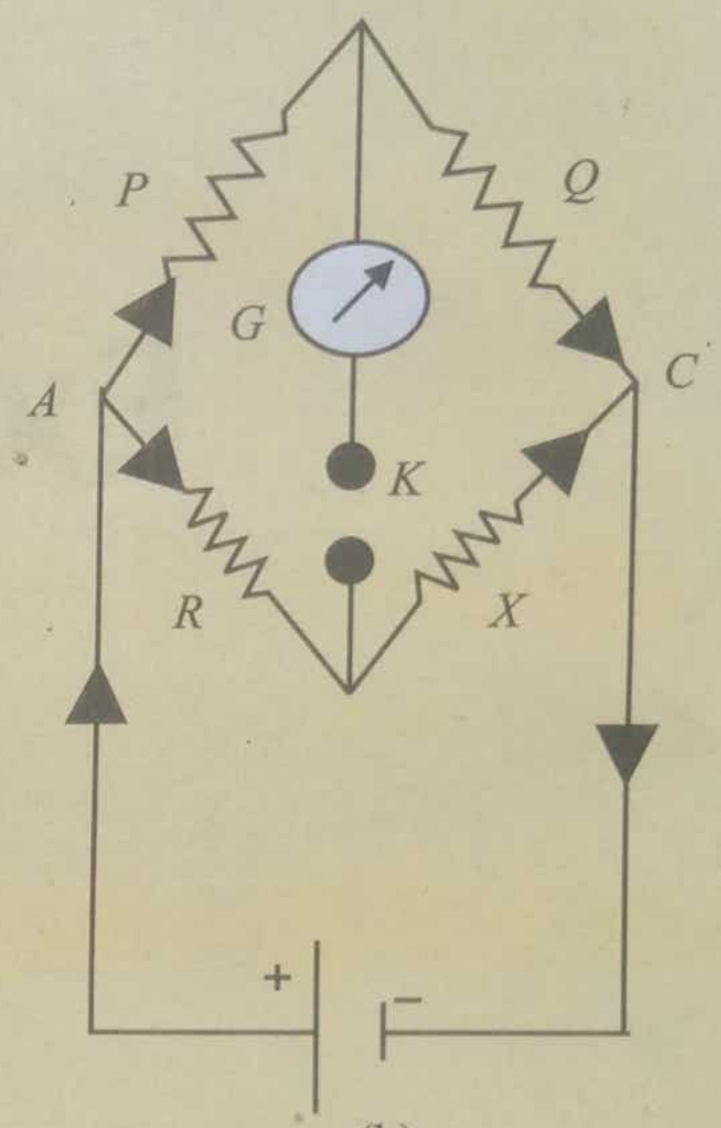
EXPERIMENT NO. 1

To determine the resistance of wire by slide wire bridge. Also, calculate the resistivity or specific resistance of the material of the wire.

APPARATUS: Slide wire bridge, resistance box, galvanometer, battery, Resistance wire plug key, connecting wires, sand paper, Rheostat, screw gauge and Jockey circuit.

DIAGRAM:





PROCEDURE:

First of all I drew circuit diagram, placed apparatus on table and made connections according to diagram. Then I took a suitable resistance R from resistance box and touched the jockey at end A and then at end C. I found opposite deflection on galvanometer which means connections are correct. I inserted resistance back in the resistance box.

I again took out resistance R from box. I pressed jockey on wire of slide wire bridge at end A and observed deflection on galvanometer. Now I pressed jockey on wire at different positions between A and C. I found the balance point (zero deflection) at B which is somewhere in the middle of wire. I noted the length l_1= BC and l_2 = AB. I calculated the value of unknown resistance by formula

$$X = R\frac{l_2}{l_1}$$

I took three more observations by same procedure by changing value of resistance R and calculated mean resistance X.

OBSERVATIONS AND CALCULATIONS:

Length of the slide wire = AC = 100 cm

No. of Obs.	Resistance taken out from Resistance Box R (Ω)	Distance of Balance point from the end A l_1 (cm)	Distance of Balance point from the end C $l_2 = 100 - l_1$ (cm)	Unknown Resistance of wire $X = R\frac{l_2}{l_1}$ (Ω)
1	5	40.2	59.8	7.44
2	6	44.3	55.7	7.54
3	7	48.7	51.3	7.38
4	8	52.2	47.8	7.33

Mean value of unknown resistance = X = 7.42 Ω

RESULT

It is found that the resistance of the given wire = X = 7.42 Ω

(Note: Mostly it is asked to calculate unknown resistance of the wire and not to find resistivity)

ii) CALCULATION OF SPECIFIC RESISTANCE (OR RESISTIVITY):

Length of the unknown resistance wire = L = 100 cm

Diameter of the resistance wire = (i) 0.41 mm (ii) 0.41 mm (iii) 0.41 mm

Mean diameter = D = 0.41 mm = 0.041 cm

Radius of wire = r = D/2 = 0.0205 cm

Area of cross – section of the resistance wire = A = πr^2

Resistivity = ρ = X πr^2 /L = 7.42x 3.14x $(0.0205)^2$ /100 Ω-cm

= 9.8×10^{-5} Ω-cm

RESULT

It is found that Specific resistance (or resistivity) of wire = 9.8×10^{-5} Ω-cm

PRECAUTIONS

- Connections should be clean and tight.
- The wire under test should be free from kinks.
- The current passed should not be very strong and for much time.
- The portion of the wire inside the binding screw should be excluded in measuring its length.
- The null point should be obtained somewhere near the middle of the wire, possibly between the region of 40 – 60 cm.
- The jockey should not be pressed too much while sliding it over the wire.
- The battery circuit should be closed before the galvanometer circuit.

VIVA VOCE:

Q: How to check that the connections of Slide Wire Bridge circuit are correct? Write two methods.

Ans: (i) If we put the jockey at one end of slide wire and then the other, the deflection of galvanometer is reversed.

(ii) If we put the jockey on one end of slide wire then taking out infinite resistance key from the high resistance box reverses the deflection in the galvanometer.

Q: Define specific resistance.

Ans: Resistance of one cubic meter of wire is called resistivity or specific resistance.

Q: What is effect of temperature upon Specific resistance?

Ans: Specific resistance increases with the increase in temperature.

Q: Will a thicker wire have a larger or smaller Specific resistance?

Ans: No, thicker wire will have same specific resistance.

Specific resistance is the property of nature of material; it does not depend on dimensions of wire.

Q: What is condition for balancing the Wheatstone bridge?

Ans: The galvanometer shows zero deflection when

$$R_1 / R_2 = R_3 / R_4$$

Q: When bridge is said to be balanced?

Ans: When galvanometer shows zero deflection then the bridge is said to be balanced.

Q: Why galvanometer current becomes zero?

Ans: Two equal and opposite currents balance each other.

Q: Why Slide Wire Bridge is called so?

Ans: Because null condition is adjusted by sliding jockey on the slide wire.

Q: Define unit of resistance.

Ans: If 1volt potential difference is applied across the ends of a conductor and 1 ampere current passes through it then its resistance is said to be 1ohm.

Q: Define resistance.

Ans: Opposition offered by a conductor to the flow of current is called resistance.

Q: On what factors resistance of wire depends?

Ans: Resistance of wire depends upon nature of material, dimensions of wire, and temperature.

Q: What is difference between resistance and resistivity?

Ans: Resistance changes with the length and area of cross section of wire while resistivity does not change. Resistance is the property of wire while resistivity is the property of material.

Q: What is unit of resistivity?

Ans: Resistivity is measured in Ωm.

Q: What is length of slide wire bridge wire?

Ans: 100cm

Q: Why should ends of wire be cleaned?

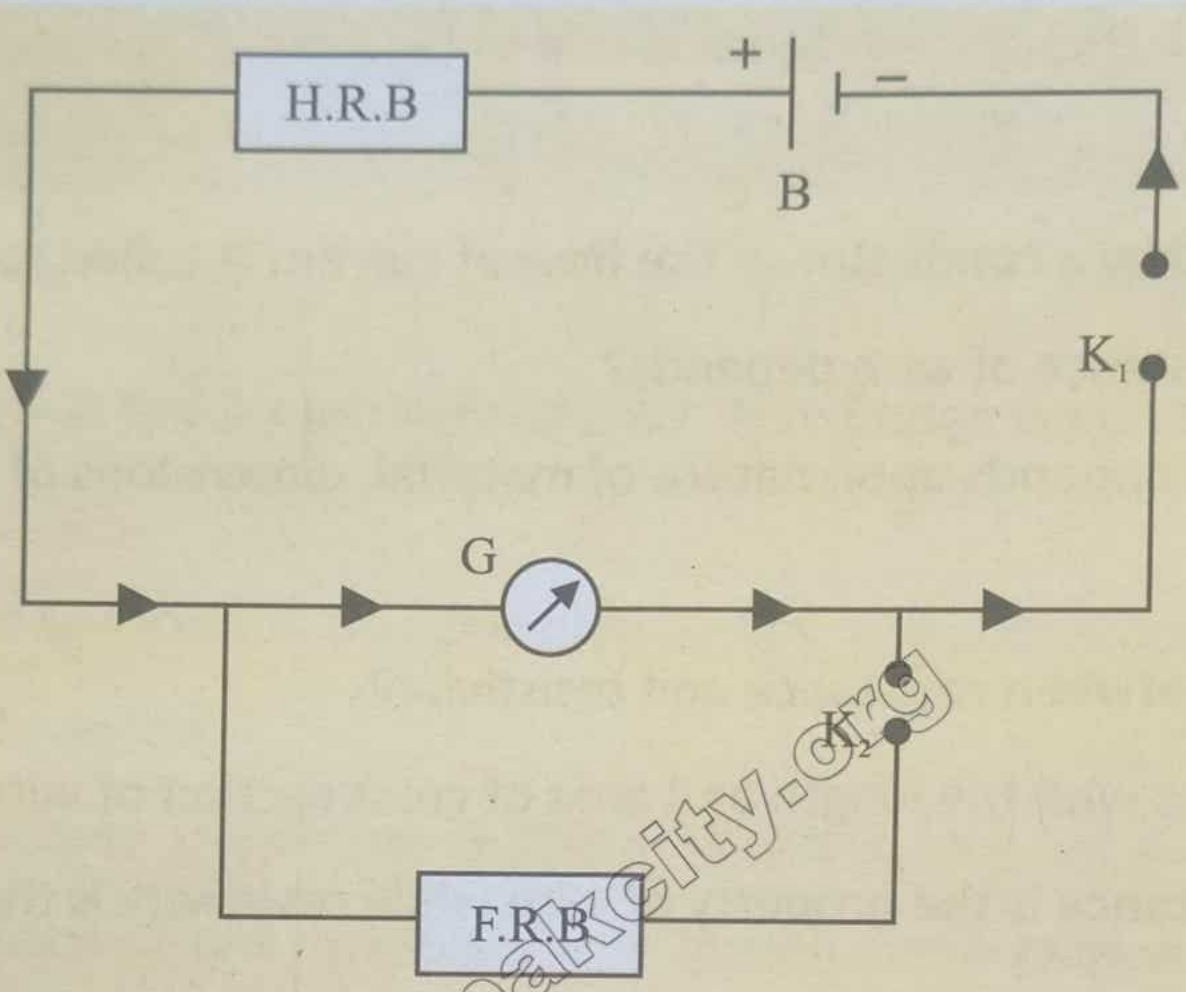
Ans: To make the connections good.

EXPERIMENT NO. 2

To determine the resistance of a galvanometer by the half deflection method.

APPARATUS: Moving coil galvanometer, high resistance box, fractional resistance box, two plug keys, battery or cell, connecting wires and sand paper.

DIAGRAM:



PROCEDURE:

I drew circuit diagram and made tight connections according to diagram. I connected H.R.B, battery, key K_1 and galvanometer in series which forms a loop. Then I connected F.R.B along with K_2 in parallel to galvanometer. I closed K_1 and opened K_2. I plug out suitable resistance from H.R.B and obtained even number deflection on galvanometer. Now I also closed K_2 and observed that deflection on galvanometer becomes zero. When both K_1 and K_2 are closed, I plug out shunt resistance S from F.R.B which makes deflection on galvanometer half. I calculated resistance of galvanometer by formula

$$G = \frac{RS}{R-S}$$

I took three more observations by changing values of R and S by same method. I calculated mean value of resistance of galvanometer.

OBSERVATIONS AND CALCULATIONS:

Zero reading of the galvanometer = 0 div.

No. of Obs.	High Resistance R Ω	Deflection in Galvanometer θ divs.	Half Deflection $\theta/2$ divs.	Shunt Resistance S Ω	Resistance of Galvanometer $G=\frac{RS}{R-S}$ Ω
1	5000	28	14	110	112
2	5700	26	13	110	112
3	6800	22	11	120	122
4	7500	20	10	110	112

Mean value of G = 114.5 Ω

RESULT

Resistance of the galvanometer = G = 114.5 Ω ohms.

PRECAUTIONS

- The connections should be neat and tight.
- All the plugs of the resistance boxes must be tight.
- A low resistance box should be used as the shunt resistance
- The deflection of the galvanometer should be an even number of divisions.
- The value of the resistance should be high for each observation.

(Note: We can also find the resistance of galvanometer by drawing a graph between R-S and RS and finding the slope $G=\frac{RS}{R-S}$)

VIVA VOCE:

Q: How resistance of galvanometer is calculated?

Ans: By Half Deflection Method.

Q: Why half deflection method is so called?

Ans: Two parallel paths are provided to flow of current. When resistances of both the paths are same, half current passes through each and galvanometer shows half deflection.

Q: What is deflection of galvanometer when no resistance is taken out of low resistance box and its key is closed?

Ans: Zero

Q: Why deflection is zero when S=0?

Ans: Because all the current passes through the shunt and no current passes through the galvanometer.

Q: What is effect on deflection of galvanometer when resistance of resistance box is increased?

Ans: Deflection of galvanometer increases when resistance of resistance box is increased.

Q: Give formula for Ohm's law?

Ans: V= I R

Q: What is a galvanometer?

Ans: It is a device to detect the presence of current.

Q: What is shunt? Why used?

Ans: It is low resistance. It is used to bypass the current.

Q: Why galvanometer is shunted?

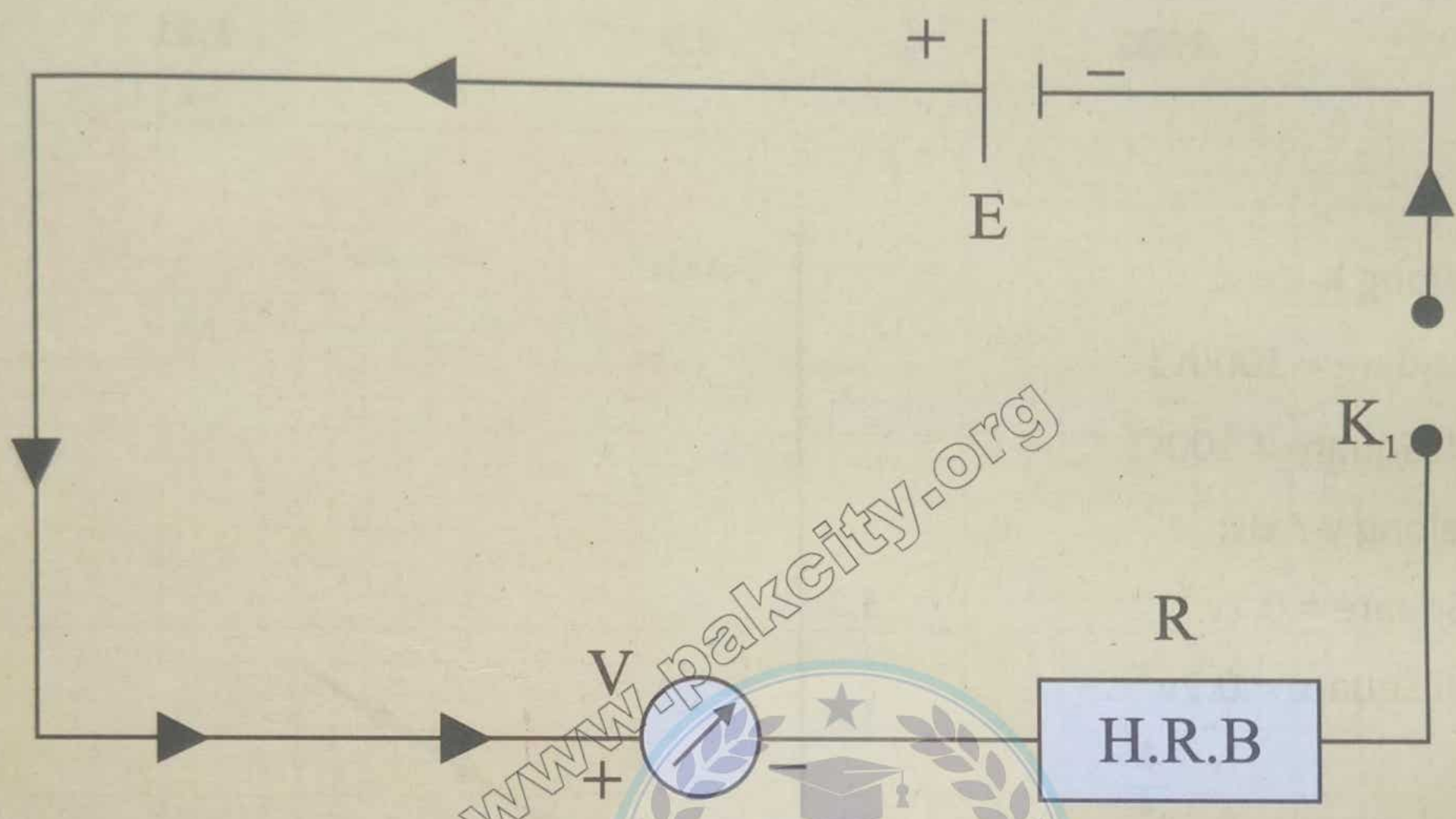
Ans: To make it ammeter.

EXPERIMENT NO. 3

To find the resistance of a voltmeter by drawing graph between R and 1/V.

APPARATUS: Voltmeter, battery or power supply, high resistance box (0-5000 ohms), plug key, connecting wires and sand paper.

DIAGRAM:



PROCEDURE :

I drew circuit diagram and made tight connections according to it with apparatus on table. I observed that high resistance box (H.R.B), battery, key K and voltmeter are connected in series which forms a loop. Then I closed the key K and took out resistance R in regular intervals of 500Ω from H.R.B and noted corresponding readings of voltage V on voltmeter and entered them in a table.

I calculated 1/V for each observation and plotted a graph between R and 1/V which came out a straight line. I reproduced straight line towards negative x-axis. I measured the resistance for point where line cuts the negative x-axis which is called resistance of voltmeter.

OBSERVATIONS AND CALCULATIONS:

No. of Obs.	Resistance from high resistance box R (Ω)	Voltmeter reading V (V)	$\frac{1}{V}$ (V^{-1})
1	0	1.9	0.53
2	500	1.6	0.63
3	1000	1.4	0.71
4	1500	1.2	0.83
5	2000	1.1	0.91
6	2500	0.9	1.11

Scale along X-Axis:

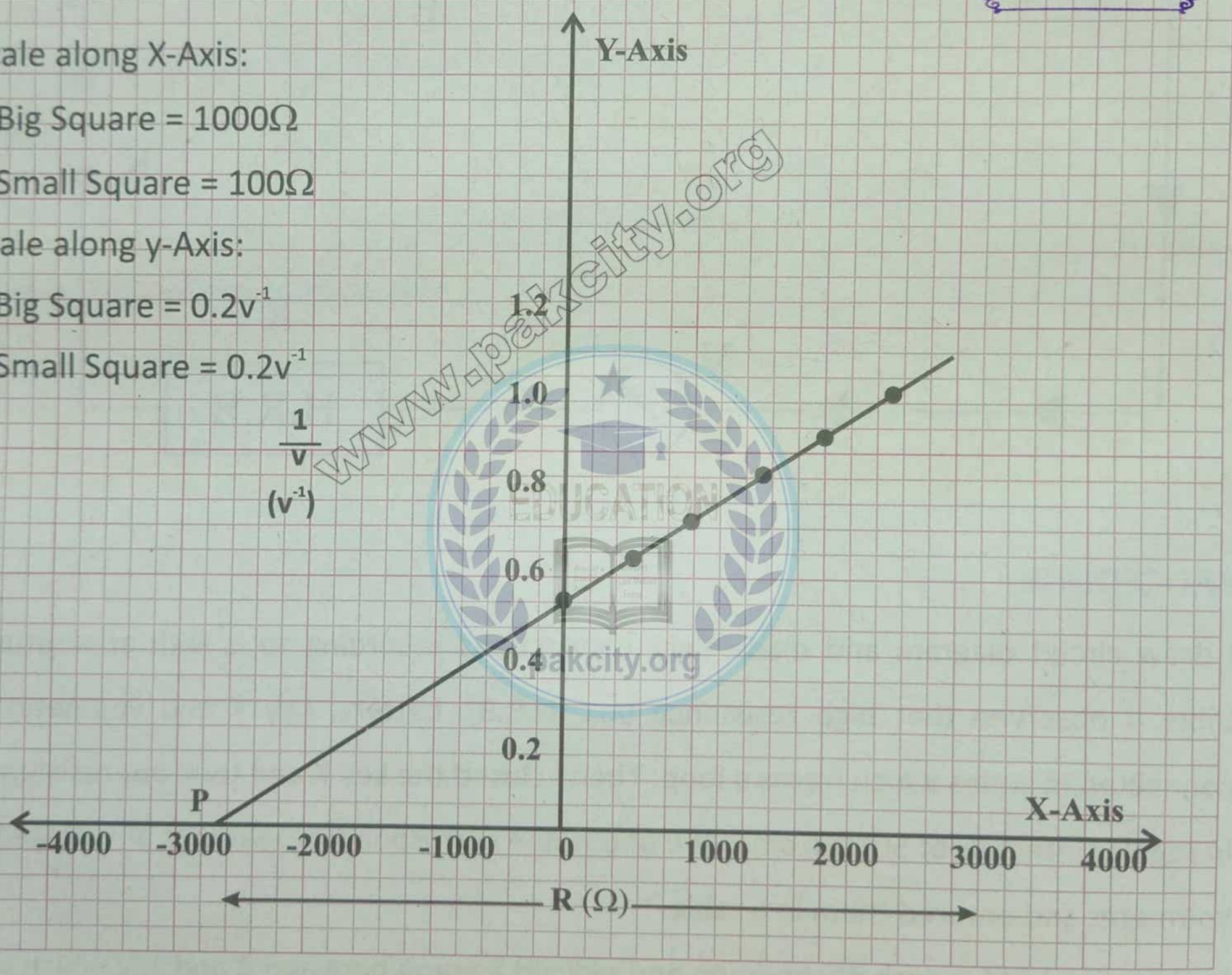
1 Big Square = 1000Ω

1 Small Square = 100Ω

Scale along y-Axis:

1 Big Square = $0.2v^{-1}$

1 Small Square = $0.2v^{-1}$



According to scale intercept on x-Axis

(Internal resistance of voltneter) OP=2700Ω

Resistance of voltmeter = R_v = Intercept OP = 2700 Ω

RESULT: -

The intercept on the x – axis which is equal to R_v (internal resistance of voltmeter) is found 2700 Ω.

PRECAUTIONS

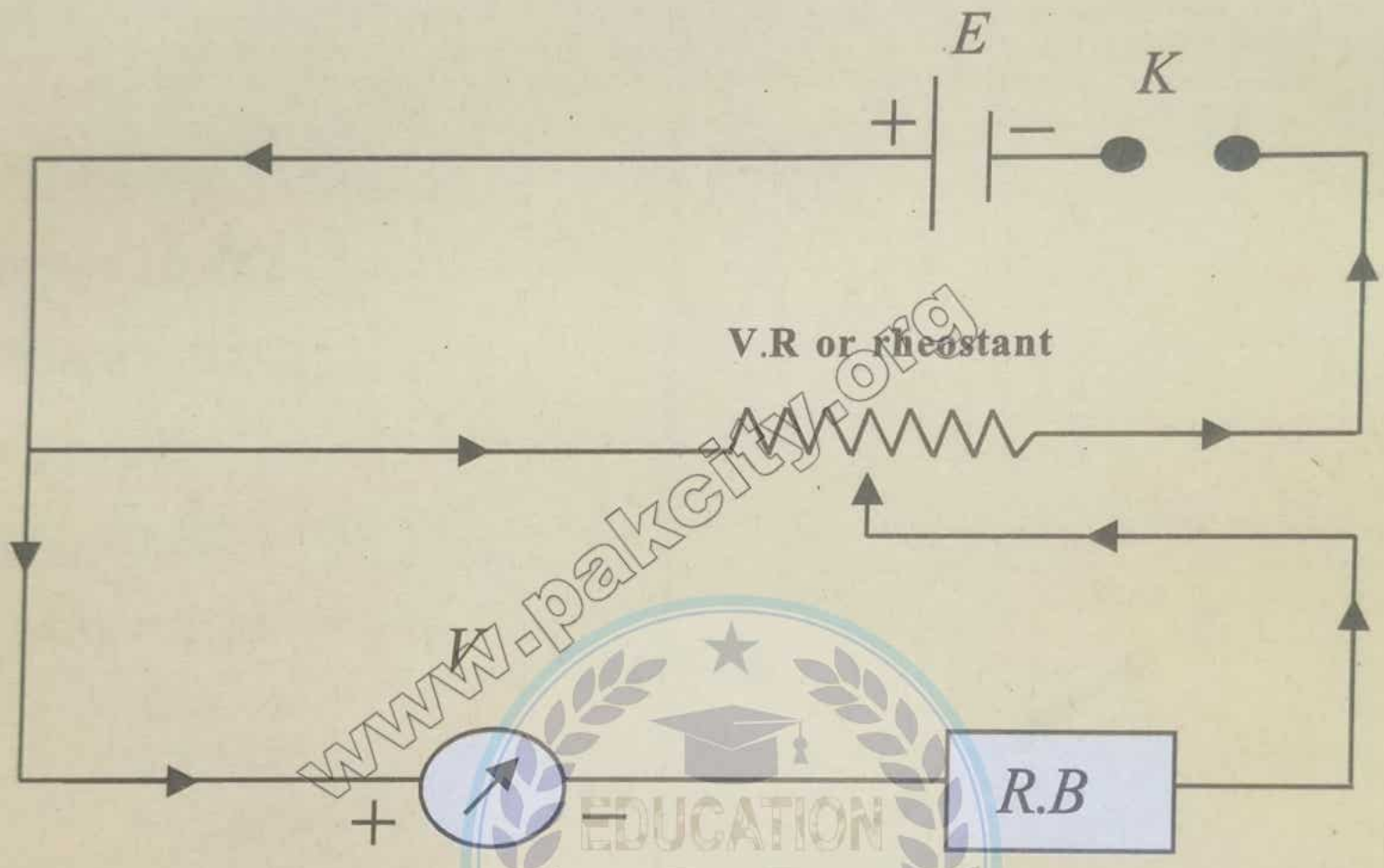
- The connections must be neat and tight.
- No rheostat should be used in the circuit.
- Use battery instead of a cell to provide a voltage equal to the maximum voltmeter reading.

EXPERIMENT NO. 4

To determine the resistance of a voltmeter, (without graph)

APPARATUS: A battery or power supply to produce maximum voltmeter reading, voltmeter, Rheostat (or variable resistor) Resistance box (0 – 5000 ohms), one way key, connecting wires and sand paper.

DiAGRAM:



PROCEDURE:

I drew circuit diagram and made tight connections according to it with apparatus on table. I observed that high resistance box (H.R.B), battery, key K and voltmeter are connected in series along with rheostat which forms a loop. Then I closed the key K and obtained even number reading on voltmeter by movement of rheostat with zero resistance of H.R.B. Then I took out suitable resistance R from H.R.B and made reading on voltmeter half. The value of R is equal to resistance of voltmeter.

I took three more observations by same method by changing even number reading on voltmeter and calculated mean resistance of voltmeter.

OBSERVATIONS AND CALCULATIONS:

No. of Obs.	Voltmeter Reading When R = 0 (V)	Voltmeter Reading When R ≠ 0 (V)	Resistance R from H.R.B Which makes deflection half (Ω)	Resistance of voltmeter $R_v = R$ (Ω)
1	2.4	1.2	3200	3200
2	2.0	1.0	3100	3100
3	1.6	0.8	3000	3000
4	1.2	0.6	3100	3100

Mean resistance = R_v = 3100 Ω

RESULT:

Resistance of given voltmeter = R_v = 3100 Ω

PRECAUTIONS

- High resistance box should be used
- No rheostat should be used with power supply.
- Voltmeter reading should be taken in even divisions.

VIVA VOCE:

Q: What is voltmeter?

Ans: It is a device which is used to measure potential difference or voltage across two ends.

Q: How voltmeter is constructed?

Ans: A high resistance is connected in series with a galvanometer.

Q: How voltmeter is used in circuits?

Ans: It is connected in parallel to the circuit.

Q: Why voltmeter is used in parallel?

Ans: If voltmeter is not used in parallel, it will draw current from the circuit and the potential difference which is to be measured will change

Q: What is property of a good voltmeter?

Ans: A good (ideal) voltmeter draws no current from the circuit.

Q: Why resistance of voltmeter must be very high?

Ans: So that it may draw a very small current from the circuit.

Q: Give formula for Ohm's law?

Ans: $V = IR$

Q: Define a volt.

Ans: If 1J of work is done on 1C charge to move it from one point to the other against the electric field, then the potential difference will be 1V.

Q: How the range of a voltmeter is increased?

Ans: By increasing the high resistance which is connected in series with the galvanometer.

Q: Can you use D.C voltmeter in an A.C circuit?

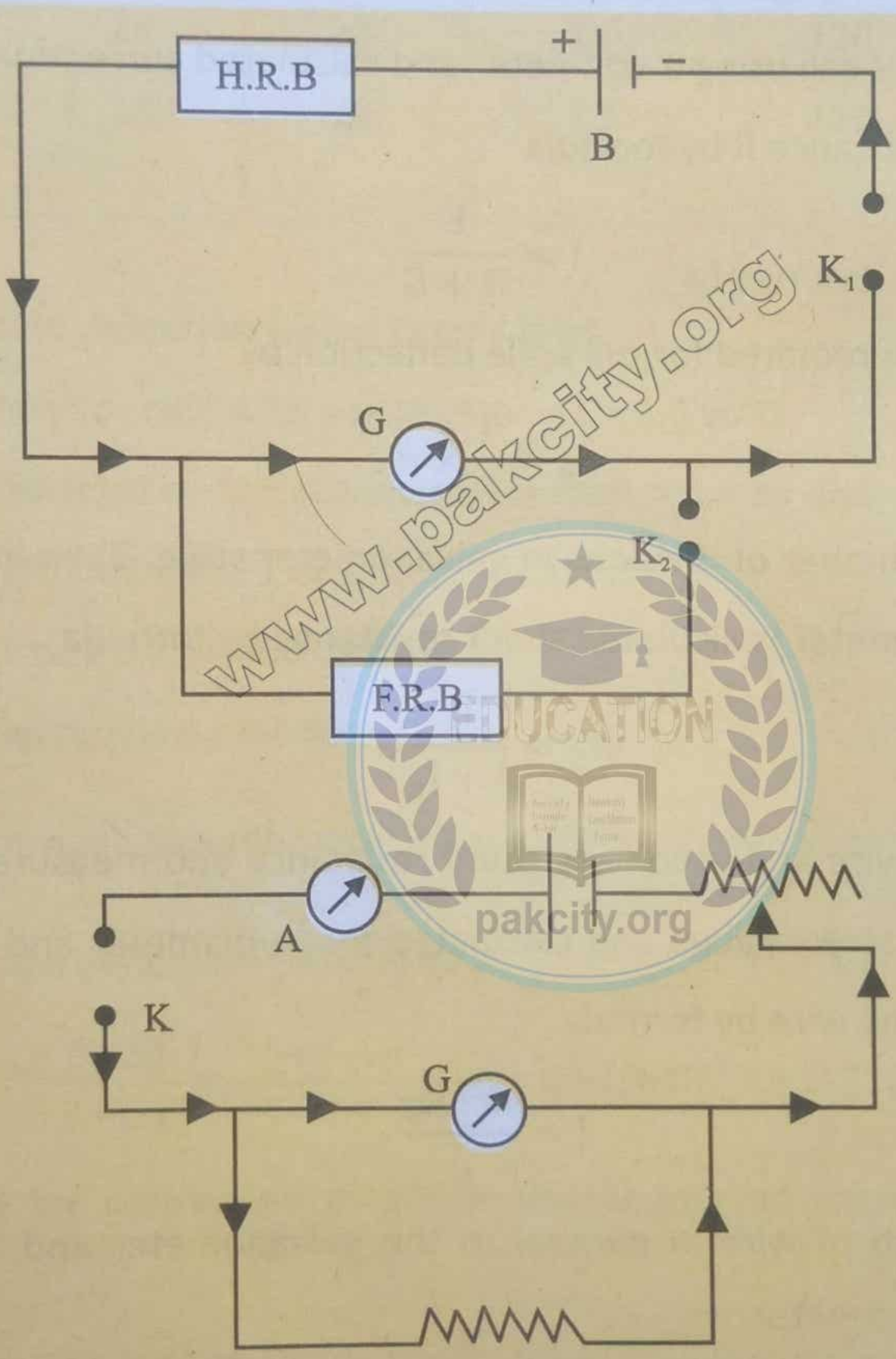
Ans: No, we cannot use D.C voltmeter in an A.C circuit.

EXPERIMENT NO. 5

To convert a Weston – type galvanometer into an ammeter reading up to 1.0 ampere (0 – 1.0 amp. Range)

APPARATUS: A moving coil galvanometer (Weston type), high resistance box (H.R.B), voltmeter, ammeter of 1.0 amp range, fractional resistance box (F.R.B), rheostat, two plug keys, screw gauge, battery (2 – 3 cells), sand paper and connecting wires, shunt wire (copper).

DIAGRAM:



PROCEDURE:

I drew circuit diagram and made tight connections according to diagram. I connected H.R.B, battery, key K_1 and galvanometer in series which forms a loop. Then I connected

F.R.B along with K_2 in parallel to galvanometer. I closed K_1 and opened K_2. I plug out suitable resistance from H.R.B and obtained even number deflection on galvanometer. Now I also closed K_2 and observed that deflection on galvanometer becomes zero. Then I plug out shunt resistance S from F.R.B which makes deflection on galvanometer half. I calculated resistance of galvanometer by formula

$$G = \frac{RS}{R-S}$$

I took two more observations by changing values of R by same method. I calculated mean value of resistance of galvanometer.

Then I noted the emf of cell using a voltmeter and calculated current passing through the galvanometer with resistance R by formula

$$I = \frac{E}{R+G}$$

I calculated the current required for full scale deflection by

$$I_g = \frac{I}{\theta} \times n$$

Where n is the total number of divisions in galvanometer scale. Then in order to convert galvanometer into ammeter I calculated shunt resistance by formula

$$R_S = \frac{I_g}{I - I_g} G$$

Then I took a copper wire and used it as shunt resistance and measured its diameter at different points using screw gauge and calculated mean diameter and radius (r). Then I calculated length l of the wire by formula

$$l = \frac{\pi r^2 R_s}{\rho}$$

I connected this length of wire in parallel to the galvanometer and this arrangement worked as converted ammeter.

I connected ammeter in series to galvanometer according to circuit diagram and I took out a suitable resistance from H.R.B and noted the reading on both meters. Then I converted the galvanometer into ammeter and calculated the difference between two readings which came out nil.

OBSERVATIONS AND CALCULATIONS:

No. of Obs.	Resistance taken out from H.R.B R (Ω)	Deflection in Galvanometer θ		Half deflection $\frac{\theta}{2}$ (divs.)	Resistance taken out from F.R.B S (Ω)	Galvanometer Resistance $G=\frac{RS}{R-S}$ (Ω)
		Observed (divs.)	Corrected (divs.)			
1	4000	30	30	15	120	123.7
2	4800	28	28	14	120	123.1
3	5500	26	26	13	120	122.7

Mean value of G = 123.2 Ω

Current for full scale defection (using Ohm's law):

E.M.F. of the battery (or cell) with a voltmeter = E = 1.3 volts

Total number of divisions on the galvanometer scale = n = 30 divs.

From observation No. 01 (take 1 or 2 or 3),

Resistance R = 4000 Ohms.

Deflection = θ = 30 divs.

Current passing through galvanometer = $I = \frac{E}{R+G}$ (Ohm's law)

Current for full scale deflection (30 div) = $I_g = \frac{I}{\theta} \times n$

Hence $I_g = \frac{E \times 30}{(R+G)\theta} = \frac{1.3 \times 30}{(4000+123.2)30}$ A = 0.315×10^{-3} A = 0.315 mA

Shunt resistance for conversion of galvanometer into an ammeter of range 0 – 1.0 amperes:

The range of ammeter for conversion i.e. I = 1.0 A

The shunt resistance = $R_S = \frac{I_g}{I-I_g} G$

$$R_S = \frac{0.315 \times 10^{-3}}{1-0.315 \times 10^{-3}} 123.2$$

= 0.0388 Ω

Calculation of length of shunt wire (Copper):

Least count of screw gauge = 0.01 mm

Zero correction = zero

Observed diameter = (i) 0.40 mm (ii) 0.40 mm (iii) 0.40 mm

Mean diameter = $\frac{0.40+0.40+0.40}{3}$ = 0.40 mm

Radius of the copper wire = r = d/2 = 0.40/2 = 0.20 mm = 0.020 cm

Specific resistance of copper wire = ρ = 1.72 x 10^{-6} Ω-cm

Length of wire used as shunt = $l = \frac{\pi r^2 R_S}{\rho}$

$$l = \frac{3.14x\,(0.02)^2 x 0.0388}{1.72\,x\,10^{-6}} = 28.33\ cm$$

Verification:

Checking the accuracy of converted galvanometer

Total number of divisions of galvanometer = n = 30 divs.

So, the value of each division of shunted galvanometer = $\frac{I}{n}\theta = \frac{1.0}{30}\ \theta$

No. of Obs.	Reading of Shunted galvanometer		Standard Ammeter Reading	Difference (Error)
	Deflection θ (div.)	Current = $\frac{1.0}{30}\theta$ (A)	(A)	(A)
1	16	0.53	0.52	0.01
2	22	0.73	0.72	0.01
3	27	0.90	0.89	0.01

RESULT:

It is found that to convert the galvanometer into an ammeter reading up to 1.0 ampere, the galvanometer should be shunted with a resistance of 0.0388 Ω.

PRECAUTIONS

- All the connections should be neat and tight.
- The shunt wire should be connected in such a way that not portion of the calculated length of the wire should be under the binding screw of the galvanometer.
- Large currents should be passed to produce large deflection when checking

the accuracy of the galvanometer. This reduces the percentage in observation.

- The wire used as a shunt should have a convenient length.
- The diameter of the wire should measure carefully in two mutually perpendicular directions at each point.

VIVA VOCE:

Q: What is ammeter?

Ans: It is a device used to measure the flow of current.

Q: How ammeter is formed from galvanometer?

Ans: Shunt is connected in parallel with the galvanometer.

Q: How range of ammeter is increased?

Ans: By decreasing the shunt which is connected in parallel with the galvanometer.

Q: Why ammeter is connected in series?

Ans: It is connected in series to provide a single path of flow of current, so that the exact value of current does not change.

Q: Why resistance of ammeter must be very low?

Ans: Ammeter is connected in series to measure the current. If resistance of ammeter is high then it will change the value of current which is to be measured.

Q: What is the difference between an ammeter and a galvanometer?

Ans: When a galvanometer is shunted, it becomes an ammeter. Galvanometer detects while ammeter measures the flow of current.

Q: How voltmeter is different from ammeter?

Ans: Voltmeter is used to measure potential difference while ammeter measures the current.

Q: How much is the value of "g" at the centre of earth?

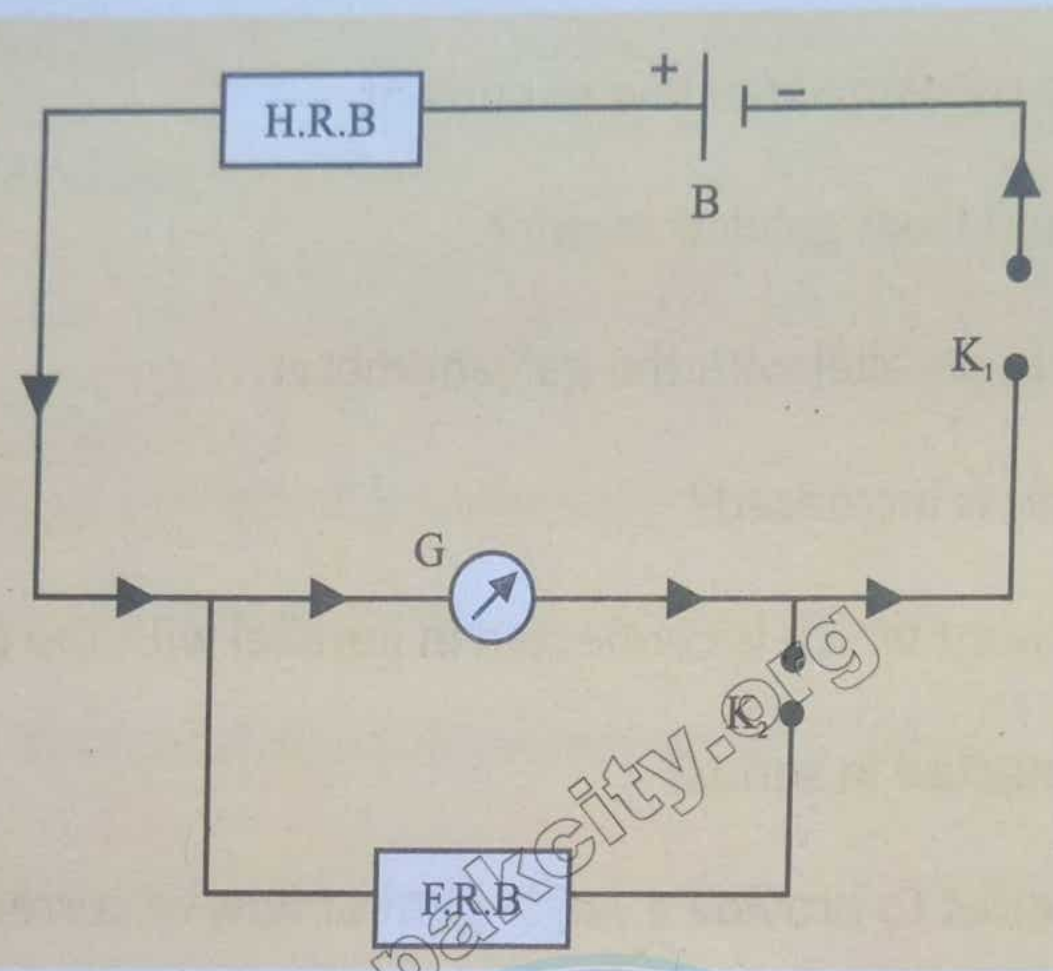
Ans: Zero.

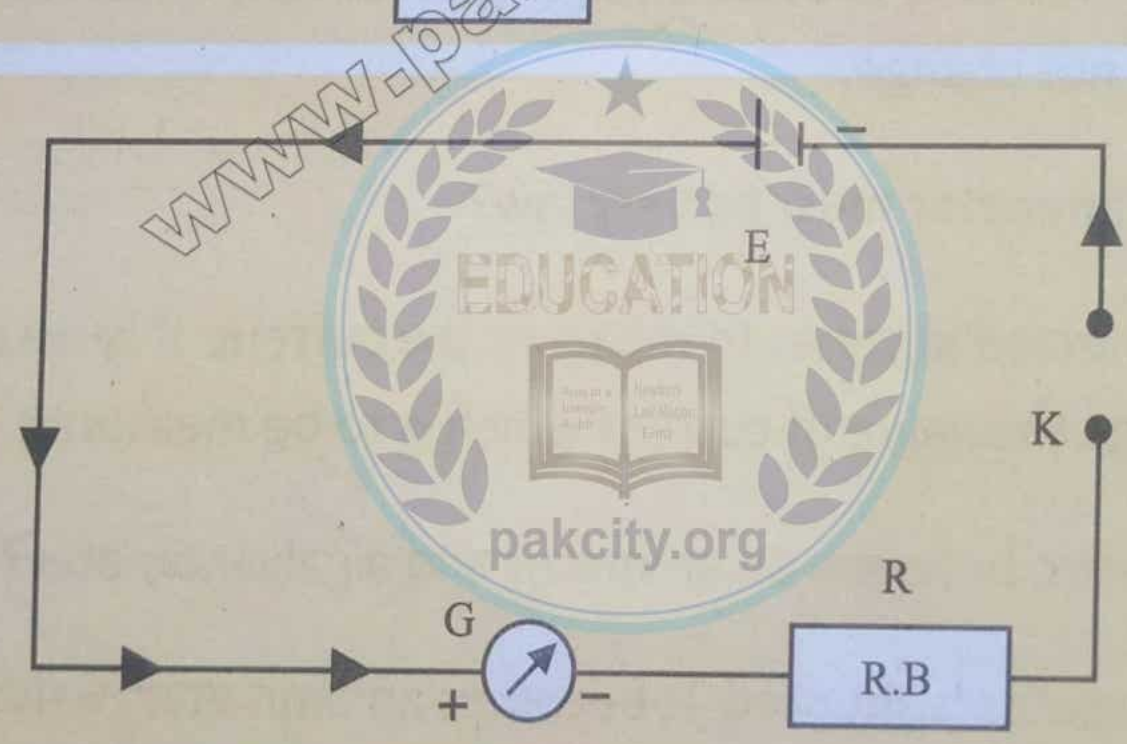
EXPERIMENT NO. 6

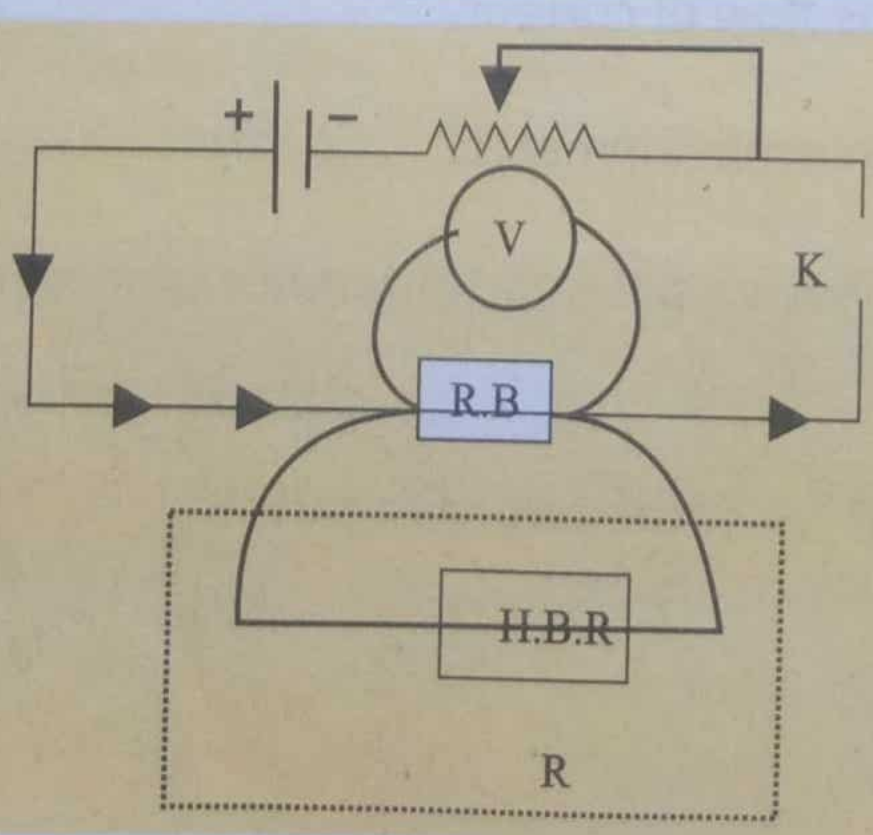
To convert a moving coil (Weston type) galvanometer into a voltmeter up to 3 volts (0 – 3 volts range).

APPARATUS: A moving coil (Weston type) galvanometer, voltmeter of 0 – 3 volts range, High resistance box, fractional resistance box, battery (of 2 or 3 cells), two plug keys, rheostat, connecting wires and sand papers.

DIAGRAM:







PROCEDURE:

I drew circuit diagram and made tight connections according to diagram. I connected H.R.B, battery, key K_1 and galvanometer in series which forms a loop. Then I connected F.R.B along with K_2 in parallel to galvanometer. I closed K_1 and opened K_2. I plug out suitable resistance from H.R.B and obtained even number deflection on galvanometer. Now I also closed K_2 and observed that deflection on galvanometer becomes zero. Then I plug out shunt resistance S from F.R.B which makes deflection on galvanometer half. I calculated resistance of galvanometer by formula

$$G = \frac{RS}{R-S}$$

I took two more observations by changing values of R and S by same method. I calculated mean value of resistance of galvanometer.

Then I noted the emf of cell using a voltmeter and calculated current passing through the galvanometer with resistance R by formula

$$I = \frac{E}{R+G}$$

I calculated the current required for full scale deflection by

$$I_g = \frac{I}{\theta} \times n$$

Where n is the total number of divisions in galvanometer scale. For conversion of galvanometer into a voltmeter up to 3 volt, I calculated the suitable high resistance required to convert galvanometer using formula

$$R_h = \frac{3.0}{I_g} - G$$

Then I connected a H.R.B, voltmeter and galvanometer according to circuit diagram (C) and noted the deflection θ on galvanometer and reading on voltmeter. The potential difference shown by converted galvanometer is equal to the reading on standard voltmeter. I took three number of readings by varying the rheostat.

OBSERVATIONS AND CALCULATIONS:

No. of Obs.	Resistance taken out from H.R.B R (Ω)	Deflection in Galvanometer θ		Half deflection $\frac{\theta}{2}$	Resistance taken out from F.R.B S	Galvanometer Resistance $G=\frac{RS}{R-S}$
		Observed (divs.)	Corrected (divs.)	(divs.)	(Ω)	(Ω)
1	4000	30	30	15	120	123.7
2	4800	28	28	14	120	123.1
3	5500	26	26	13	120	122.7

Mean value of G = 123.2 Ω

Current for full scale defection (using Ohm's law)

E.M.F. of the battery (or cell) with a voltmeter = E = 1.3 volts

Total number of divisions on the galvanometer scale = n = 30 divs.

From observation No. 01 (take 1 or 2 or 3),

Resistance R = 4000 Ohms.

Deflection = θ = 30 divs.

Current passing through galvanometer = $I=\frac{E}{R+G}$ (Ohm's law)

Current for full scale deflection (30 div) = $I_g = \frac{I}{\theta}$ x n

Hence:

$$I_g=\frac{E\times 30}{(R+G)\theta}=\frac{1.3\ x30}{(4000+123.2)30}\ A = 0.315x10^{-3}\ A = 0.315\ mA$$

Range of voltmeter = 3V

High resistance which is to be connected with the galvanometer = $R_h = \frac{V}{I_g} - G$

$$R_h = \frac{3.0}{0.315x10^{-3}} - 123.2$$

$$R_h = 9524\ \Omega$$

Checking the accuracy of the converted galvanometer

Each scale division on the converted galvanometer = $\frac{V}{n}\ \theta = \frac{3}{n}\ \theta$

No. of Obs.	Resistance taken out from H.R.B. (Ω)	Readings of converted galvanometer		Standard voltmeter Reading (V)	Difference (error) (V)
		Deflection θ (div.)	Voltage in volts $\frac{3}{n}\ \theta$		
1	3000	10	1.0	1.0	0
2	3800	14	1.4	1.4	0
3	4300	19	1.9	1.9	0

RESULT:

In order to convert the galvanometer into voltmeter reading up to 3.0 volts, a high resistance R_h = 9524 ohms must be connected in series with the galvanometer.

PRECAUTIONS

- All the connections should be neat and tight.
- The positive marked terminal of standard voltmeter should go to the positive terminal of the battery.
- Both voltmeter i.e standard voltmeter and converted galvanometer should be connected parallel with the resistance box.
- Suitable resistance should be taken out from the resistance box to produce large deflection in both voltmeters.
- The rheostat used as potential divider should not have low resistance.

(Note: If the difference between the readings of converted galvanometer and voltmeter is large we should adjust the value of external resistance in the resistance box placed in series with the galvanometer unless the readings coincide.)

VIVA VOCE:

Q: What is voltmeter?

Ans: It is a device used to measure potential difference or voltage.

Q: How voltmeter is formed from galvanometer?

Ans: A high resistance is connected in series with the galvanometer.

Q: How range of voltmeter is increased?

Ans: By increasing the value of high resistance which is connected in series with the galvanometer.

Q: How voltmeter is connected in circuit?

Ans: It is connected parallel in circuit.

Q: Why voltmeter is connected in parallel?

Ans: So that the current in circuit will not change and it can measure the exact value of voltage.

Q: Why the resistance of voltmeter must be very high?

Ans: If the resistance of voltmeter is low then current will pass through it and the potential difference changes which is to be measured.

Q: How voltmeter is different from ammeter?

Ans: High resistance connected in series with the galvanometer makes a voltmeter while shunt connected in parallel with the galvanometer makes an ammeter.

Q: Can a D.C voltmeter or a D.C ammeter be used to measure alternating volatage or alternating current?

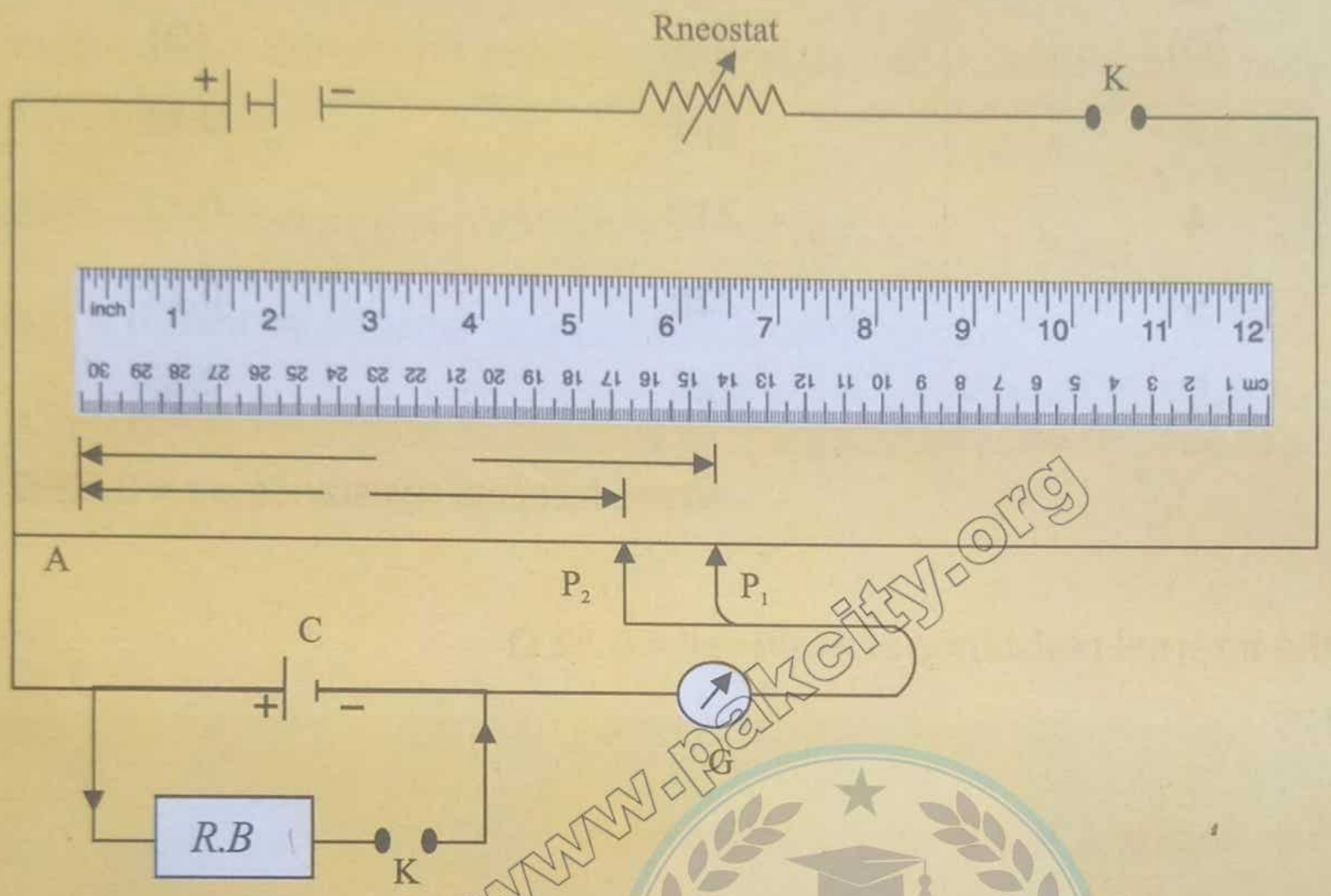
Ans: No, they cannot be used.

EXPERIMENT NO. 7

To determine internal resistance of a cell by using a potentiometer.

APPARATUS: Potentiometer, galvanometer, rheostat, battery, resistance box, keys, cells, connecting wires, sand paper etc.

DIAGRAM:



PROCEDURE:

I made the connections according to circuit diagram. Closed key K_1 and pressed the jockey at both ends one by one and observed that the deflection is reversed which proves that the circuit is correct. I got balance point (galvanometer shows zero deflection) l_1 by sliding jockey on the wire. Then I took out some resistance from low resistance box, closed key K_2 , found balance point l_2. Calculated the internal resistance of cell by using formula

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

By changing resistance taken out from low resistance box, I repeated the same method three times and calculated mean value.

OBSERVATIONS AND CALCULATIONS:

Length of wire for dry cell C when K_2 open (i) 256 cm (ii) 256 cm (iii) 256 cm

Mean length of wire l_1= 256 cm

When k_2 is also closed

No. of Obs.	Resistance taken out from R.B R (Ω)	Balancing length when R is taken out l_2 (cm)	Internal resistance of cell $r = \frac{(l_1 - l_2)R}{l_2}$ (Ω)
1	3	201	0.82
2	4	213	0.81
3	5	220	0.82
4	6	225	0.83

Mean internal resistance = r = 0.82 Ω

RESULT:

It is found that the internal resistance of given cell = 0.82 Ω

PRECAUTIONS

- When finding l_1, key k_2 must be kept open
- Allow the current to flow at the time of taking observations. After every reading key k_1 should be opened to allow the wires to cool for correct value of l_1.
- The e.m.f of battery E should be greater than e.m.f of cell C.

VIVA VOCE:

Q: What is potentiometer?

Ans: It is a device which is used to measure e.m.f of a cell or battery, compare e.m.f of two cells and find internal resistance of a cell.

Q: What is length of potentiometer wire?

Ans: Length of potentiometer wire is 400cm.

Q: For measurement of emf of a cell which of the two is more suitable, voltmeter or potentiometer?

Ans: Potentiometer is accurately measuring device because it draw no current from the circuit.

Q: What are uses of potentiometer?

Ans: It is used; as a potential divider circuit, to find internal resistance of a cell or battery, to measure e.m.f of a cell, to compare e.m.f of two cells.

Q: Why the potentiometer is considered to be an accurate device for measuring potential difference?

Ans: Because it draws no current from the circuit.

Q: What is meant by internal resistance of a cell?

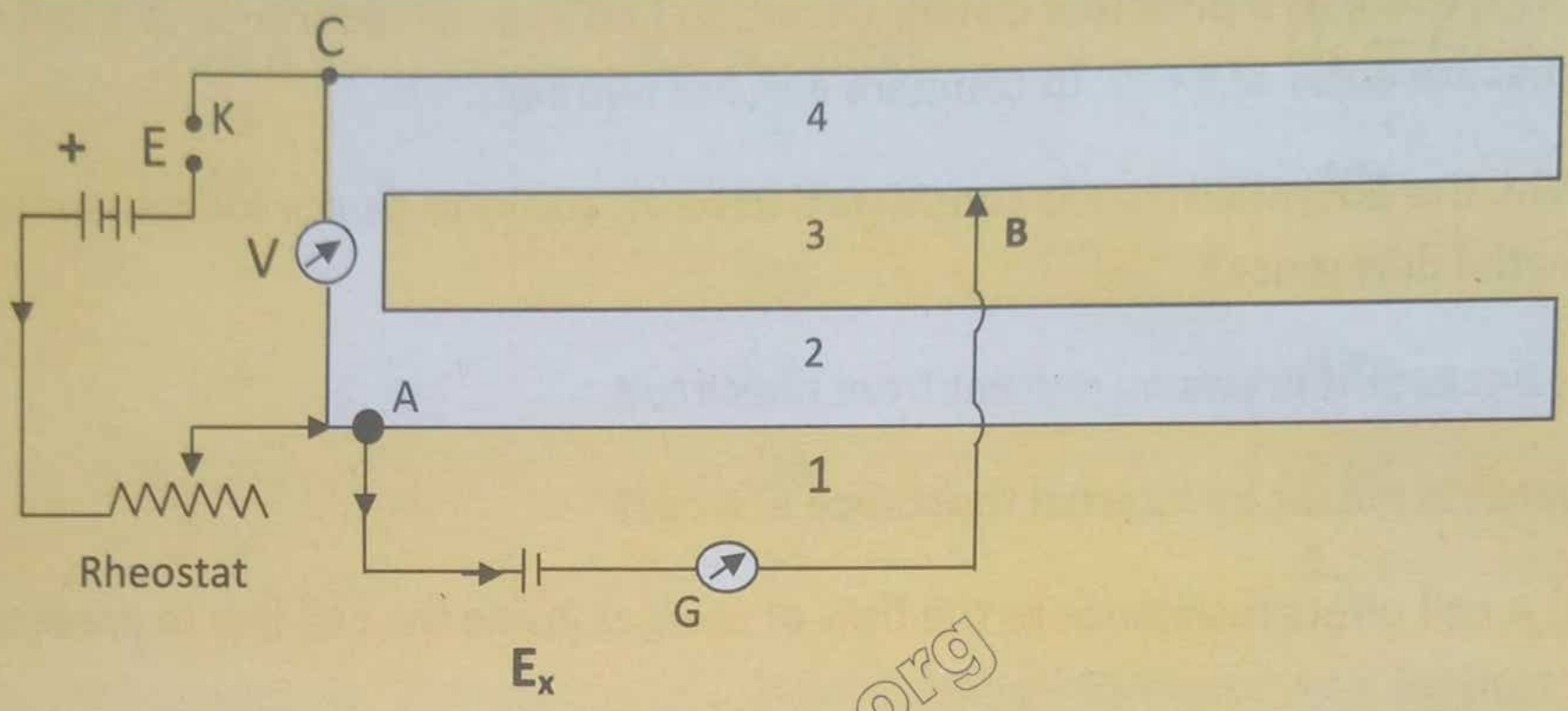
Ans: A cell offers resistance to the flow of charges inside the cell due to presence of electrolyte.

EXPERIMENT NO. 8

To determine the e.m.f of a cell using a potentiometer.

APPARATUS: Potntiometer, rheostat, connecting wires, cells, keys, sand paper etc.

DIAGRAM:



PROCEDURE:

I made connections according to the circuit diagram. I measured the length of wire 'L' of potentiometer with meter rod. Closed key K and pressed the jockey at both ends one by one and observed that the deflection is reversed which proves that the circuit is correct. I adjusted the voltage between A and B by rheostat and then measured this voltage 'E' by voltmeter. I noted length of balance point (where galvanometer shows zero deflection) AB = l by sliding jockey on the wire of potentiometer. I calculated emf of the cell by formula

$$E_x = E \times l/L$$

By changing potential difference between A and B, I took three more observations by same method. I found mean value of emf of given cell.

OBSERVATIONS AND CALCULATIONS:

Rest position of galvanometer = 0 div.

Length of potentiometer wire = AB = L = 400cm

Emf of battery in potentiometer circuit = 3 V

No. of Obs.	Potential difference between terminal A and B of potentiometer E (V)	Length of balance point C from end A when cell E_x in the galvanometer circuit l			$E_x = E \times l/L$ (V)
		1 (cm)	2 (cm)	Mean (cm)	
1	3.0	174	174	174	1.31
2	2.5	209	209	209	1.31
3	2.0	261	261	261	1.31
4	1.5	348	348	348	1.31

Means $E_x = 1.31$ V

RESULT:

Actual value of $E_x = 1.31$ V

Difference = 0 V

Percentage error = $\frac{Actual\ value - Observe\ \ value}{Actual\ value} \times 100\%$

Percentage error = 0%

PRECAUTIONS

- The e.m.f of the battery must be greater than that of E_x.
- Allow the current to flow in the potentiometer wire only when taking observations.
- Positive terminals of the battery E and E_x should be connected to the common terminal A of the potentiometer.
- Distance should be measured from the positive terminal A of the potentiometer.

VIVA VOCE:

Q: What is emf of a cell?

Ans: Work done by the cell per unit charge is called its emf.

Q: What is unit of emf?

Ans: It is measured in volts.

Q: Differentiate between emf and terminal potential difference?

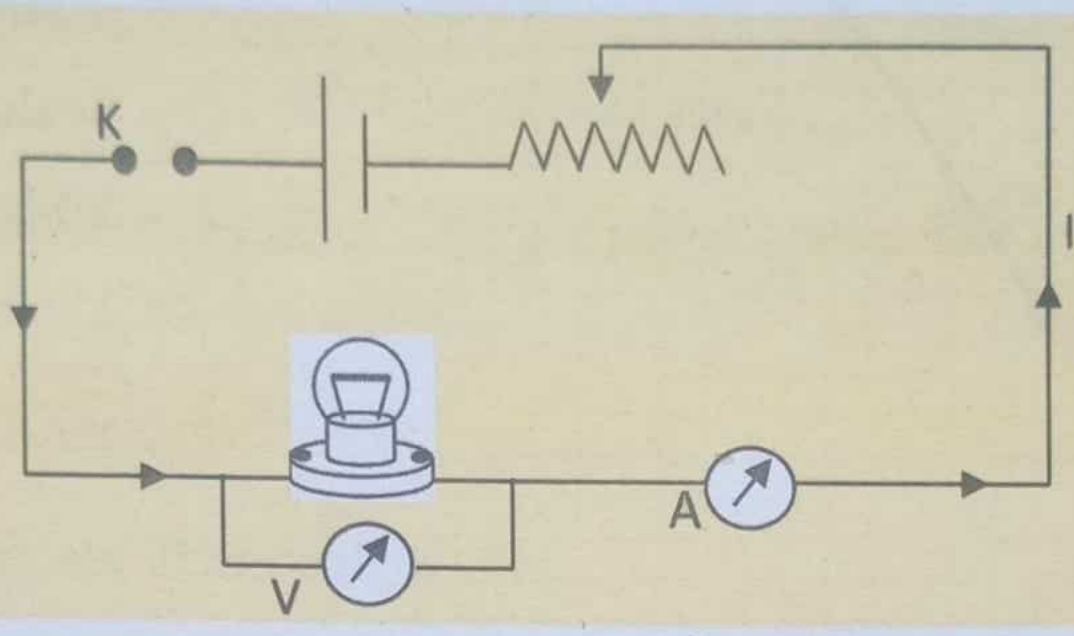
Ans: Potential difference across the ends of cell when the circuit is open measures the emf of cell while the potential difference between the ends of cell when the current is passing through it is called terminal potential difference. Emf is cause while terminal potential difference is its effect.

EXPERIMENT NO. 9

To study the relation between the current passing through tungsten – filament lamp and the potential applied across it.

APPARATUS: 12 Volt battery, ammeter (0 – 3 amperes) high resistance rheostat, 36 watt – 12 volt car bulb, a key, a high resistance voltmeter (0 – 12 volts).

DIAGRAM:



PROCEDURE:

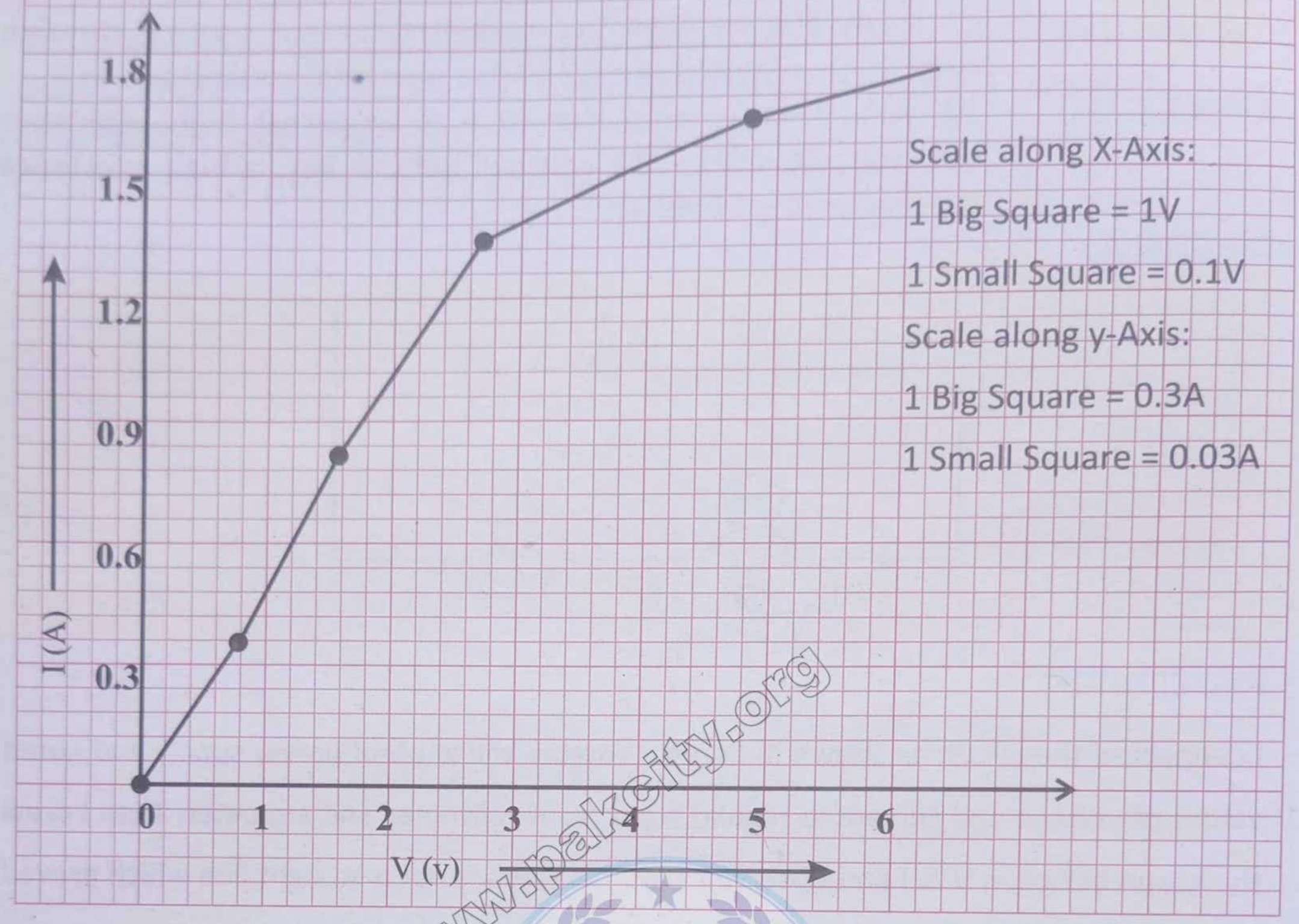
I connected the circuit as shown in figure. I rotated the knob of power supply and noted values of voltage and current in regular steps from voltmeter and ammeter. Then I drew the graph between V & I and observed that the graph is not a straight line which proved that tungsten filament lamp does not obey Ohm's law.

OBSERVATIONS AND CALCULATIONS:

Zero correction of voltmeter = ± 0 V

Zero correction of ammeter = ± 0 A

No. of Obs.	Voltmeter reading V (V)	Ammeter reading I (A)	Resistance R = V/I (Ω)
1	0	0	0
2	0.8	0.4	2.0
3	1.5	0.8	1.88
4	2.7	1.3	2.08
5	3.9	1.5	2.6
6	4.9	1.6	3.06



Result = This graph is not a straight line which proves that I is not proportional to V.

RESULT:

It is found that the ratio V/I is not constant. The graph between V and I is not a straight line, so V is not proportional to I and thus Ohm's law is not valid.

PRECAUTIONS

- Voltmeter must be connected in parallel across the bulb and ammeter in series.
- Voltmeter and ammeter must be connected according to the polarity shown in circuit diagram i.e positive terminals of ammeter and voltmeter should be connected with positive terminal of battery.
- High resistance rheostat should be used.

VIVA VOCE:

Q: State Ohm's law?

Ans: The current passing through a wire is directly proportional to the potential difference across the ends of the wire.

Q: What is graphical representation of Ohm's law?

Ans: V-I graph is a straight line showing that I is proportional to V.

Q: What is meant by ohmic and non ohmic substances?

Ans: The substances which obey Ohm's law are called ohmic. The substances which do not obey Ohm's law are called non-ohmic.

Q: Give examples of ohmic substances?

Ans: All the conductors are ohmic substances.

Q: Give examples of non ohmic substances?

Ans: Semiconductors and filament bulbs are non-ohmic substances.

Q: Why I-V graph is not straight line for tungsten filament lamp?

Ans: Because it is a non-ohmic substance.

Q: Tungsten filament of bulb obeys Ohm's law or not? Why?

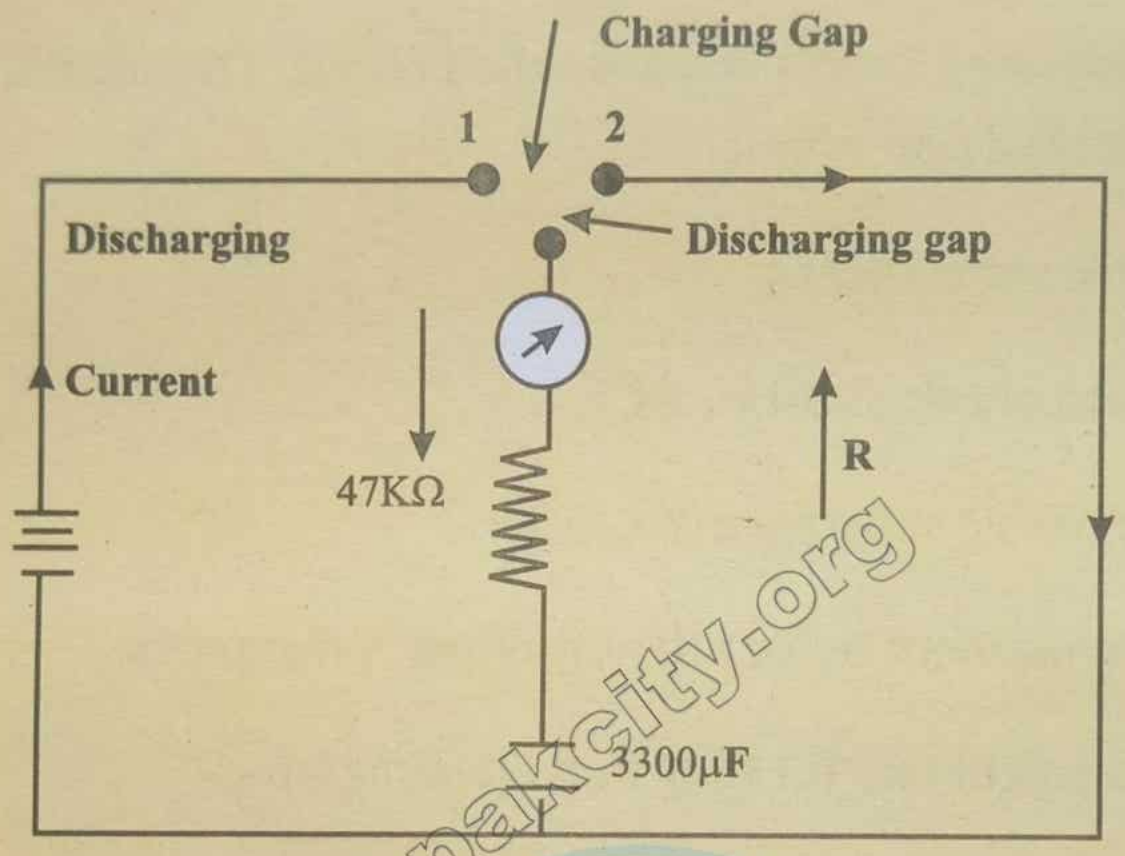
Ans: It does not obey Ohm's law because temperature and resistance of filament changes.

EXPERIMENT NO. 10

Charging and discharging of a capacitor and to measure time constant.

APPARATUS: Resistance of about 47 $K\Omega$ fitted on base, micro-ammeter 0 – 200 (μA), capacitor of $2200\mu F - 3300\mu F$, two way key, stop watch and power supply or battery of 12 volts

DIAGRAM:



PROCEDURE:

Charging of Capacitor:

I drew circuit diagram and made connections according to it. I closed gap 1 and opened gap 2 of two ways key and started stopwatch. I noted current on ammeter after every 10s. I noted that after some time current through capacitor becomes constant which means capacitor is fully charged. I measured this constant current and calculated maximum charge.

I plotted a graph between t and I and observed that graph is exponential increasing function. I marked a point at 0.63 I_o on current axis and measured the corresponding value of time t on time axis. This is called time constant and I calculated its value by formula t = RC and found that both values are equal.

Discharging of Capacitor

I opened gap 1 and closed gap 2 of two ways key and started stopwatch. I noted reading on digital micro-ammeter after every 10s until ammeter reading becomes zero. I noted that after some time current through capacitor becomes zero which means capacitor is fully discharged.

I plotted a graph between t and I and observed that graph is exponential decreasing function. I noted the current I_o at a time when capacitor just started discharging. I marked a point at 0.37 I_o on current axis and measured the corresponding value of time t on time axis. This is called time constant and I calculated its value by formula $\tau_C = RC$ and found that both values are equal. Also, I observed that value of time constant for charging and discharging of capacitor is same.

OBSERVATIONS AND CALCULATIONS:

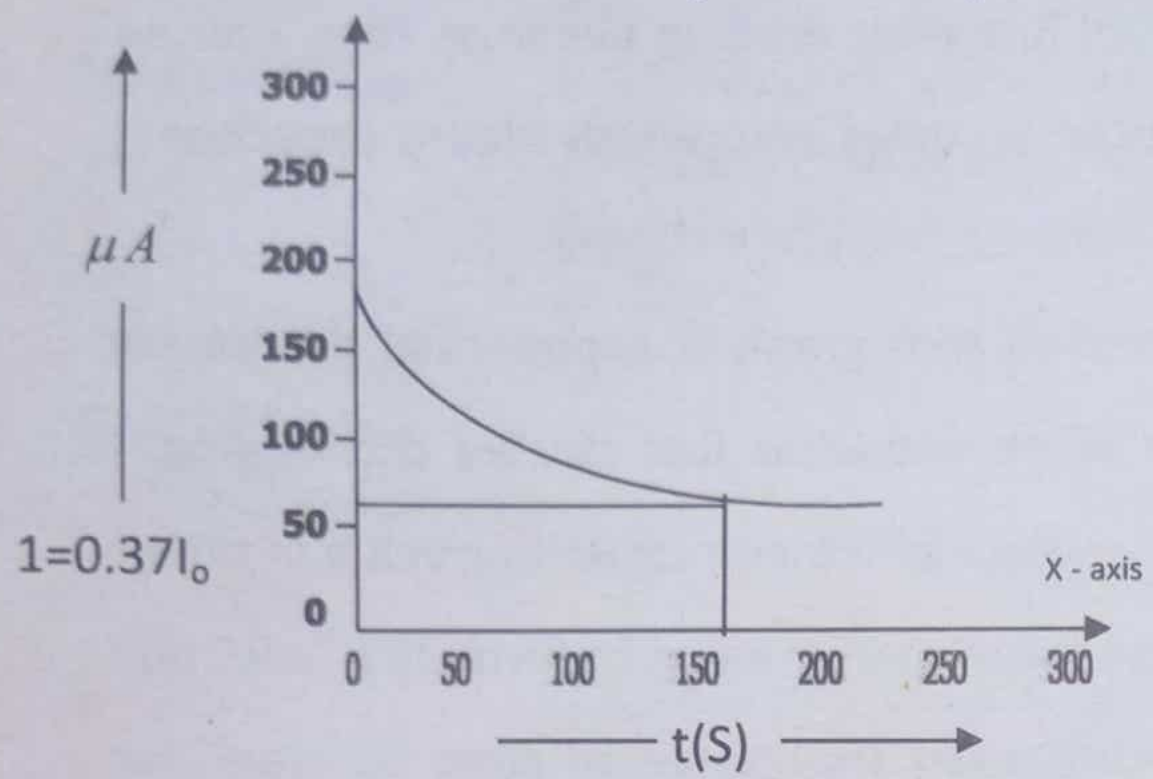
Value of resistance = R = 47000 Ω

Value of capacitance = 3300 μF

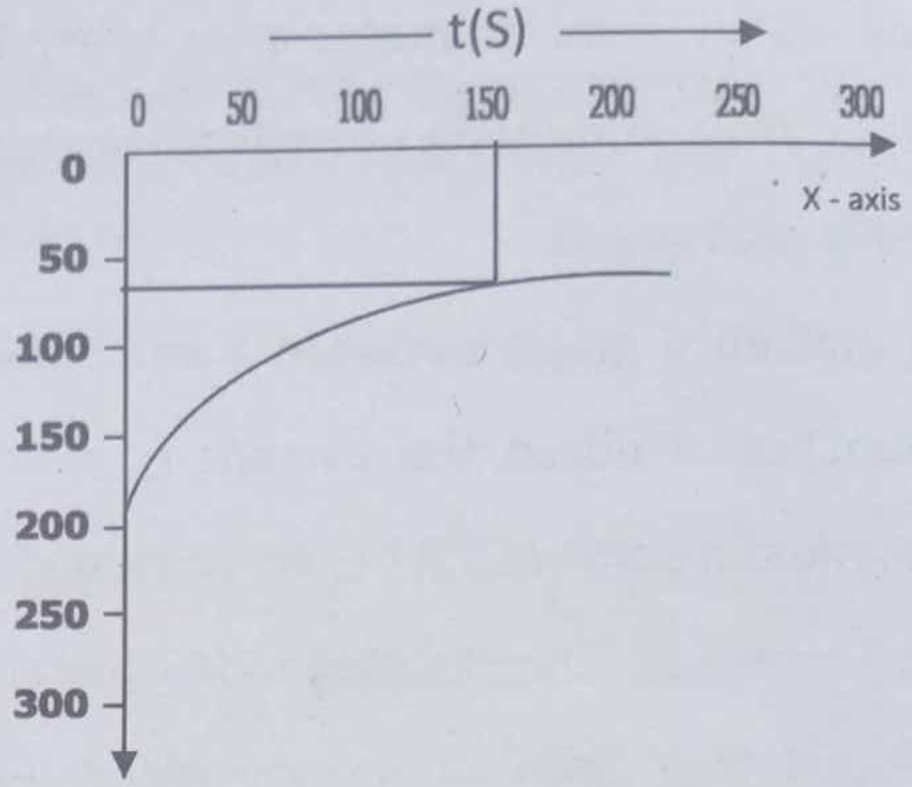
No. of Obs.	For charging current		For discharging current	
	Time t (S)	Current I (mA)	Time t (S)	Current I (mA)
1	0	170	0	- 170
2	10	150	10	- 150
3	20	135	20	- 135
4	30	122	30	- 122
5	40	105	40	- 105
6	50	90	50	- 90
7	60	76	60	- 76
8	70	55	70	- 55

GRAPHS:

a) Charging



b) Discharging



CALCULATIONS OF TIME CONSTANT FROM GRAPHS:-

Maximum charging current at start t = 0, I_o= 170 μA

$$0.37\ I_o = 0.37 \times 170 = 62.9\ \mu A$$

From graph time corresponding to 0.37 I_o = 150.5 s

Or Time constant = 150.5 s

Time constant from graph in charging $t_1 = 150.5\ s$

Time constant from graph in discharging $t_2 = 150.5\ s$

Mean time constant = t = $\frac{t_1 + t_2}{2}$ = 150.5 s

Calculated value of time constant of circuit RC = t = CR = 47000 x 3300 = 155.5 s

Difference = 155.5 – 150.5 = 0.5 s

NOTE:

In both cases on the graph, note the time after which the charging or discharging current I becomes 0.37 times its value at t = 0

PRECAUTIONS

- The connections should be neat and tight.
- The reading of the current should be noted till the current drops to 20% of the maximum value.
- As the key is opened, at the same time the stop watch should be started.
- High value capacitor and high value resistance must be used.

VIVA VOCE:

Q: What is a capacitor?

Ans: Capacitor is a device which stores charge.

Q: What is capacitance? What is its unit?

Ans: The capacity of a capacitor to store charge is called its capacitance. Its S.I unit is Farad.

Q: What are the factors upon which capacitance depends?

Ans: Capacitance depends upon dimensions of plates, gap between the plates, and nature of dielectric medium.

Q: What is effect of dielectric on capacitance?

Ans: Capacitance increases due to the presence of dielectric.

Q: What is effect on capacitance by doubling the area of plates?

Ans: It will be doubled.

Q: What is effect on capacitance by doubling the distance between plates?

Ans: It will be halved.

Q: What is time constant for charging?

Ans: The product RC is called time constant. It is time to store $0.63q_o$ charge.

Q: What is time constant for discharging?

Ans: It is time to discharge $0.63q_o$ charge or it is the time after which $0.37q_o$ charge remains stored.

Q: Give formula for time constant.

Ans: $t = RC$

Q: What is unit of RC?

Ans: It is time constant. Its unit is seconds.

Q: Give formula for energy stored in a capacitor.

Ans: $E = \frac{1}{2} CV^2$

Q: What is energy density?

Ans: Energy stored per unit volume of the capacitor is called energy density.

Q: How does the charge on a capacitor build up with time?

Ans: Battery does work to transfer charge.

Q: Which factors determines the rate at which charge grows on a capacitor?

Ans: Time constant determines the rate of charging and discharging.

Q: How is the charging time constant of an RC circuit related to its discharging time constant?

Ans: Both are same.

Q: How does the current through a capacitor vary during its charging?

Ans: Current increases with the increase in charge.

Q: Why is the discharging current maximum initially?

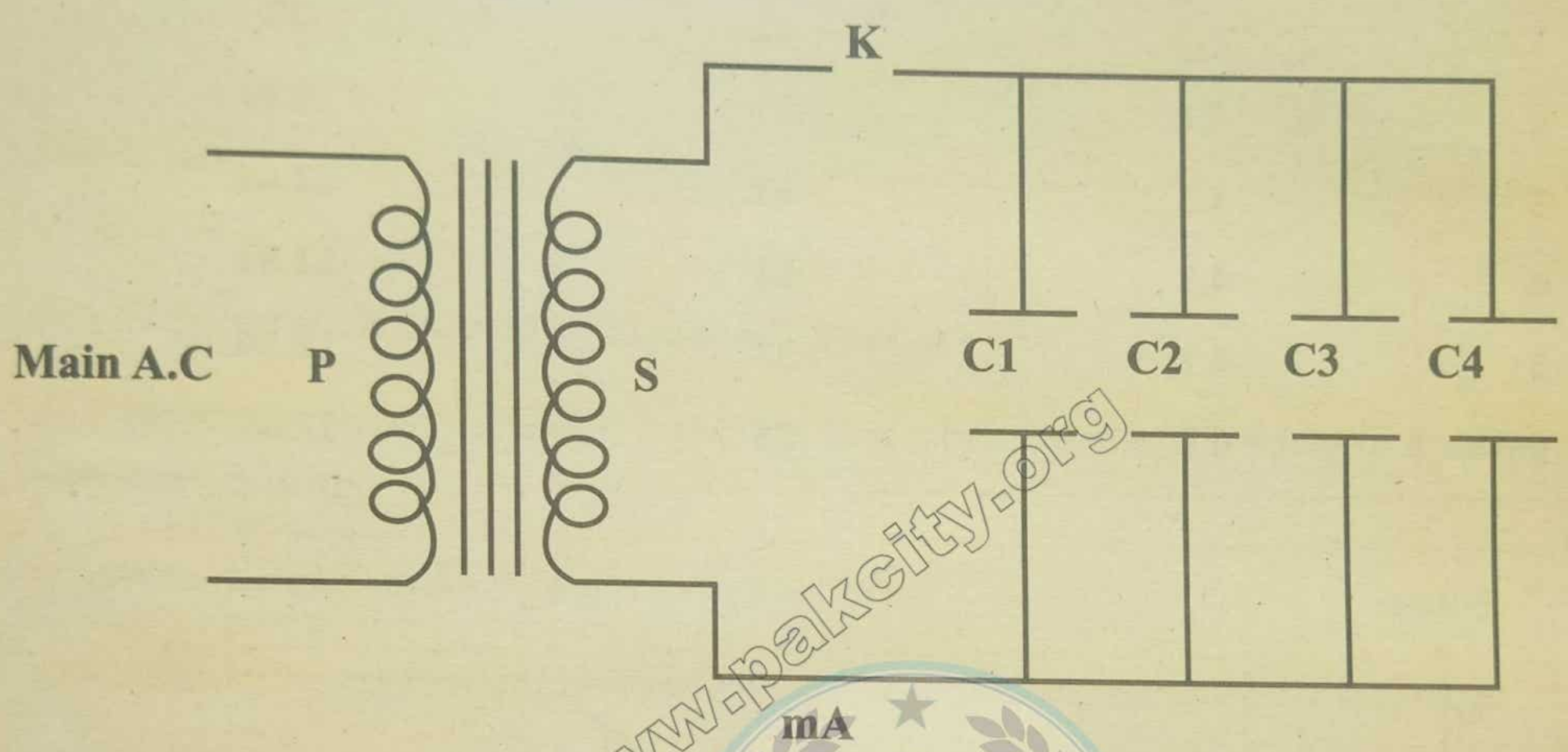
Ans: Because initially charge and potential difference is maximum.

EXPERIMENT NO. 11

Study the relationship between current and capacitance when different capacitors are used in AC circuit.

APPARATUS: AC milli-ammeter, AC voltmeter, different capacitors having capacitance 1.0μF, 2.2μF, 3.3μF, 4.3μF, 4.7μF, 6.8μF, AC power supply with step-down transformer of range 25V, switches, connecting wires and key.

DIAGRAM:



PROCEDURE:

I drew circuit diagram and made tight connection according to it with apparatus on table.

I measured voltage across secondary of step-down transformer with AC voltmeter. I closed switch S_1 which inserted capacitor of capacitance 0.1μF in circuit and measured corresponding current on AC milli-ammeter. I took four more readings by inserting different capacitors in circuit by its switch using same method.

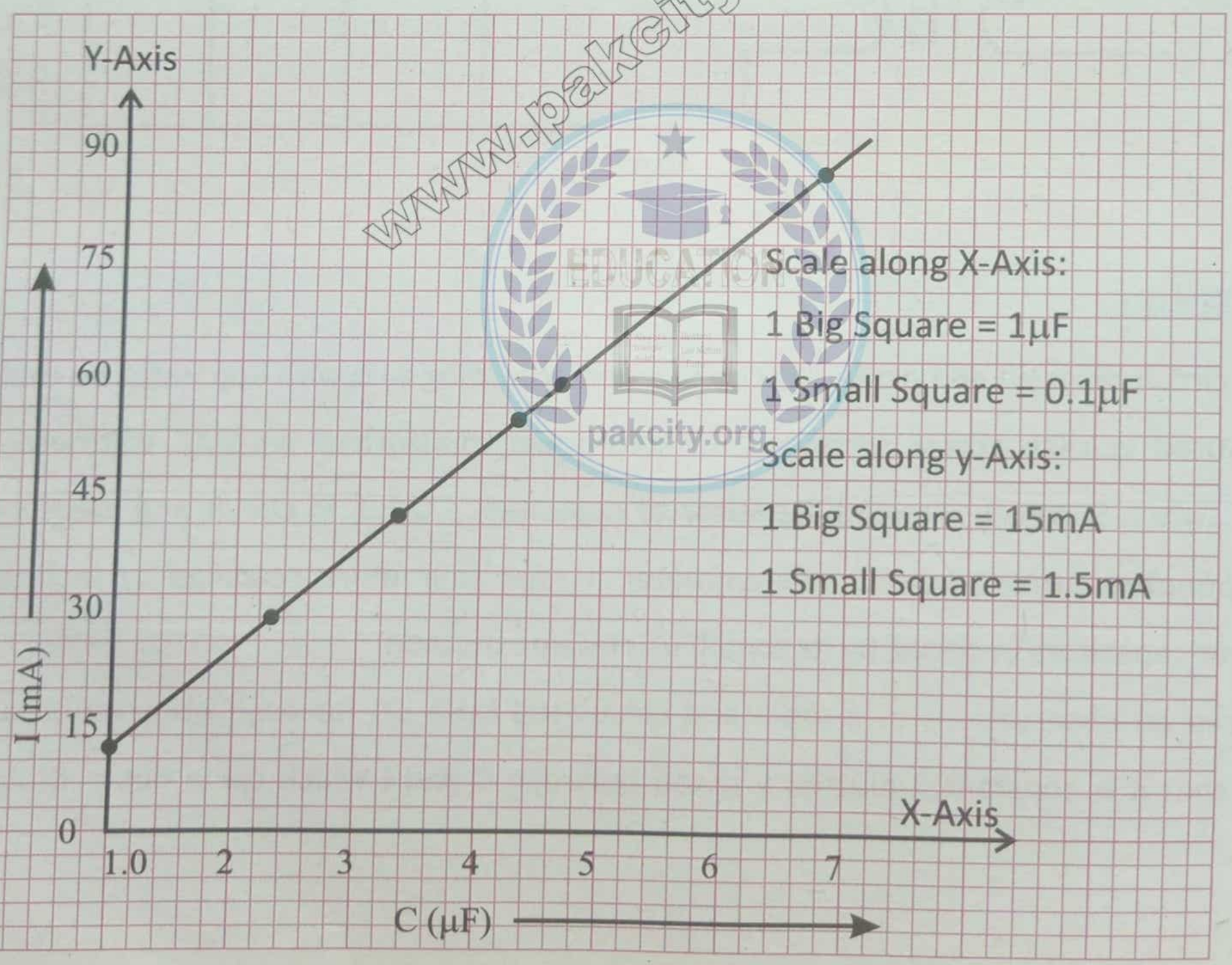
I entered all observations in a table and calculated ratio I/C for each observation and noted that it is constant. I plotted a graph between C and I which came out a straight line.

OBSERVATIONS AND CALCULATIONS:

Least count of the millimeter = 1 mA

Zero correction of millimeter = $\pm$ 0 mA

No. of Obs.	Capacitance of Capacitor C (μF)	Current measured I (mA)	Ratio of current and capacitance $\frac{I}{C}$ (mA/μF)
1	1.0	12	12
2	2.2	27	12.27
3	3.3	41	12.42
4	4.3	53	12.33
5	4.7	58	12.34
6	6.8	84	12.35



RESULT:

As the ratio I/C is constant and also graph between their values is a straight line, so we conclude that the current "I" is directly proportional to the capacitance in an A.C circuit.

PRÉCAUTIONS

- Do not use the electrolytic condenser.
- Do not try to touch to the primary of the transformer.
- Use A.C voltmeter and A.C ammeter.
- The condensers should be discharged after the experiment.
- Do not use the higher voltages in this experiment.

VIVA VOCE:

Q: Which current is blocked by capacitor? Why?

Ans: Direct current is blocked by capacitor. This is because there is insulator between the plates of capacitor.

Q: Which current passes through capacitor? Why?

Ans: Alternating current passes through capacitor due to polarization of dielectric.

Q: What is equivalent capacitance of capacitors connected in parallel?

Ans: Equivalent capacitance of capacitors connected in parallel is given as

$C_e = C_1 + C_2 + C_3 + ...$

Q: What is equivalent capacitance of capacitors connected in series?

Ans: Equivalent capacitance of capacitors connected in series is given as

$1/C_e = 1/C_1 + 1/C_2 + 1/C_3 + ...$

Q: How does an A.C differ from D.C?

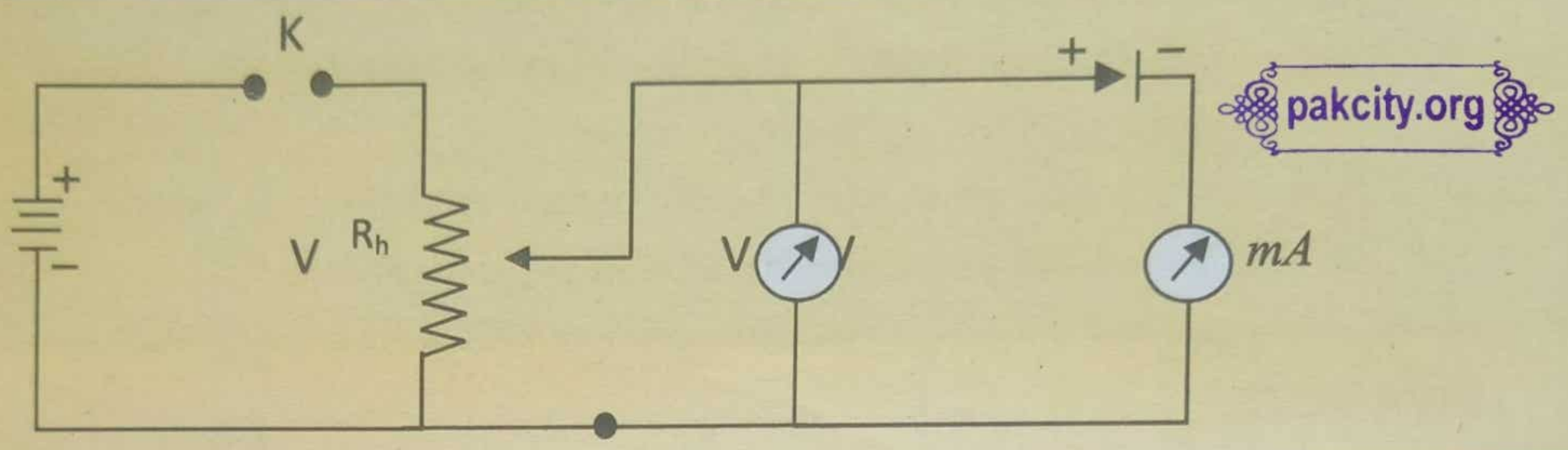
Ans: A.C changes with time. Polarity of A.C reverses with a specific frequency while D.C has a constant value.

EXPERIMENT NO. 12

To study the characteristics of a semi – conductor diode and calculation of forward and reverse current resistance.

APPARATUS: Semiconductor diode, power supply, voltmeter, milli-ammeter, micro-ammeter, potential divider, digital multimeter.

DIAGRAM:



PROCEDURE:

The procedure of this experiment has two parts.

Forward Bias:

I drew circuit diagram and connected the diode across the leads of a digital multimeter to check the resistance of a diode. Then I made second resistance check of the diode with the leads reversed. I observed that diode will measure high resistance when it is reverse biased and low resistance when it is forward biased. Also, I observed that the ratio of reverse resistance reading to forward resistance reading is about 10:1 which means it is a good diode. I took a diode and made connections according to circuit diagram. I increased the anode potential in regular steps by using potential divider and measured the corresponding current on millimeter.

I plotted a graph between potential difference V and current I to study characteristics of diode and observed that graph is non-linear. I determined the forward resistance from the graph. $r_f = \frac{\Delta v}{\Delta I}$

OBSERVATIONS AND CALCULATIONS:

Zero correction for voltmeter = ± 0 V

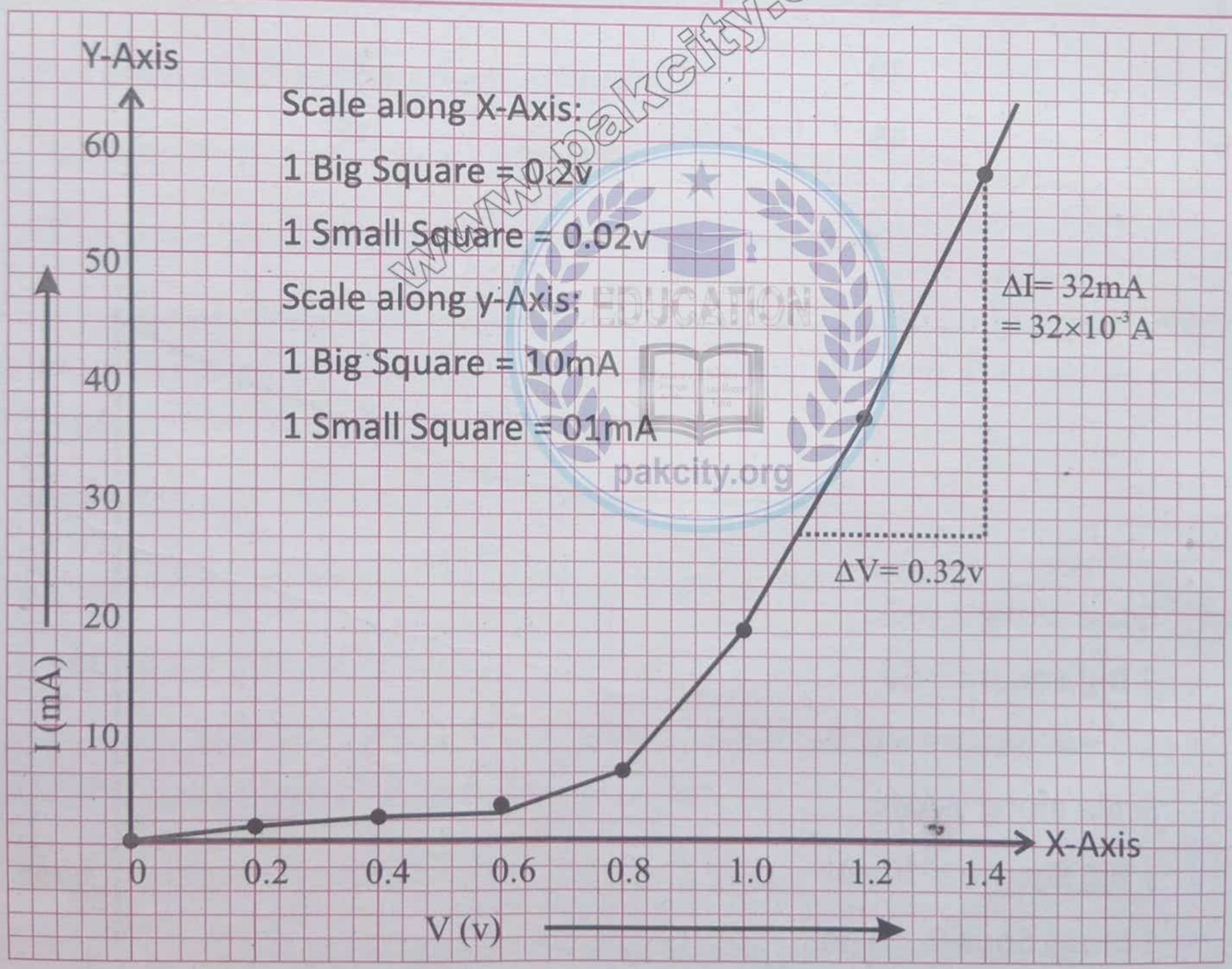
Zero correction for milli ammeter = ± 0 mA

Leas count of voltmeter = 0.1 V

Least count of milli ammeter = 1.0 mA

FORWARD CHARACTERISTICS

No. of Obs.	Voltmeter Reading V (V)	Milli Ammeter Reading I (mA)
1	0	0
2	0.2	1
3	0.4	2
4	0.6	3
5	0.8	6
6	1.0	18
7	1.2	36
8	1.4	57



Result from graph = $r_f = \frac{\Delta V}{\Delta I} = \frac{0.32}{32\times10^{-3}} = 10\Omega$

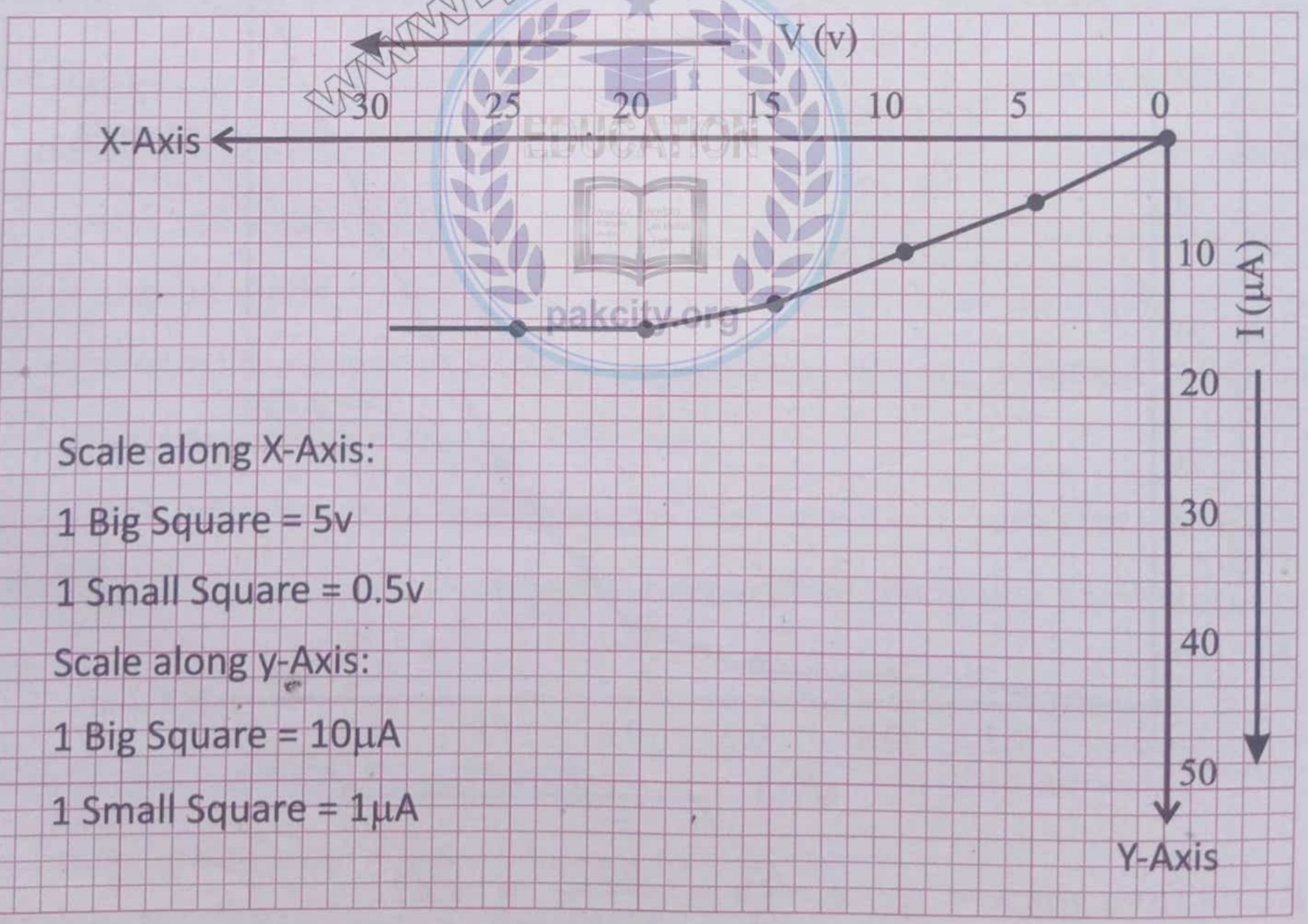
(Note: In the final exam practical question paper mostly forward biased characteristics are asked and not reverse biased.)

Reverse Bias:

I drew circuit diagram and made connections according to circuit diagram. I increased the anode potential in regular steps by using potential divider and measured the corresponding current on micro-ammeter. I plotted a graph between potential difference V and current I to study characteristics of diode.

REVERSE CHARACTERISTICS

No. of Obs.	Voltmeter Reading V (V)	Micro Ammeter Reading I (μA)
1	0	0
2	5	5
3	10	9
4	15	13
5	20	15
6	25	15



Scale along X-Axis:

1 Big Square = 5v

1 Small Square = 0.5v

Scale along y-Axis:

1 Big Square = 10μA

1 Small Square = 1μA

PRECAUTIONS

- Make sure that all the connections are neat, clean and tight.
- The voltage should be increased by regular steps.
- The current should be passed for a short interval of time.
- We should be careful in connecting positive and negative terminals of the voltmeter and milli ammeter.

VIVA VOCE:

Q: What are semiconductors?

Ans: The elements lying in the 4^{th} group of periodic table such as Si and Ge are semiconductors.

Q: What are types of semiconductors?

Ans: Semiconductors are of two types; intrinsic and extrinsic

Q: What are types of Extrinsic Semiconductors?

Ans: Extrinsic Semiconductors are of two types; p-type and n-type.

Q: Differentiate between p-type and n-type semiconductors?

Ans: In p-type semiconductor holes are majority charge carriers and electrons are minority charge carriers while in n-type semiconductor electrons are majority charge carriers and holes are minority charge carriers.

Q: What is PN junction?

Ans: Single semiconductor crystal is made half p-type and half n-type.

Q: What is depletion region?

Ans: Electrons and holes diffuse at the junction, produced positive and negative ions make a chargeless region called depletion region.

Q: What are types of biasing?

Ans: There are two types of biasing; Forward biasing and Reverse biasing.

Q: What is effect on depletion region when diode is in, reverse and when in forward biasing?

Ans: In reverse biasing depletion region becomes widened and in forward biasing it becomes narrow.

Q: What is barrier voltage?

Ans: Potential difference due to positive and negative ions at the juction which stops the further diffuse of electrons and holes across the junction is called barrier voltage. For Si = 0.7V and for Ge = 0.3V.

Q: How much is the forward resistance?

Ans: Forward resistance is small i.e of few ohms.

Q: How much is the reverse resistance?

Ans: Reverse resistance is very high of the order of several mega ohms.

Q: How forward and reverse currents are compared?

Ans: Forward current is in milli amperes while reverse current is in micro amperes.

Q: What are the uses of diodes?

Ans: Diodes are used as rectifier, light source, indicators, and light detectors.

Q: What is rectification? Briefly explain.

Ans: Conversion of A.C into D.C is called rectification. It is of two types; half wave and full wave rectification.

Q: Explain forward and reverse biasing of a semi-conductor diode.

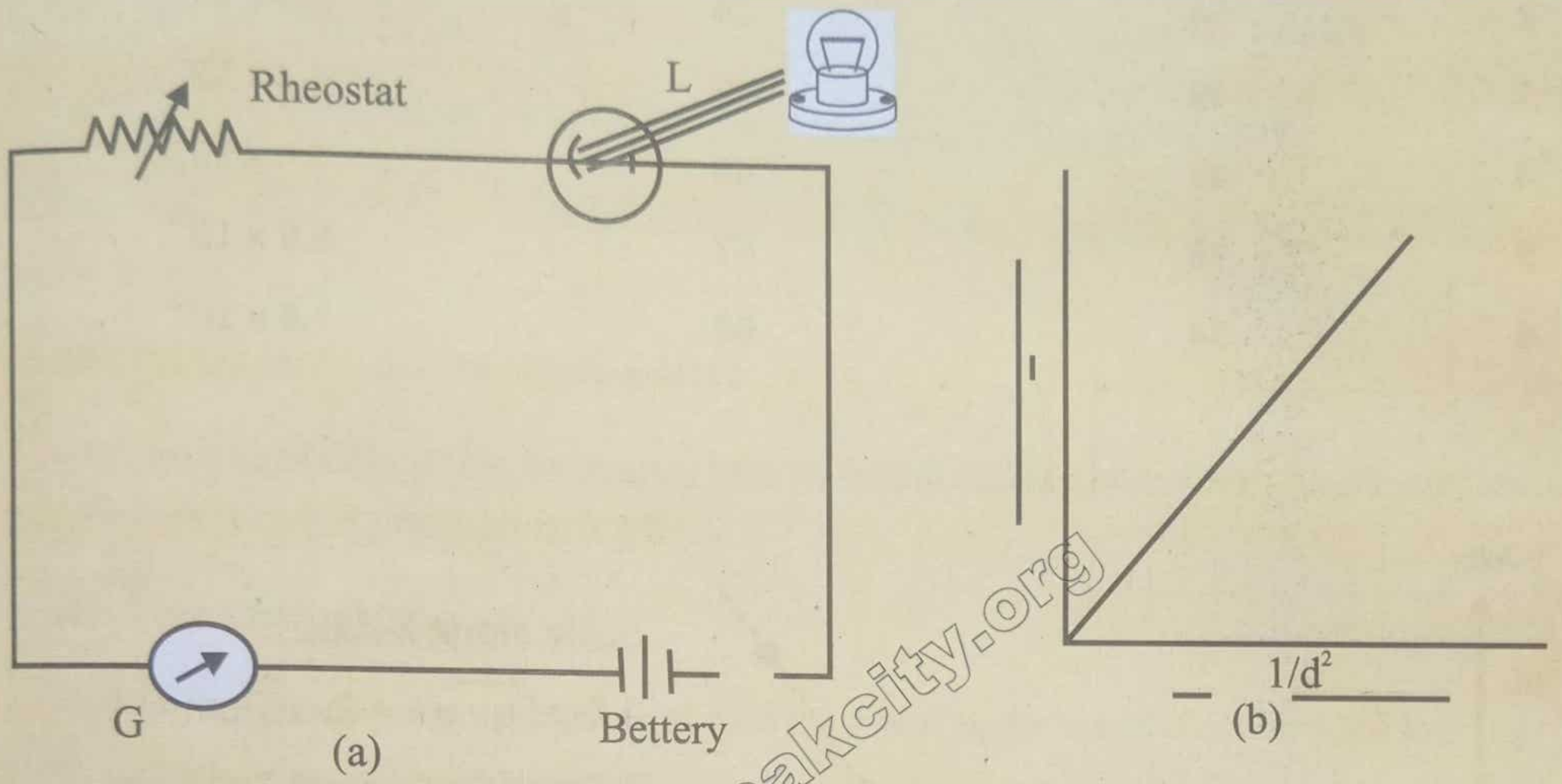
Ans: When positive terminal of battery is connected with p-type and negative terminal with n-type substance then the diode is said to be forward biased and vice versa.

EXPERIMENT NO. 13

To study the variation of photoelectric current with intensity of light using a photocells

APPARATUS: Photo – cell, sensitive galvanometer, Rheostat, key, electric lamp, meter scale (or optical bench) and connecting wires.

DIAGRAM:



PROCEDURE:

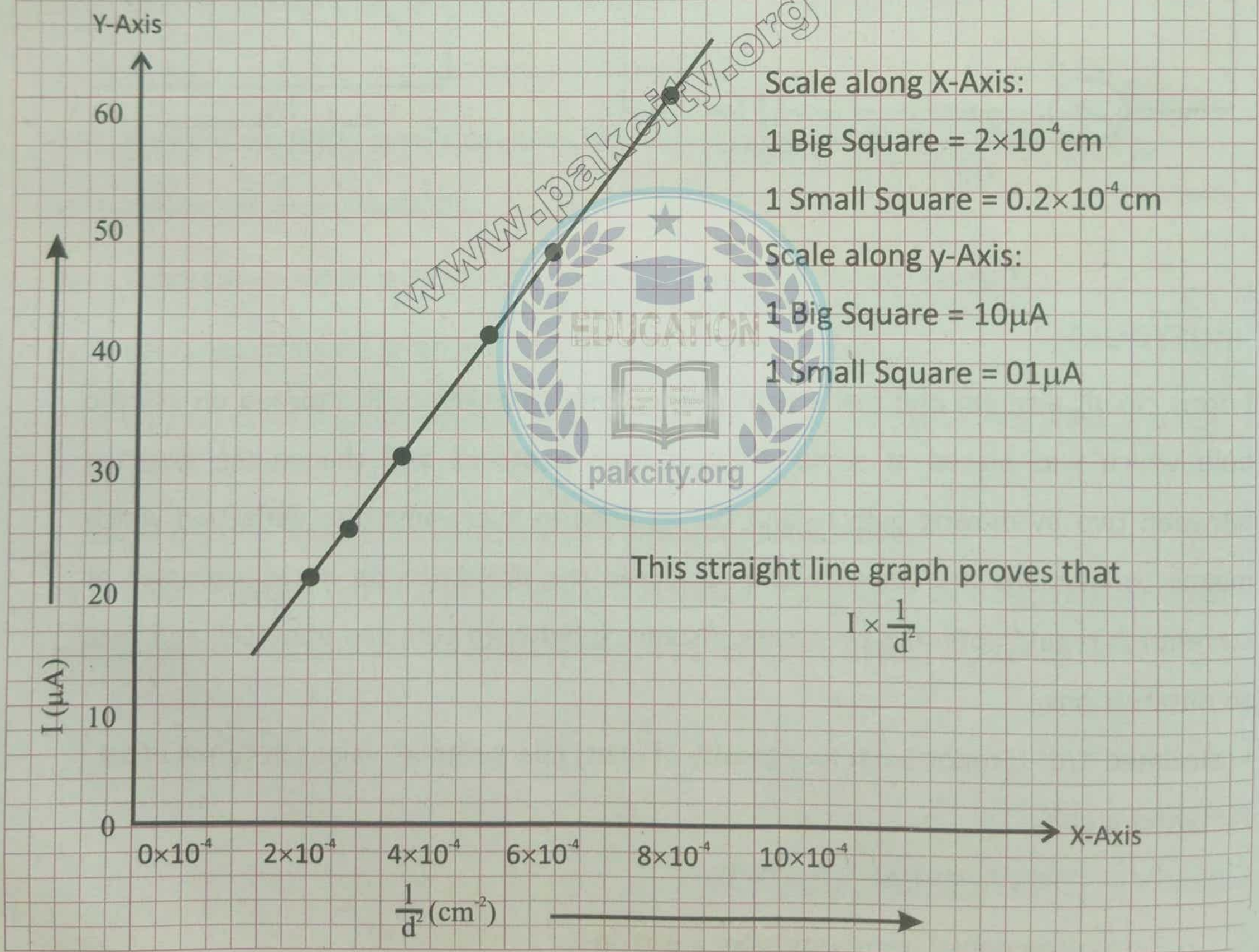
I drew circuit diagram and made tight connections according to it. I turned on electric bulb which was placed at some distance from photocell and change the distance between two by moving bulb to and fro resulting in micro-ammeter deflection which means connections are correct. So I measured the deflection on micro ammeter as current I in regular intervals by varying distance d between bulb and photocell and took six observations.

I calculated $1/d^2$ (proportional to intensity of light) and wrote all values in terms of 10^{-6} for better graph.

OBSERVATIONS AND CALCULATIONS:

Zero correction of micro-ammeter = $\pm$ 0 divs.

No. of Obs.	Distance of bulb from photocell d cm	Photoelectric current I (μA)	Intensity of light $1/d^2$ (cm^{-2})
1	60	20	2.8×10^{-4}
2	54	24	3.4×10^{-4}
3	49	30	4.2×10^{-4}
4	43	40	5.4×10^{-4}
5	38	47	6.9×10^{-4}
6	34	60	8.6×10^{-4}



RESULT:

Since the graph between $1/d^2$ and I is a straight line, so the photoelectric current varies directly to the intensity or light.

PRECAUTIONS

- Experiment should be started with maximum distance of the bulb from the cell and distance should be decreased in regular steps.
- The photocell should not be exposed to light for a long time.
- The bulb should be shifted towards the photocell along the same straight line.

VIVA VOCE:

Q: What is meant by photoelectric effect?

Ans: When a light of suitable frequency falls on metal surface and electrons are ejected, this process is called photoelectric effect.

Q: What are photoelectrons?

Ans: When a light of suitable frequency falls on metal surface and electrons are ejected, these electrons are called photoelectrons.

Q: What is photoelectric current?

Ans: The current produced due to the flow of photoelectrons is called photoelectric current.

Q: What is threshold frequency?

Ans: The minimum frequency which is required to eject electrons from a metal surface is called threshold frequency.

Q: What is work function?

Ans: The minimum amount of energy needed to remove an electron from the metal surface is called work function.

Q: What is relation between work function and threshold frequency?

Ans: Threshold frequency photon has energy equal to work function.

Q: On what factors K.E of photoelectrons depends?

Ans: K.E of photoelectrons depends upon the frequency of incident light.

Q: On what factors number of photoelectrons depends?

Ans: Number of photoelectrons depends upon the intensity of incident light

Q: What is Einstein's equation of photoelectric effect?

Ans: $hf = \phi + K.E_{max}$

Q: What is the rest mass of a photon?

Ans: Rest mass of a photon is zero.

Q: Does photon carry any charge or energy?

Ans: There is no charge on a photon. The energy of photon is given as $E = hf$

Q: With what speed does a photon move?

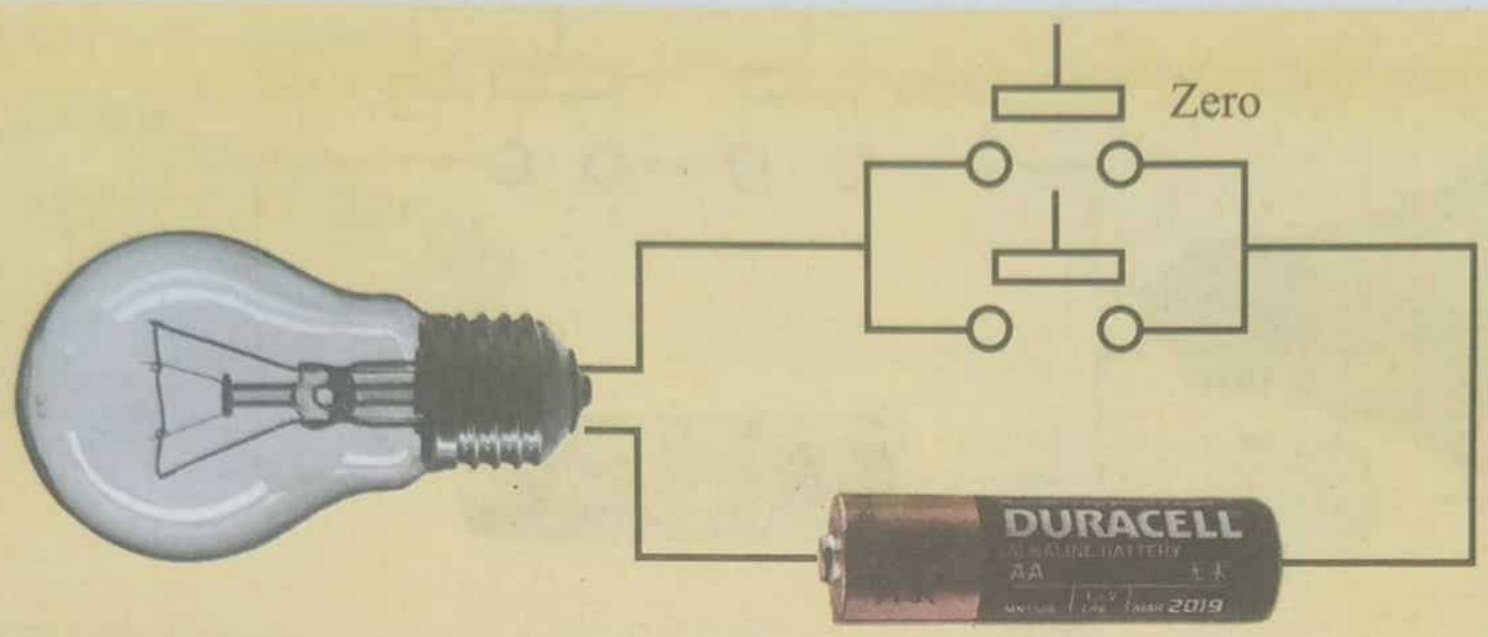
Ans: Photon moves with the speed of light ($3x10^8$ m/s).

EXPERIMENT NO. 14

To verify truth table for logic gates.

APPARATUS: OR, AND, NOT, NAND logic modules, power supply 5 – 8 volts, connecting wires with crocodile clips.

PART A: - OR Gate:



0+0=0

PROCEDURE:

I drew circuit diagram and made tight connections according to it with apparatus on table. I applied +5V at V_{cc}. I applied (0,0) input signal at terminal A and B and I observed that LED at output does not glow. I applied (0,1) input signal at terminal A and B and I observed that LED at output glows. I applied (1,0) input signal at terminal A and B and I observed that LED at output glows. I applied (1,1) input signal at terminal A and B and I observed that LED at output glows. I noted all observations in a table called truth table.

OBSERVATIONS AND CALCULATIONS:

Symbol of OR Gate

Boolean Expression is Y = A + B

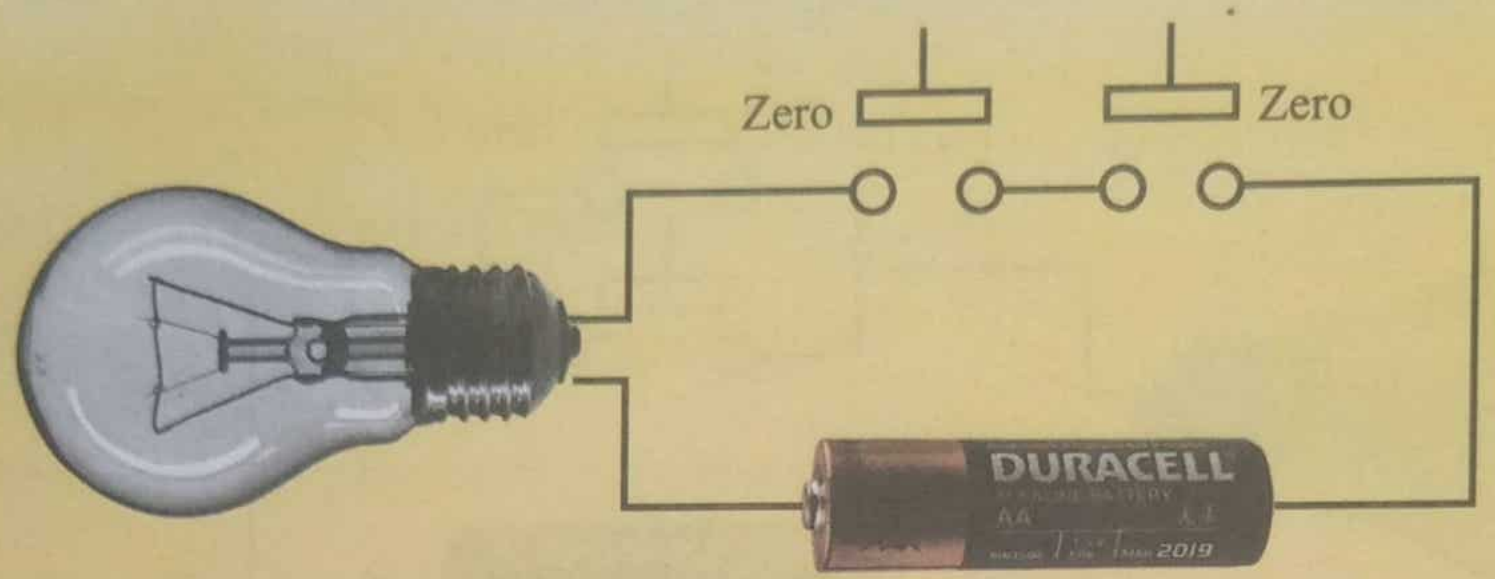
The truth table of this operation is given below:

Input A	Input B	Output Y
0	0	0
0	1	1
1	0	1
1	1	1

RESULT:

In case of OR gate, the output becomes high when any one of inputs is high. All the outputs shown to the examiner and verified the truth table.

PART B: - AND Gate

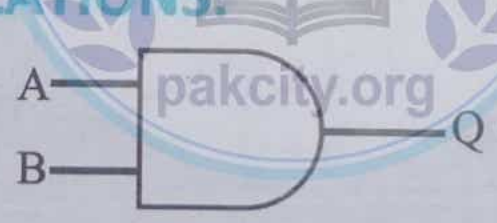


PROCEDURE:

I drew circuit diagram and made tight connections according to it with apparatus on table. I applied +5V at V_{cc}. I applied (0,0) input signal at terminal A and B and I observed that LED at output does not glow. I applied (0,1) input signal at terminal A and B and I observed that LED at output does not glow. I applied (1,0) input signal at terminal A and B and I observed that LED at output does not glow. I applied (1,1) input signal at terminal A and B and I observed that LED at output glows. I noted all observations in a table called truth table.

OBSERVATIONS AND CALCULATIONS:

Symbol of AND Gate



Boolean Expression is Y = A . B

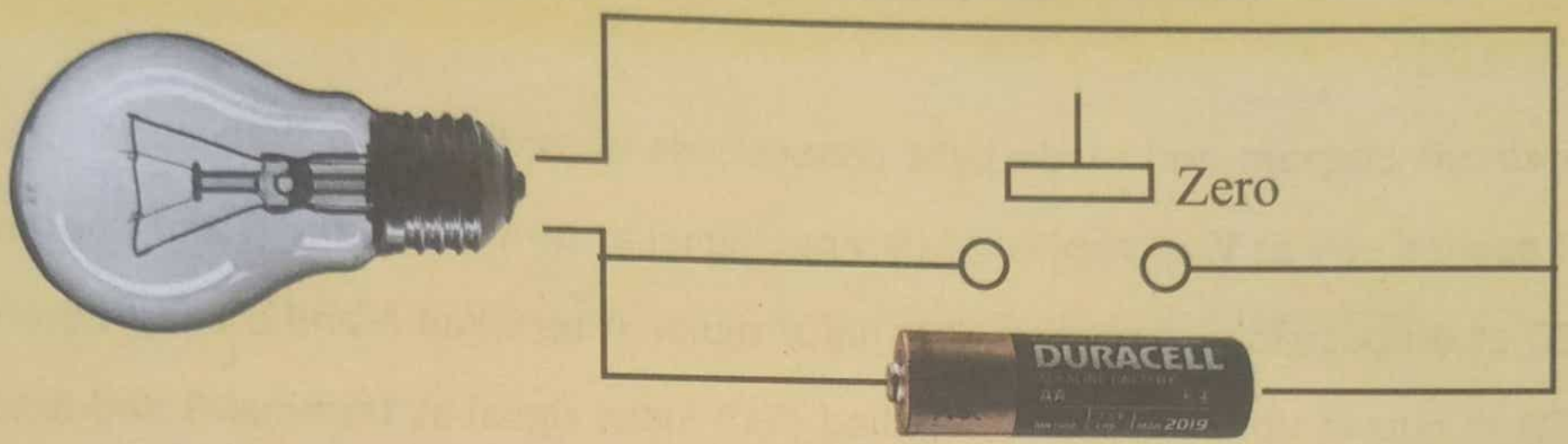
The truth table of this operation is given below:

Input A	Input B	Output Y
0	0	0
0	1	0
1	0	0
1	1	1

RESULT:

In case of AND gate, the output becomes high when any one of inputs is high. All the outputs shown to the examiner and verified the truth table.

PART C: - NOT Gate



0=1

PROCEDURE:

I drew circuit diagram and made tight connections according to it with apparatus on table. I applied +5V at V_{cc}. I applied 0 input signal at terminal A and I observed that LED at output glows. I applied 1 input signal at terminal A and I observed that LED at output does not glow. I noted all observations in a table called truth table.

OBSERVATIONS AND CALCULATIONS:

Symbol of NOT Gate

Boolean Expression is $Y = \bar{A}$

The truth table of this operation is given below.

Input A	Output Y
0	1
1	0

RESULT:

In case of NOT gate, the output is the complement of input. All the outputs shown to the examiner and verified the truth table.

PART D: - NAND Gate

PRECAUTIONS

Precautions in all the parts of this experiment are the same.

- Do not exceed power supply voltage beyond 8 Volt D.C.
- Always keep input either disconnected to high pin or low pin.
- Do not keep inputs disconnected.

VIVA VOCE:

Q: What are logic gates?

Ans: Circuits which perform different logic operations are called logic gates.

Q: What is OR gate?

Ans: It implements OR operation. Its Boolean expression is Y=A+B. It may have two or more than two inputs and a single output.

Q: What is AND gate?

Ans: It implements AND operation. Its Boolean expression is Y=A.B. It may have two or more than two inputs and a single output.

Q: What is NAND gate?

Ans: It is combination of two logic gates; AND gate and NOT gate. Its Boolean expression is $Y=\overline{A.B}$. It has two inputs and a single output.

Q: What is NOR gate?

Ans: It is combination of two logic gates; OR gate and NOT gate. Its Boolean expression is $Y=\overline{A+B}$. It has two inputs and a single output.

Q: What is NOT gate?

Ans: It implements NOT operation. Its Boolean expression is $Y=\bar{A}$. It has a single input and a single output. It is also called inverter.

Q: What do you mean by truth table?

Ans: Truth table summarizes all the possible combinations of inputs and outputs of a logic circuit.

Q: What is meaning of logic 1 and 0?

Ans: Logic 1 represents high value and 0 means low value.

Q: What is binary number system?

Ans: Number system consisting of only two digits 0 and 1 is called binary number system.

Q: Which system is used by a computer for its operation?

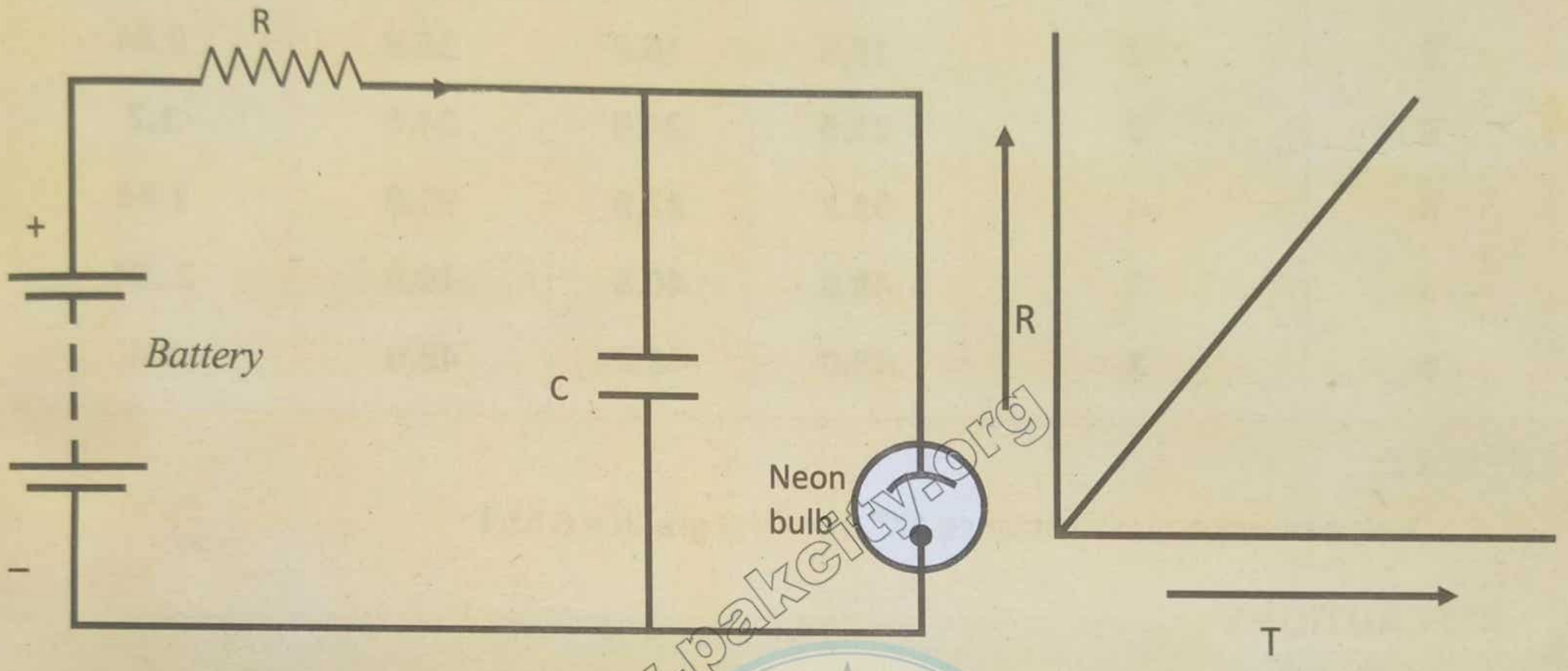
Ans: Binary number system.

EXPERIMENT NO. 15

To determine the high resistance by Neon flash lamp.

APPARATUS: Neon lamp, power supply or high tension batteries, capacitor of known capacitance i.e. 0.2μF, Mega ohm resistances box or known mega ohm resistances (1-10 mega ohms), stop watch and unknown high resistance.

DIAGRAM:



PROCEDURE:

I drew circuit diagram. I took ten resistances having range 1-10MΩ (or it could be resistance box) and a capacitor of any capacity i.e. 0.2μF. I connected a pair (1 MΩ, 0.2 μF) in the circuit and turned on the power supply which resulted in flashing of neon lamp. I measured the time t for 20 flashes and calculated time period T by T=t/20. Then I calculated the time period for pairs (2 MΩ, 0.2 μF), (3 MΩ, 0.2 μF), (4 MΩ, 0.2 μF), and (5 MΩ, 0.2 μF) turn by turn by same method.

I plotted a graph between time period along x-axis and resistance along y-axis which came out a straight line. Then I connected unknown resistance R_X in circuit and calculated the time period T_X for pairs (X MΩ, 0.2 μF). I marked the time period T_X on x-axis and measured corresponding value of resistance R_X on y-axis which is value of unknown resistance from graph.

OBSERVATIONS AND CALCULATIONS:

Striking voltage of neon lamp = V_s = 116 V

Capacitance of the capacitor = C = 0.2 μF

No. of Obs.	Resistance R (MΩ)	Time for 20 flashes			Flashing period T = t/20 (s)
		t_1 (s)	t_2 (s)	Mean time t (s)	
1	1	8.5	8.3	8.4	0.42
2	2	16.8	16.8	16.8	0.84
3	3	24.0	24.0	24.0	1.2
4	4	32.7	32.9	32.8	1.64
5	5	40.8	40.8	40.8	2..04
6	X	48.0	48.0	48.0	2.4

RESULT:

Value of unknown resistance "X" from the graph = 6 MΩ

PRECAUTIONS

- The applied voltage should be kept constant throughout the experiment.
- The applied voltage should always be greater than the striking voltage of the neon flash lamp.
- The capacitance of the capacitor should be selected so as to get a measurable rate of flashing with the used resistance.
- The resistances should be changed step by step but the capacitor should not be changed for a set of observations.
- The stop watch should be started at the same time when flashes start.

VIVA VOCE:

Q: Define flashing period.

Ans: The time between two consecutive glows is called flashing period.

Q: What is meant by striking voltage?

Ans: The potential difference across a neon bulb at which it begins to glow is called striking voltage.

Q: Is it an accurate method?

Ans: No, we can't avoid random error.

Q: What type of graph do you get between flashing time T and the resistance R?

Ans: Straight line