PRACTICAL ZONE

CLASS -12

PHYSICS

PHYSICS PRACTICAL TERM-1& 2

EXPERIMENT – 1

Aim: To determine resistance per cm of a given wire by plotting a graph of potential difference versus current.

Apparatus: A metallic conductor (coil or a resistance wire), a battery, one way key, a voltmeter and an ammeter of appropriate range, connecting wires and a piece of sand paper, a scale.

Formulae Used: The resistance (R) of the given wire (resistance coil) is obtained by Ohm's Law $\frac{V}{I} = R$

Where, V : Potential difference between the ends of the given resistance coil. (Conductor)

I: Current flowing through it.

If l is the length of resistance wire, then resistance per cm of the wire = $\frac{R}{l}$

Observation:

(i) Range:

Range of given voltmeter = 3 v

Range of given ammeter = 500 mA

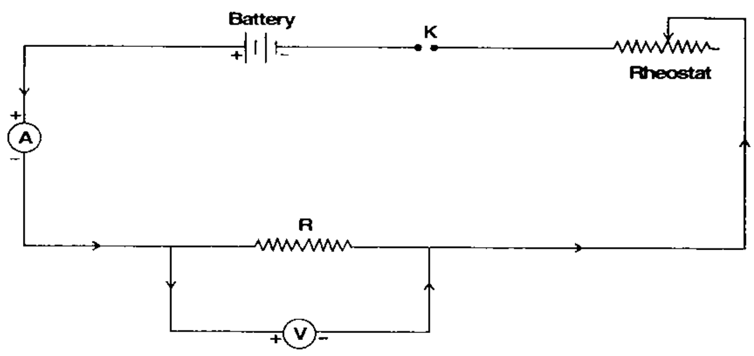


Fig. 1.1

(ii) Least count:

Least count of voltmeter = 0.05v

Least count of ammeter = 10 mA

(iii) Zero error:

Zero error in ammeter, $e_1 = 0$

Zero error in voltmeter, $e_2 = 0$

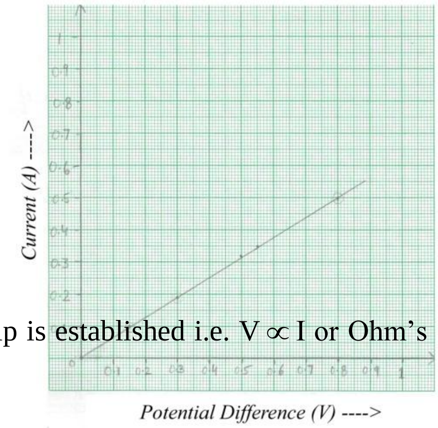
Ammeter and Voltmeter Readings:

Sr. No.	Ammeter Reading I (A)		Voltmeter Reading, V (v)		$\frac{V}{I} = R$
	Observed	**Value**	**Observed**	**Value**	
1	50	500 mA	16	16x0.05=0.8	1.6Ω
2	35	350 mA	11	0.55	1.57Ω
3	32	320 mA	10	0.50	1.56Ω
4	19	190 mA	6	0.30	1.58Ω
5	10	100 mA	3	0.15	1.5Ω

Mean R = 1.56

Length of resistance wire: 28 cm

Graph between potential difference & current:



Scale: X – axis : 1 cm = 0.1 V of potential difference

Y – axis: 1 cm = 0.1 A of current

The graph comes out to be a straight line.

Result: It is found that the ratio V/I is constant, hence current voltage relationship is established i.e. $V \propto I$ or Ohm's Law is verified.

Unknown resistance per cm of given wire = $5.57 \times 10^{-2}\,\Omega\,cm^{-1}$

Precautions: Voltmeter and ammeter should be of proper range.

- The connections should be neat, clean & tight.

Source of Error: Rheostat may have high resistance.

The instrument screws may be loose.

EXPERIMENT – 2

Aim: To find resistance of a given wire using Whetstone's bridge (meter bridge) & hence determine the specific resistance of the material.

Apparatus: A meter bridge (slide Wire Bridge), a galvanometer, a resistance box, a laclanche cell, a jockey, a one-way key, a resistance wire, a screw gauge, meter scale, set square, connecting wires and sandpaper.

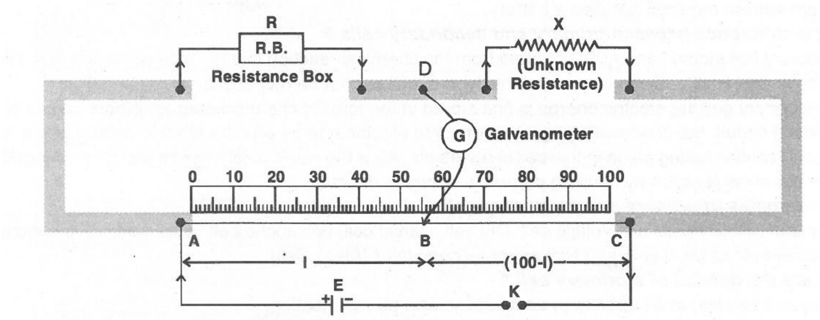


Fig. 2.1 Circuit Diagram - Meter Bridge

Formulae Used:

(i) The unknown resistance X is given by:

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

R = known resistance placed in left gap.

X = Unknown resistance in right gap of meter bridge.

l=length of meter bridge wire from zero and upto balance point (in cm)

(ii) Specific resistance (ρ) of the material of given wire is given $\rho = \frac{X\pi D^2}{4L}$

Where,

D: Diameter of given wire **L**: Length of given wire.

Observation Table for length (*l*) & unknown resistance, X:

Sr. No.	**Resistance from resistance box R (ohm)**	**Length AB = *l* cm**	**Length BC = (100-l) cm**	**Unknown Resistance X = R.** $\frac{(100-l)}{l}\Omega$
1	**2**	**41**	**59**	**2.87**
2	**4**	**60**	**40**	**2.66**
3	**6**	**69**	**31**	**2.69**
4	**8**	**76**	**24**	**2.52**

Table for diameter (D) of the wire:

Sr. No.	**Linear Scale Reading (N) mm**	**Circular Scale Reading**		**Observed diameter D = N + n x L.C. mm**
		No. of circular scale divisions coinciding (n)	**Value n x (L.C.) mm**	
1	**0**	**34**	**0.34**	**0.34**
2	**0**	**35**	**0.35**	**0.35**
3	**0**	**36**	**0.36**	**0.36**
4	**0**	**35**	**0.35**	**0.35**

Observations:

- Least count of screw gauge: 0.001 cm

Pitch of screw gauge: 0.1 cm

Total no. of divisions on circular scale: 100

Least Count = $\frac{Pitch}{No.\ of\ \ divisions\ on\ circular\ \ scale}$

$\therefore LC = 0.001\,cm$

- **Length of given wire, L = 25cm**
  Calculation:
- For unknown resistance, X:
  Mean X = $\frac{X_1 + X_2 + X_3 + X_4}{4} = 2.68\Omega$
- Mean diameter, D = $\frac{D_1 + D_2 + D_3 + D_4}{4} = 0.035\,cm$
- Specific Resistance, $\rho = X.\frac{\pi D^2}{4L} = 1.03 \times 10^{-4}\,\Omega\,cm$

Result: Value of unknown resistance = 2.68 Ω

Specific resistance of material of given wire $= 1.03 \times 10^{-4}\,\Omega\,cm$

Precautions: All plugs in resistance box should be tight. Plug in key, K should be inserted only while taking observations.

Sources of Error: Plugs may not be clean.

Instrument screws maybe loose.

EXPERIMENT – 3

Aim: To compare the E.M.F.'s of two given primary cells using a potentiometer.

Apparatus: A potentiometer, a laclanche cell, a Daniel cell, an ammeter, a voltmeter (0-5v), a galvanometer, a battery (or battery eliminator), a rheostat of law resistance, a resistance box, a one-way key, a two-way key, a jockey, a set square, connecting wires and a piece of sand paper.

Circuit Diagram :

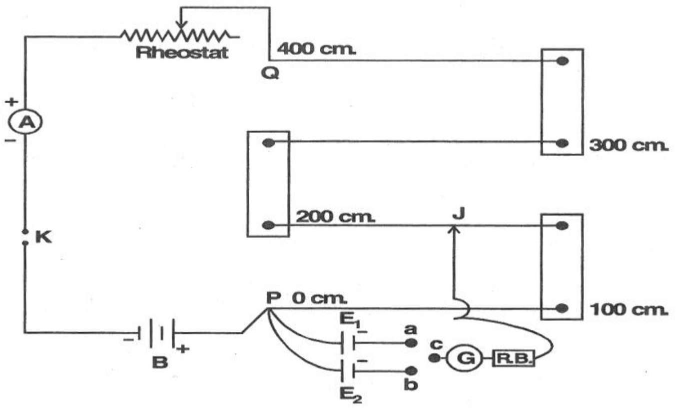


Fig. 4.1 : Comparison of e.m.f.'s of two cells

Observations:

Range of voltmeter: 5V

Least count of voltmeter: 0.05V

E.M.F. of battery E: 3V

E.M.F. of Laclanche Cell, E_1: 1.45V

E.M.F. of Daniel Cell, E_2: 1.125V

Table for Lengths:

S. No.	Balancing length when E_1 (Leclanche Cell) is in the circuit (cm) (l_1)	Balancing length when E_2 (Daniel Cell) is in circuit (cm) (l_2)	Ratio $\frac{E_1}{E_2} = \frac{l_1}{l_2}$
1	558	437	558/437 = 1.277
2	789	617	1.278
3	848	670	1.266
4	893	706	1.265
5	662	521	1.270

Calculations: Mean $\frac{E_1}{E_2} = 1.271$ (Unit less)

Result: The ratio of E.M.F.'s $\frac{E_1}{E_2} \approx 1.27$

Precautions:

(i) The connections should be neat, clean & tight.

(ii) The positive poles of the battery E and cells E_1 and E_2 should all be connected to the terminals at the zero of the wires.

(iii) The jockey should not be rubbed along the wire. It should touch the wire gently.

Sources of Error:

(i) The auxiliary battery may not be fully charged.

(ii) The potentiometer wire may not be of uniform cross-section and material density throughout its length.

(iii) Heating of potentiometer wire by current, may introduce some error.

EXPERIMENT – 4

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

Apparatus: A potentiometer, a battery, two one-way keys, a rheostat of law resistance, a galvanometer, a high resistance box, a fractional resistance box (1-10 Ω), an ammeter, a voltmeter (0-5V), a cell, a jockey, a set square, connecting wires & piece of sand paper.

Circuit Diagram :

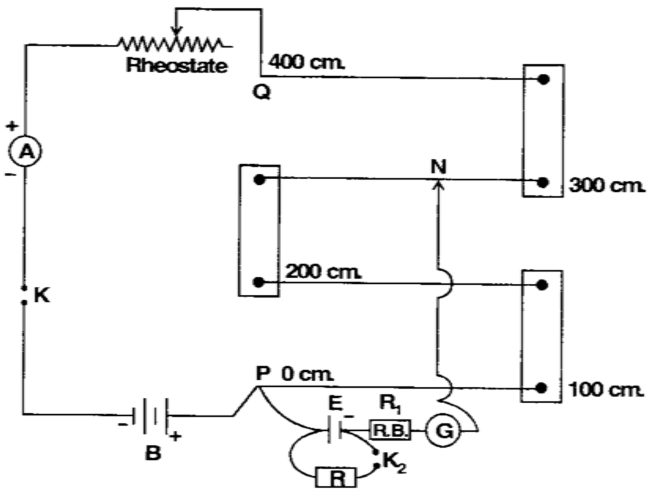


Fig. 5.1 : Internal Resistance of a Cell

Observations:

(i) EMF of battery = 2V

EMF of cell = 1.35V

(ii) Table for lengths:

Sr. No.	Position of Null pt (cm)		Value of shunt resistance R (Ω)	Internal resistance
	Without shunt R, l_1 cm	With shunt R_1, l_2 cm		r = $\left(\frac{l_1 - l_2}{l_2}\right) R\ \Omega$
1	571	67	1	7.53
2	619	91	1.5	8.10
3	689	129	2	8.68
4	749	196	2.5	7.05
5	882	221	3	8.97
6	950	289	3.5	7.9

Result: The internal resistance of the given cell is 8.11 Ω

Precautions:

(i) The EMF of the battery should be greater than that of cell.

(ii) For one set of observations, the ammeter reading should remain constant.

(iii) Rheostat should be adjusted so that initial will point lies on last wire of potentiometer.

Sources of Error:

(i) The auxiliary battery may not be fully charged.

(ii) End resistance may not be zero.

(iii) Heating of potentiometer wire by current, may introduce some error.

EXPERIMENT – 5

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

Apparatus: An optical bench with four uprights (2 fixed upright in middle two outer uprights with lateral movement), convex lens, convex mirror, a lens holder, a mirror holder, 2 optical needles (one thin, one thick), a knitting needle, a half meter scale.

Ray Diagram :

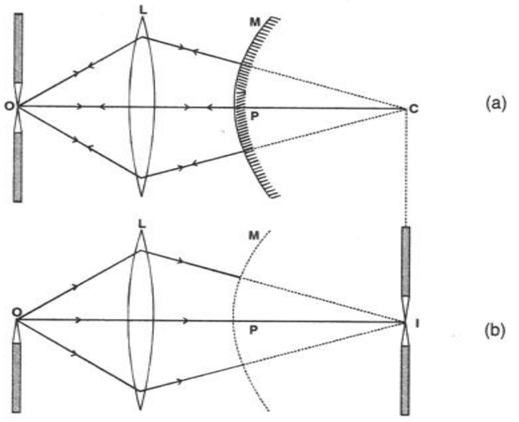


Fig. : 10.1 Focal Length of Convex Mirror

Formula Used:

Focal length of a convex mirror $f = \frac{R}{2}$

Where R is radius of curvature of the mirror.

Observation:

(i) Actual length of knitting needle, x = 15 cm.

(ii) Observed distance between image needle I and back of convex mirror, y = 15 cm

(iii) Index error = y - x = 15 – 15 = 0 cm No index correction

Observation Table:

S. N.	Position of:				Radius of Curvature MI (cm)
	Object needle 0 (cm)	Lens L cm	Mirror M cm	Image needle I (cm)	
1	25	50	56	70.5	14.5
2	28.5	50	60	73.3	13.3
3	31.5	50	65	78.4	13.4
4	30.5	50	60	74	14

Mean R = 13.8

Calculation:

Mean corrected MI = R = 13.8 cm $f = \frac{R}{2} = 6.9\ cm$

Result:

The focal length of the given convex mirror = 6.9 cm

Precautions:

(i) The tip of the needle, centre of the mirror & centre of lens should be at the same height.

(ii) Convex lens should be of large focal length.

(iii) For one set of observations, when the parallax has been removed for convex lens alone, the position of the lens & needle uprights should not be changed.

EXPERIMENT – 6

Aim: To find the focal length of a convex lens by plotting a graph:

(i) between u and v (ii) between $\frac{1}{u}$ *and* $\frac{1}{v}$

Apparatus: An optical bench with three uprights, a convex lens, lens holder, two optical needles, a knitting needles & a half-metre scale.

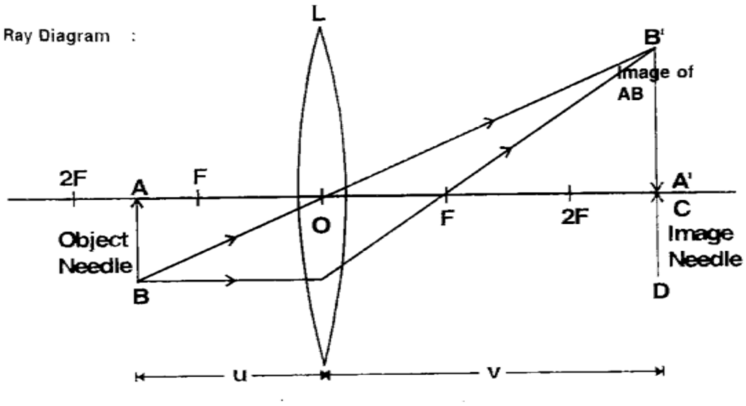


Fig. 11.1 : Focal Length of Convex Lens

Formula Used:

The relation between *u, v and f* for convex lens is:

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

Where *f:* focal length of convex lens

u: distance of object needle from lens' optical centre.

v: distance of image needle from lens' optical centre.

Observations:

(i) Rough focal length of the lens = 10 cm

(ii) Actual length of knitting needle, x = 15 cm.

(iii) Observed distance between object needle & the lens when knitting needle is placed between them, y = 15.2 cm.

(iv) Observed distance between image needle & the lens when knitting needle is placed between them, z = 14.1 cm.

(v) Index correction for the object distance u, x – y = – 0.2 cm

(vi) Index correction for the image distance v, x – z = +0.9 cm

Observation Table:

S. No.	Position of: (cm)			*u (cm)*	*v (cm)*	*1/v* (cm^{-1})	*1/u* (cm^{-1})
	Object needle	Lens	Image needle				
1	66	50	26	16	24	0.041	0.062
2	67	50	27	17	23	0.043	0.058
3	68	50	28	18	22	0.045	0.055
4	70	50	30	20	20	0.05	0.05
5	75	50	33	23	17	0.058	0.043
6	80	50	34	24	16	0.062	0.041

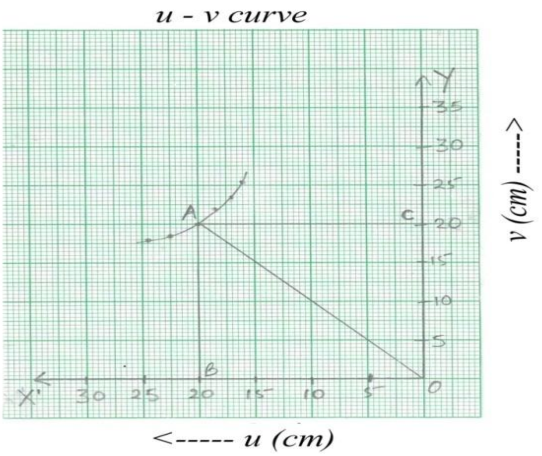
Calculation of focal length by graphical method:

(i) ***u – v* graph:** The graph is a rectangular hyperbola:

Scale: X' axis: 1 cm = 5 cm of *u*

Y' axis: 1 cm = 5 cm of *v*

AB = AC = 2*f* or OC = OB = 2*f*



$\therefore f = \dfrac{OB}{2}$ *and also* $f = \dfrac{OC}{2}$

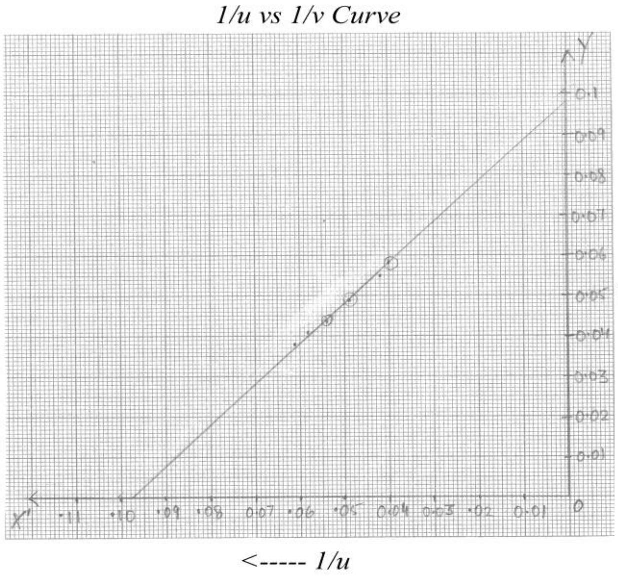
$\therefore$ Mean value of f = 10.1 cm.

(ii) $\frac{1}{u} - \frac{1}{v}$ *graph*: The graph is a straight line.

Scale; X' axis: 1 cm = 0.01 cm^{-1} of $\frac{1}{u}$

Y' axis: 1 cm = 0.01 cm^{-1} of $\frac{1}{v}$

Focal length, $f = \dfrac{1}{OP} = \dfrac{1}{OQ} = 10.2 cm.$



Result:

(i) From *u-v* graph is, f = *10.1 cm*

(ii) From $\frac{1}{u} - \frac{1}{v}$ graph is, f = *10.2 cm*

Precautions:

(i) Tips of object & image needles should be at the same height as the centre of the lens.

(ii) Parallax should be removed from tip-to-tip by keeping eye at a distance at least 30 cm. away from the needle.

(iii) The image & the object needles should not be interchanged for different sets of observations.

EXPERIMENT –7

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

Apparatus: An optical bench with four uprights, a convex lens (less focal length), a concave lens (more focal length), two lens holder, two optical needles, a knitting needle & a half – metre scale.

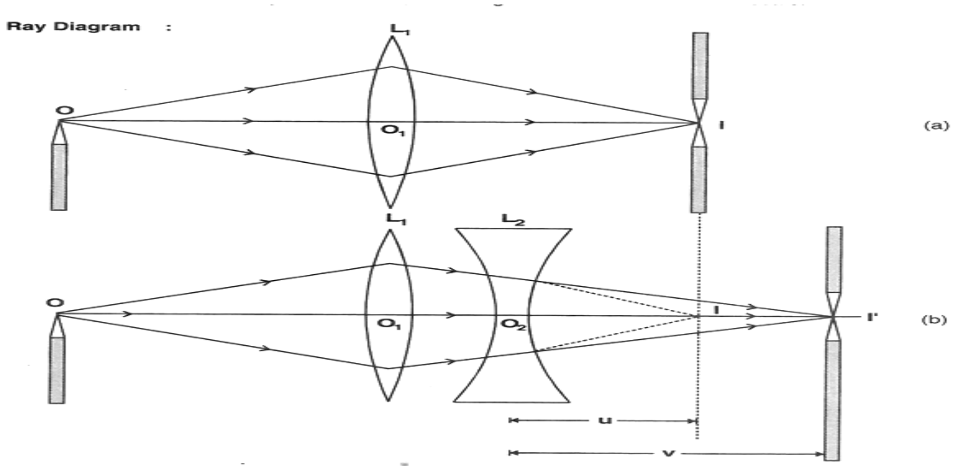


Fig. 12.1 : Focal Length of a concave lens

Formulae Used: From lens formula, we have:

$$f = \frac{uv}{u - v}$$

Observations:

Actual length of knitting needle, x= 15 cm.

Observed distance between object needle & the lens when knitting needle is placed between them, y = 15 cm.

Observed distance between image needle & the lens when knitting needle is placed between them, z = 15 cm.

Index correction for u = x – y = 0 cm

Index correction for v = x – z = 0 cm

Observation Table:

S. No.	Position of (cm)					$u = IL_2$	$v = I'L_2$	$f = \frac{uv}{u-v}$
	0 (cm)	L_1 at O_1	I	L_2	I'			
1	29	50	75	69	78	6.0	9.0	–18.0
2	27	50	71.5	65	77.5	6.5	12.5	–13.54
3	25	50	70.5	65	72.8	5.5	7.8	–18.64
4	28	50	71.3	63	71.2	8.3	8.2	–17.45

Calculations:

Mean $f = \frac{f_1 + f_2 + f_3 + f_4}{4}$

$= -16.9$ cm ≈ -17cm.

Result: The focal length of given concave lens = – 17 cm.

Precautions:

(i) The lenses must be clean.

(ii) A bright image should be formed by lens combination.

(iii) Focal length of the convex lens should be less than the focal length of the concave lens, so that the combination is convex.