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1.	Resistance measurement		28-4-2022		

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RESISTANCE MEASUREMENT

Aim of experiment : To determine the resistance of a ginen wire using a meter bridge.

Apparatus : A meter bridge, leclanche cell, key, resistance box, galvanometer, jockey, connecting wires, sand paper and wire of unknown resistance.

Theory : When the meter bridge is balanced, the resistance, X of the experimental wire is ginen by

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

where R = resistance introduced from the resistance box and l = length of wire between A and B (see fig.)

Exercise 1 : Verify the laws of resistances in series and parallel

Hints : (i) Connect resistance r_1 in gap (ii) and repeat the above experiment to determine r_1

(ii) Remove r_1 and connect r_2 in gap (ii). Repeat the above experiment to determine r_2.

(iii) Connect r_1 and r_2, in series with each other, as shown fig. Connect this combination in gap (ii) and repeat the above experiment to determine the combined resistance R_s.

(iv) Connect r_1 and r_2 in parallel with each other as shown in fig. connect this combination in gap (ii) and repeat The above experiment to determine the combined resistance R_p.

$l_1 = 31.5$ cm $l_2 = 15.5$ cm

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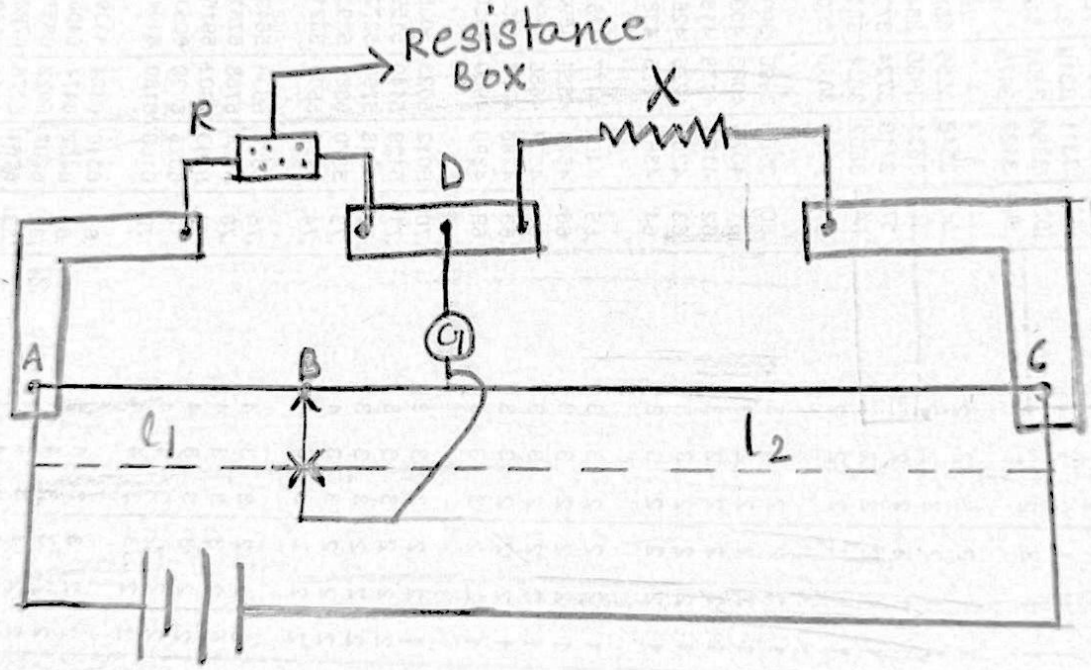
Resistance
Box
R
X
D
G
A
B
C
l_1
l_2

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	Sl No.	R (ohm)	l_1 (cm) (i)	l_1 (cm) (ii)	Mean l_1 (cm)	$R\frac{100-l}{l}$
	1.	0.2	11	11.2	11.1	1.6018
r_1	2.	0.5	27.3	27.5	27.4	1.3450
	3.	0.7	26.5	26.7	26.6	1.9315
					Mean r_1 =	1.6261 ohm
	1.	0.2	21.8	21.9	21.9	0.7132
r_2	2.	0.5	39.2	39.3	39.3	0.7722
	3.	0.7	39.7	39.8	39.8	1.0587
					Mean r_2 =	0.8480 ohm
	1.	0.2	34.6	34.7	34.7	0.3763
R_s	2.	0.5	19	19.1	19.1	2.1178
	3.	0.7	16.5	16.6	16.6	3.5168
					Mean R_s =	2.0036 ohm
	1.	0.2	66.87	66.9	66.9	0.0989
R_p	2.	0.5	42	42.1	42.1	0.6061
	3.	0.7	45.1	45.2	45.2	0.8486
					Mean R_p =	0.5178 ohm

Verification: From the above observation it can be observed that

(i) $R_s = r_1 + r_2 \Rightarrow (1.6261 + 0.8480) \Rightarrow 2.4741 \approx 2.0036$

This verify the law of resistance in series.

(ii) $R_p = \frac{r_1 r_2}{r_1 + r_2} \approx 0.557347237$

This verifies the law of resistance in parallel.

Exercise 2: Determine the specific resistance of the material of given wire

Hint : Resistance X of a wire is given by

$$X = \rho \frac{l}{a}$$

where, ρ = resistivity or specific resistance of the material of wire.
l = length of wire
a = area of cross-section of wire
r = radius of wire

$$\therefore \rho = \frac{Xa}{l} \quad \text{or} \quad \rho = X \cdot \frac{\pi r^2}{l}$$

(i) Connect the given wire in gap(ii) and determine X as explained above.
(ii) Cut the wire from the points where it emerges out of the terminals and find its length with the help of a meter rod
(iii) Find the diameter of the wire, with help of a screw gauge at three or four places. At each place the diameter should be determined in two mutually perpendicular directions.

(ii) Length of wire l = _____ cm
= _____ m

(iii) Diameter of the wire (with screw gauge)
Pitch of screw gauge (P) = 0.05 cm L.C. of screw gauge = 0.001 cm

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No. of Obs.	L.C.S.R (I)	F.C.S.R (F)	No. of rotation (N)	C.S.R (I~F) x L.C (cm)	P.S.R N x P (cm)	Total (d) PSR+CSR	r = d/2 (cm)	Mean (cm)
1.	48	28	1	0.02	0.05	0.07	0.035	
2.	42	28	1	0.014	0.05	0.064	0.032	
3.	43	26	1	0.015	0.05	0.065	0.0326	0.034
4.	47	26	1	0.019	0.05	0.069	0.0345	
5.	3	26	1	0.025	0.05	0.075	0.0375	

Radius of the wire $r = \frac{D}{2} = 0.034$ cm

Calculations:

$$\rho_1 = X_2 \frac{\pi r^2}{l_1} = \frac{1.6261 \times 3.14 \times (0.0343)^2}{31.5}$$

$\rho_1 = 1.907 \times 10^{-4}$ ohm meter.

$$\rho_2 = X_2 \frac{\pi r^2}{l_2} = \frac{0.8460 \times 3.14 \times (0.0343)^2}{15.5}$$

$\rho_2 = 2.021 \times 10^{-4}$ ohm meter.

$$\sigma_1 = \frac{1}{\rho_1} = 0.5243 \times 10^4$$

$$\sigma_2 = \frac{1}{\rho_2} = 0.4948 \times 10^4$$