Experiment no: 3

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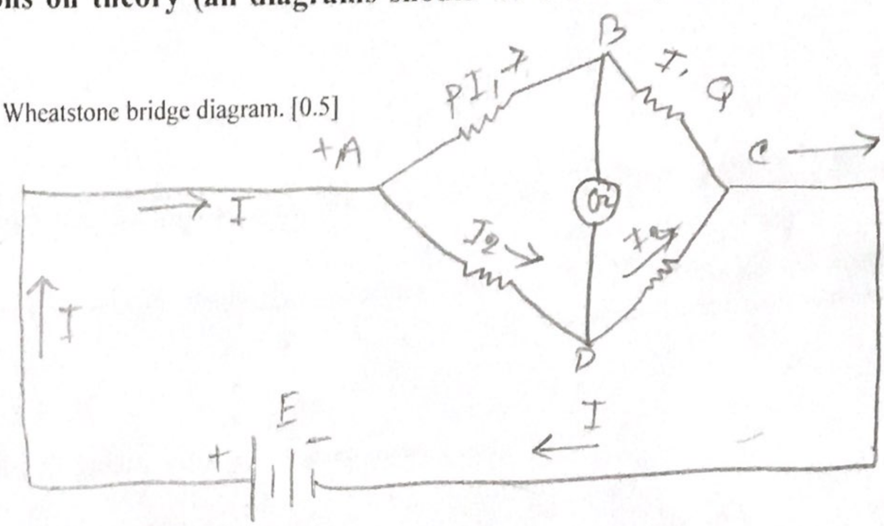
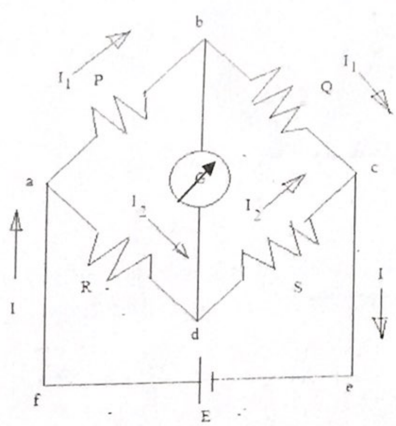
Name of the Experiment: Determination of the resistance of a wire and the specific resistance of it's material using ameter bridg

Questions on theory (all diagrams should be drawn by using a pencil and a scale)

*1) Draw Wheatstone bridge diagram. [0.5]

Ans:





2) See the figure shown above. Derive the equilibrium condition of Wheatstone bridge by applying Kirchhoff's loop-voltage law around the loops abda and bcdb. [1]

Ans: According to kirchhoff's law,

$$I_1 P - I_2 R = 0 \Rightarrow I_1 P = I_2 R \cdots (i)$$

$$I_1 Q - I_2 S = 0 \Rightarrow I_1 Q = I_2 S \cdots (ii)$$

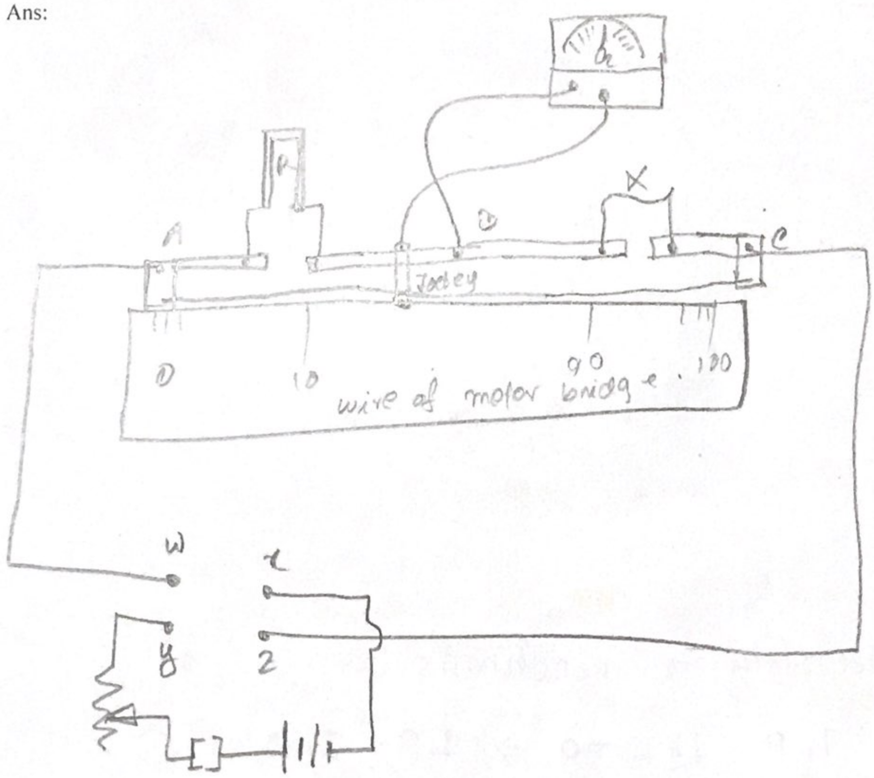
$$\therefore \frac{I_1 P}{I_1 Q} = \frac{I_2 R}{I_2 S} \quad [(i) \div (ii)]$$

$$\Rightarrow \frac{P}{Q} = \frac{R}{S}$$

Thus, the equilibrium condition of wheat bridge is showed by kirchoff's loops law.

*3) Draw the arrangement of this experiment. You may denote the galvanometer, resistances of the resistance box and the wire by  and -WW- symbols. You can omit the meter scale but make it neat and clean and use a pencil and a scale. [0.5]

Ans:



*4) When the resistance box is in the left gap and the wire of unknown resistance is on the right gap derive the equation for the equilibrium condition for Meter Bridge. [0.5]

Ans:

$$R/x = \frac{l}{100-l}$$

$$\Rightarrow X = \frac{100-l}{l} \times R.$$

*5) What will be the equilibrium condition of the meter bridge, when the resistance box is on the right side and the wire is on the left side? [0.5]

Ans:

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

$$\Rightarrow X = \frac{l'}{100-l'} \times R.$$

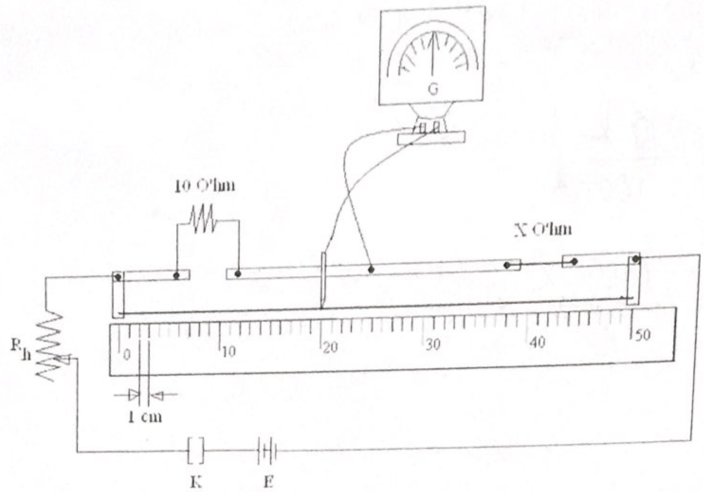
*6) Define the specific resistance of the material of a body. [0.5]

Ans: The resistence offered by a unit length and unit cross section area of that materia is called specific resistance.

7) See Figure 3. Which will direction the current flow, if (w, x) & (y, z) are connected? Which direction will it flow, if (w, y) & (z, x) are connected? [0.5]

Ans: If we connect (w, x) and (Y, z) the current will ~~be~~ flow unknown resistance to resistance box or point e to A.

If we connect (w, x) and (X, z) the current will flow from Resistance box to unknown resistance on A to e.



8) In the above figure you see a semi-meter bridge (the length of the wire of this bridge is 50 cm). The arrangement of the system is almost same (only commutator is not used here) as that of the experiment what you are going to do. Now find out the value of X. [1]

Ans: If there is no commutator the current will flow from Resistance box to wire of unknown resistence.

$$\frac{R}{X} = \frac{l}{50-l}$$

$$\Rightarrow X = \frac{l}{50-l} \times R$$

$$\Rightarrow X = \frac{50-l}{l} \times 10 \quad [R=10]$$

$$\Rightarrow X = \frac{10(50-l)}{l}$$

$$= \frac{10(50-20)}{20} \quad [l = 20 \text{ cm}]$$

$$= 15 \text{ ohm } (\Omega)$$

- Draw the data table(s) and write down the variables to be measured shown below (in the 'Data' section), using pencil and ruler BEFORE you go to the lab class.

- Write down your NAME and ID on the top of the page.
- This part should be separated from your Answers of "Questions on Theory" part.
- Keep it with yourself after coming to the lab.

Data

Table: Data for the calculations of the resistance

Known resistance R in Ω	Balance points in cm (X on the right)				Balance points in cm (X on the left)			
	Direct	Reverse	Mean (l)	X in Ω	Direct	Reverse	Mean (l')	X in Ω
2	23	23.6	23.3	6.57	76	76.5	76.25	6.41
3	20	19.4	19.7	12.23	79.5	79.6	79.55	11.67
4	13.8	14.5	14.15	24.26	83.8	84.3	84.05	21.08
5	13	12.4	19.2	21.04	87.6	87.5	87.55	35.15
5.5	10.4	10.9	10.65	46.13	89.2	89	89.1	44.96

Length of the wire, L: 6.5 cm

Diameter of the wire, d: 0.34 cm

$d_1 =$ 0.335 $d_2 =$ 0.345 $d_3 =$ 0.340

Temperature =

- **READ the PROCEDURE carefully and perform the experiment by YOURSELVES. If you need help to understand any specific point draw attention of the instructors.**
- **DO NOT PLAGIARIZE data from other group and/or DO NOT hand in your data to other group. It will bring ZERO mark in this experiment. Repetition of such activities will bring zero mark for the whole lab.**
- **Perform calculations by following the PROCEDURE . Show every step in the Calculations section.**
- **Write down the final result(s)**

Calculations

$$X = \frac{l'}{100-l'} \times R$$
(left)

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

Results:

Average value of X (Right) : 22.046

Average value of X (left): 23.859

$$P(X \text{ Right}) : P = \frac{AX}{L} = \frac{\pi d^2 X}{L} = 1.231$$

$$P(X \text{ left})\ P = \frac{AX}{L} = \frac{\pi d^2 X}{L} = 1.32$$

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Questions for Discussions

1) Had you made the end corrections of the meter bridge before you performed the experiment? How should the equation (1) be modified to make end corrections? [0.5]

Ans: Yes.

$$\frac{P}{Q} = \frac{l\alpha}{(100-l)\alpha} = \left(\frac{l}{100-l}\right).$$

2) On what factors does the specific resistance depend? [0.5]

Ans: Specific resistance depends on.

(i) temperature
(ii) Unit length
(iii) cross section.

3) Why is it advantageous to use the key K? Why should it be kept open while taking the measurements and performing other calculations, after you detect the null point? [0.5]

Ans: The key must be opened: So current i can pass through the circuit.

4) The meter bridge's wire should be made of a material of low thermal coefficient of resistivity. It means that the specific resistance of the wire's material should not vary much with temperature. Explain why. [0.5]

Ans: Temporature doesn't matter, Because resistance doesn't depend on temparature