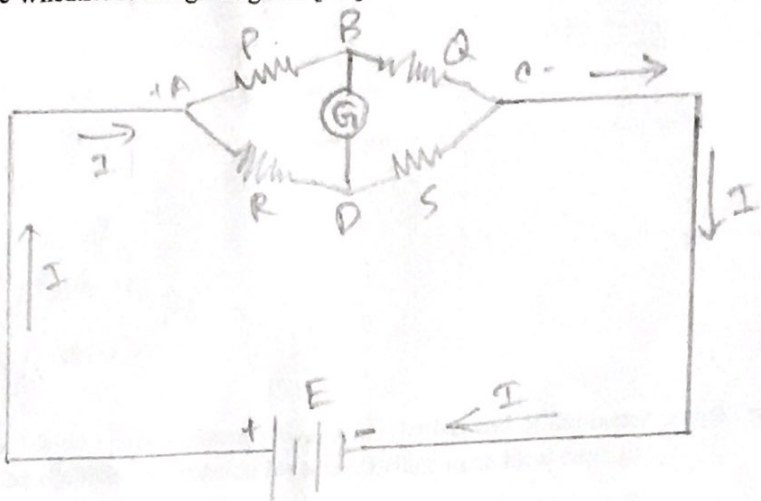
Experiment no: 2

Name of the Experiment: Determination of the end coanection of a mitten bridge.

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

*1) Draw the Wheatstone bridge diagram. [0.5]

Ans:



*2) Derive the equilibrium condition of Wheatstone bridge applying Ohm's law. [1]

Ans: $V = IR$

From A to B, $V_A - V_B = I_1 P$

From B to C, $V_B - V_C = I_1 Q$

From A to D, $V_A - V_D = I_2 R$

from D to C, $V_D - V_C = I_2 S$

$$\frac{V_A - V_B}{V_B - V_C} = \frac{P}{Q}, \text{ and } \frac{V_A - V_D}{V_D - V_C} = \frac{R}{S}$$

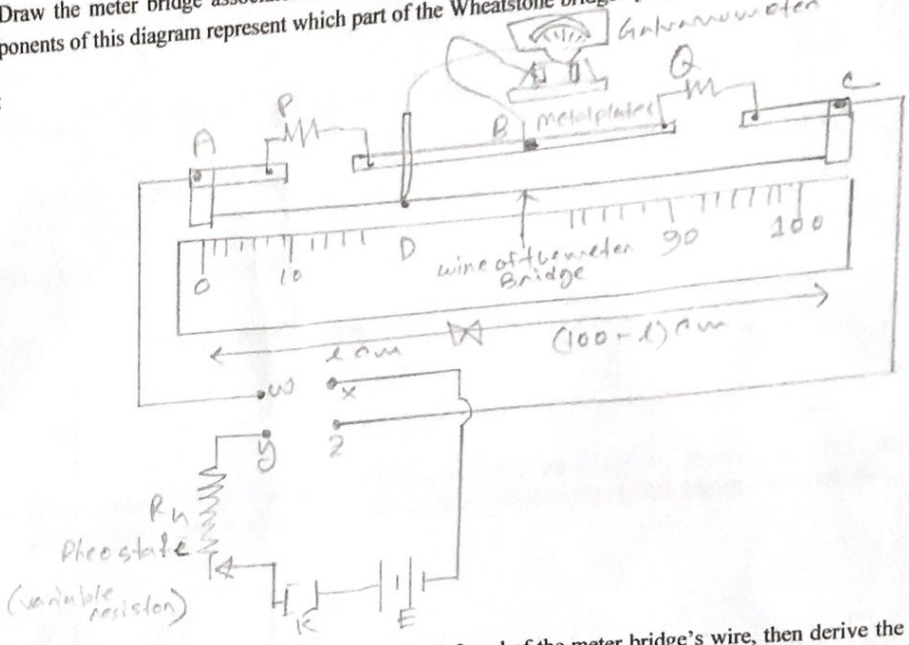
$V_B - V_D = 0 \times$ Galvanometer nisistance.

$\therefore V_B = V_D$

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

*3) Draw the meter bridge associated with other elements to construct the Wheatstone bridge. Which components of this diagram represent which part of the Wheatstone bridge? [0.5]

Ans:



*4) If we find the null point *l* distance away from the left end of the meter bridge's wire, then derive the equation for the equilibrium condition for Meter Bridge in an ideal case. [0.5]

Ans: From left end, distance = l cm

From right end, distance = $(100 - l)$ cm

the resistance per unit of the meter bridges nichrome wire is 6 ohm/cm

$\therefore$ $R = l6$ ohm and $S = (100 - l)\,6$ ohm

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

$$\Rightarrow \frac{P}{Q} = \frac{l6}{(100 - l)6}$$

$$\Rightarrow \frac{P}{Q} = \frac{l}{100 - l}$$

*5) Why do end errors happen? How should the equation of question 4 be corrected? [0.5]

Ans:

Errors happen because the meter bridges wire do not coincide with the zero / hundred marks of the meter scale.

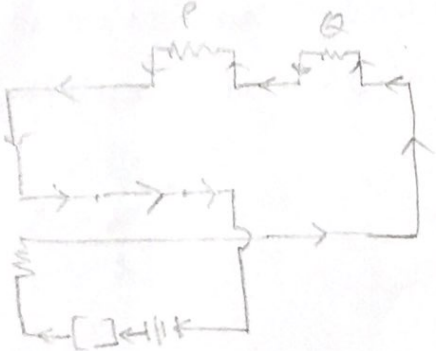
The connected equation is $\frac{P}{Q} = \frac{l+n}{100-l+y} \Omega$

*6) If we interchange the position of the two resistances and find the null point L distance away from the zero mark, write down the equation for equilibrium condition of the Meter-bridge having end errors. [0.5]

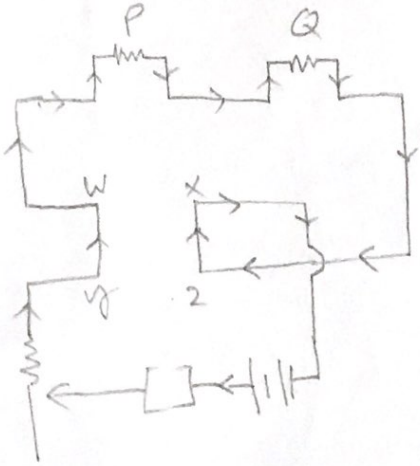
Ans:

$$\frac{1}{R} = \frac{Q}{P} = \frac{L+n}{100-L+y}$$

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



For (w,y) & (z,x) connection:



8) Solve the two equations which you have written in the answers of 6) and 7) by making the end corrections terms as subjects. [1]

$$r = \frac{l+x}{100-l+y}$$

$$\Rightarrow l+x = 100r - lr + yr$$

$$x = 100r - lr + yr - l \quad \text{(i)}$$

$$\frac{1}{r} = \frac{L+x}{100-L+y}$$

$$\Rightarrow 100 - L + y = Lr + xr$$

$$\Rightarrow 100 - L + y = Lr + 100r^2 - lr^2 + yr - lr$$

$$\Rightarrow y - yr^2 = 100r^2 - 100 + Lr + L - lr^2 - lr$$

$$\Rightarrow y(1-r^2) = -100(1-r^2) + L(r+1) - lr(r+1)$$

$$\Rightarrow y(1-r) = -100(1-r) + L - lr$$

$$\Rightarrow y = -100 + \frac{L-lr}{1-r}$$

$$\frac{1}{r} = \frac{L+x}{100-L+y}$$

$$\Rightarrow y = Lr + x - 100 + L$$

$$100r - lr + Lr^2 + xr^2 + Lr - l - 100 - x = 0$$

$$\Rightarrow x(1-r^2) = Lr(l+r) - l(1+r)$$

$$\Rightarrow x(1-r) = Lr - l$$

$$\Rightarrow x = \frac{l-Lr}{r-1}$$

- 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 End Corrections of a meter bridge

Resistance in Ohms	Ratio r = P/Q	Balance points in cm (P in the left) Direct	Reverse	Mean (l)	Balance points in cm (P in the right) Direct	Reverse	Mean (l)	x in cm	y in cm
P = ·2 Q = ·1	2	38·2	26·2	32·2	14·9	7·3	11·1	10·1	-38·7
P = ·3 Q = ·4	·75	18·9	14·8	16·86	30·1	24·9	27·5	15·06	-40
P = ·5 Q = ·3	1·7	35·1	28·1	31·62	19·1	14·8	16·95	7·01	-47·42
P = ·5 Q = ·2	2·5	40·1	26·9	33·5	16·2	19·7	17·95	-7·56	-56
P = Q =									

- 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 $x = \frac{l - nl}{n-1} = \frac{32.2 - 2 \times 11.1}{2-1} = 10.1$ $y = \frac{nl - l}{n-1} - 100 = -38.7$

Results: $x = 10.1$ $y = -38.7$

- TAKE printout of the 'Questions for Discussions' BEFORE you go to the lab class. Keep this printout with you during the experiment. ANSWER the questions in the specified space AFTER you have performed the experiment.
- Attach Data, Calculations, Results and the Answers of 'Questions for Discussions' parts to your previously submitted Answers of 'Questions on Theory' part to make the whole lab report.
- Finally, submit the lab report before you leave the lab.

Name: _____ ID: _____

Questions for Discussions

1) If you find positive values of x and y, what can be the possible implications? [What does it imply about the connecting points between the wire of the meter bridge and the metal plates and/or the resistance of the metal plates?] [0. 5]

Ans: End error arises due to the non uniformity of the meter wire End connections can be estimated by new ding known resistance.

2) If you find negative values of x and y, what can be the possible implications? [What does it imply about the connecting points between the wire of the meter bridge and the metal plates?] If you have found spurious values like -50, -80, etc, what can be the other systematic errors which may cause it? [0. 5]

Ans: To negative value of the resistance can cause this problem. More tolerance means more resistance. Thus voltage will fluctuate away from the actual value.

3) Why is it advantageous to use the rheostat, R_h, specially when the value of E is fixed?[0. 5]

Ans: Rheostat can vary the resistance value across the range & have great flexibility; if E is fixed varying the resistant position & hence resistand value, will vary the current flowing in that circuit.

4) See the following figure

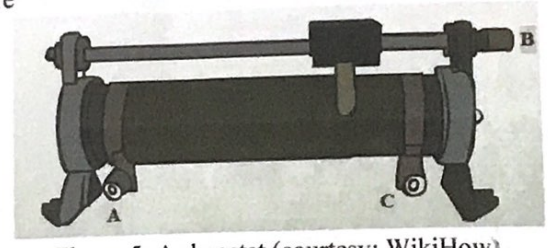


Figure 5: A rheostat (courtesy: WikiHow)

Suppose, the terminal A and the terminal B are connected with the circuit. If you move the slider rightward, will it increase or decrease the resistance of the rheostat? If the terminal B and C are connected and you move the slider rightward, would it increase or decrease the resistance of the rheostat? What would happen if A and C were connected? [0.5] (Use additional paper to answer)

Ans: i) for A and B => Intense

ii) for B and C 2) minimum resistance

iii) for A and C => Decrease