Number:
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3. WHEATSTONE BRIDGE

The Purpose of the Experiment: Finding unknown resistors by using Wheatstone Bridge.

Theoretical Background:

In the circuit in Figure 1, the currents passing through the branches are

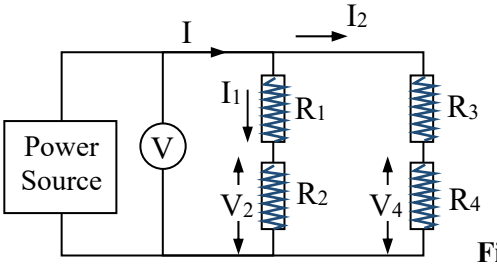

Figure 1

$I = I_1 + I_2$

$$I_1 = \frac{V}{R_1 + R_2}, I_2 = \frac{V}{R_3 + R_4}$$

Here, the voltages of the resistors R_2 and R_4 are

$$V_2 = I_1 R_2 = \frac{V R_2}{R_1 + R_2}, V_4 = I_2 R_4 = \frac{V R_4}{R_3 + R_4}$$

and the difference of these voltages is

$$\Delta V = V_2 - V_4 = V\left(\frac{R_2}{R_1 + R_2} - \frac{R_4}{R_3 + R_4}\right)$$

Condition $\Delta V = 0$ is independent of V, and the balance condition of the bridge is expressed by

$$\frac{R_1}{R_2} = \frac{R_3}{R_4}$$

*** CAUTION ***

During the experiment, set the multimeter indicated with the letter V on it as a Voltmeter at 20V and the multimeter indicated with the letter A as an Ammeter at 200mA. Use the devices at this stage during the entire experiment. *DO NOT CHANGE*.

Experiment:

i. Set up the circuit in Figure 2 and adjust the voltage from the power supply to 10 V, read the voltages from the voltmeter for the lengths x = 5, 15, 25, 35, 45 cm and write them in Table 1. (When setting up the circuit, connect the negative end of the power supply to the zero meter on the resistor bar.!)

ii. By drawing the graph $V(x)$, observe whether the voltage changes proportionally with the distance x on the resistor bar.

iii. Set up the circuit in Figure 3.

iv. For the 4, 6, 8, 10 V values, respectively, read the lengths of a and b in cases where the bridge provides the equilibrium state (the Ammeter shows zero!) and record them in Table 2.

v. By using the a and b values you determined, find the unknown resistance R_x in the expression $\frac{a}{b} = \frac{R_3}{R_x}$.

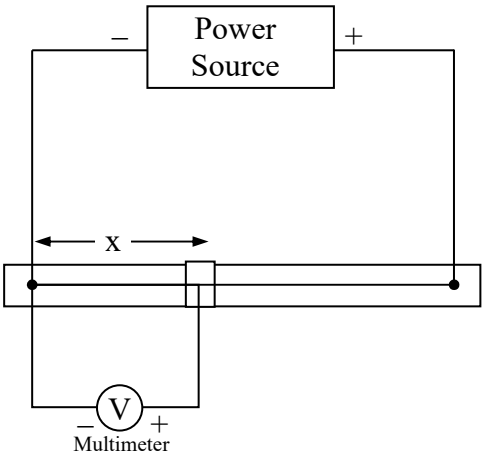

Figure 2

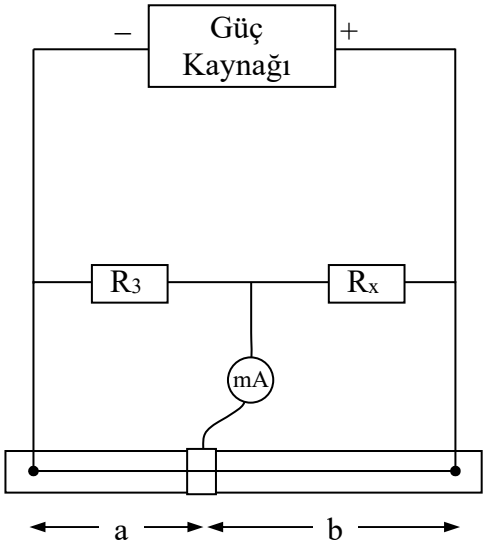

Figure 3

Table 1					
x (cm)	5	15	25	35	45
V (V)					

Table 2.

V (V)	*a* / *b*	R_x (Ω)
4		
6		
8		
10		

Comment: