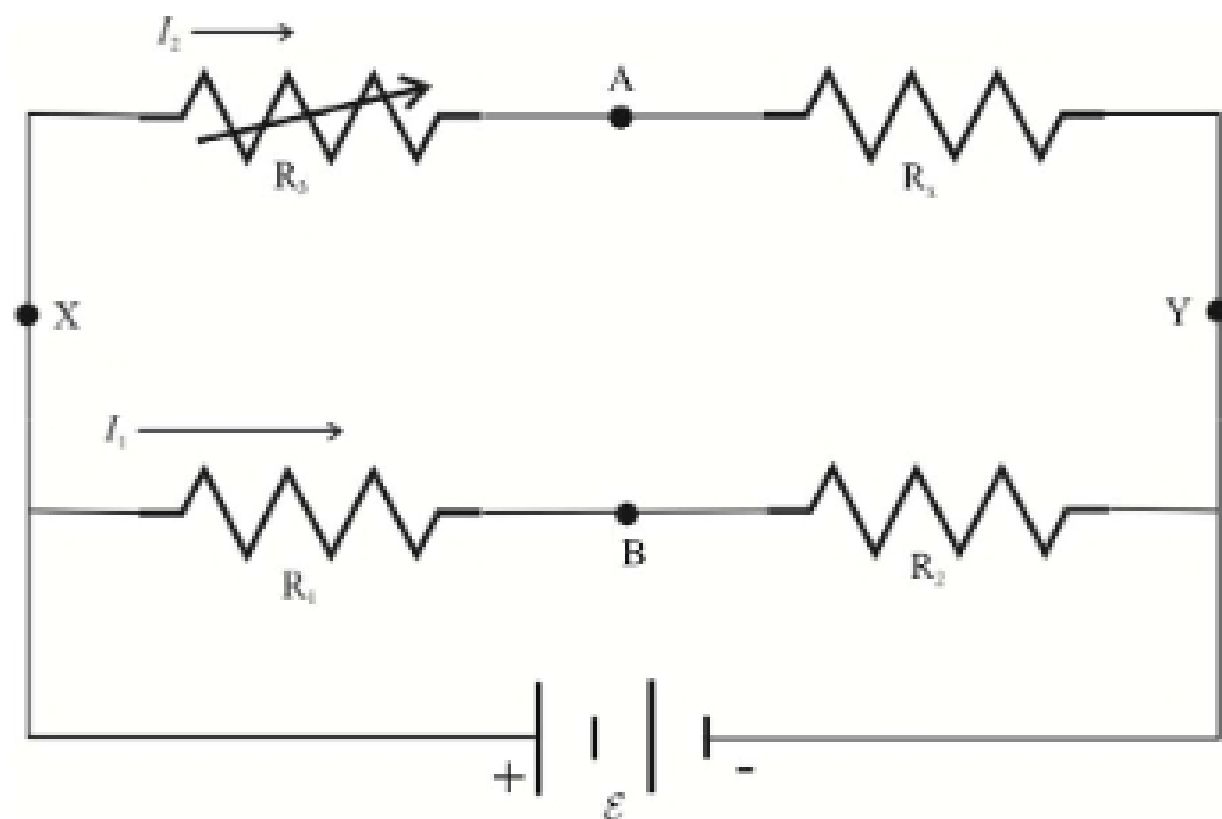


Experiment EC4: Wheatstone Bridge

In this experiment you will accomplish the following tasks:

- 1) Use a Wheatstone bridge with a DC power source to determine the resistance of an unknown resistor.
- 2) Use a Wheatstone bridge with an AC power source to determine the resistance of an unknown resistor.
- 3) Use a Wheatstone capacitance bridge with an AC power source to determine the capacitance of an unknown capacitor.



Consider this circuit. The upper branch is in parallel with the lower branch. This means that the potential difference across the upper branch is equal to that of the lower branch.

If we vary R_1 , R_2 and R_3 such that the potential difference between points A and B = 0, the bridge is balanced and the following equations hold:

$$V_1 = V_3 \quad \Rightarrow \quad I_1 \cdot R_1 = I_2 \cdot R_3$$

$$V_2 = V_x \quad \Rightarrow \quad I_1 \cdot R_2 = I_2 \cdot R_x$$

$$V_1 = V_3 \quad \Rightarrow \quad I_1 \cdot R_1 = I_2 \cdot R_3$$

$$V_2 = V_x \quad \Rightarrow \quad I_1 \cdot R_2 = I_2 \cdot R_x$$

Solving this system of equations for R_x gives $R_x = R_3 \left(\frac{R_2}{R_1} \right)$

Since the resistance of a uniform wire is proportional to its length, we can use a long wire for R_1 and R_2 . We vary the value of R_1 and R_2 by changing the location of contact B.

Because $l \propto R$

we can replace R_2/R_1 with l_2/l_1 giving $R_x = R_3 \left(\frac{l_2}{l_1} \right)$