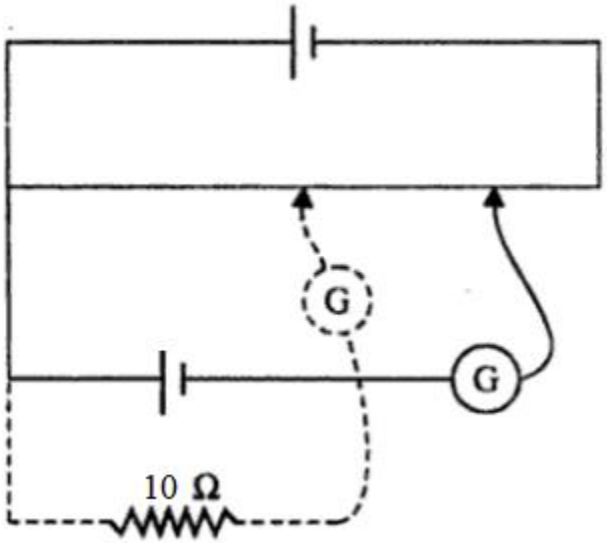
Answer on Question #74233, Physics / Other

A two-metre potentiometer wire is used in an experiment to determine the internal resistance of a voltaic cell. The e.m.f of the cell is balanced by the fall of potential along 90.6cm of wire. When a standard resistor of 10 0hms is connected across the cell the balance length is found to be 75.5cm . Draw a labelled circuit diagram and calculate from first principles, the internal resistance of the cell.

Solution:



If a cell of emf E and internal resistance r, connected to an external resistance R, then the circuit has the total resistance (R+r). The current I in the circuit is given by,

$$I = \frac{E}{R + r}$$

Hence,

$$V = IR$$

This means, V is less than E by an amount equal to the fall of potential inside the cell due to its internal resistance.

From the above equation,

$$\frac{r}{R} = \frac{E - V}{V}$$

$$E = kl_1$$

$$V = kl_2$$

Now we can modify the equation for getting the internal resistance of the given cell, by using the above relations as

$$r = \frac{R(E - V)}{V} = \frac{R(l_1 - l_2)}{l_2}$$

$$r = \frac{10.0 \times (90.6 - 75.5)}{75.5} = 2.0\ \Omega$$

Answer: $2.0\ \Omega$