Potentiometer and Applications

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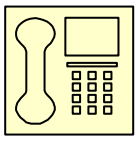

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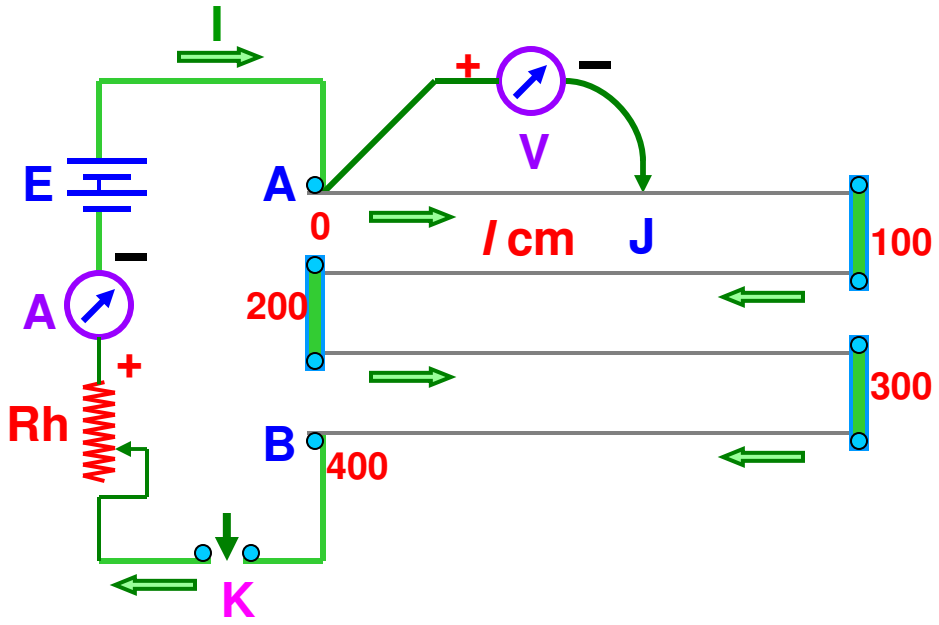
Potentiometer:



Principle:

$V = I R$

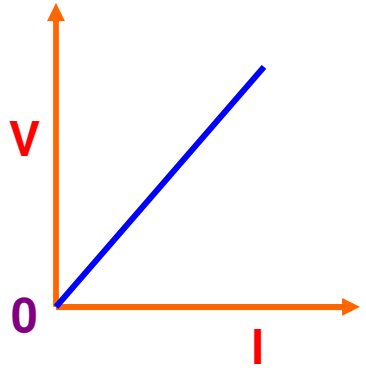
$= I \rho l/A$

If the constant current flows through the potentiometer wire of uniform cross sectional area (A) and uniform composition of material (ρ), then

$V = KI$ or $V \alpha I$

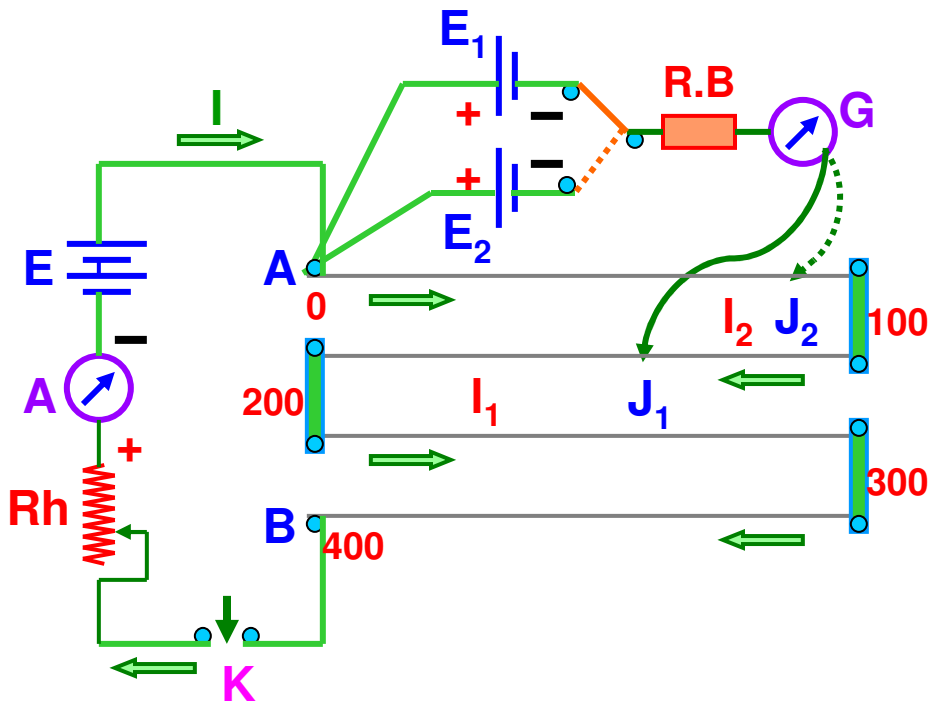
V /I is a constant.

The potential difference across any length of a wire of uniform cross-section and uniform composition is proportional to its length when a constant current flows through it.



Comparison of emf's using Potentiometer:

The balance point is obtained for the cell when the potential at a point on the potentiometer wire is equal and opposite to the emf of the cell.



$$E_1 = V_{AJ_1} = I \rho l_1 / A$$

$$E_2 = V_{AJ_2} = I \rho l_2 / A$$

$$E_1 / E_2 = l_1 / l_2$$

Note:

The balance point will not be obtained on the potentiometer wire if the fall of potential along the potentiometer wire is less than the emf of the cell to be measured.

The working of the potentiometer is based on null deflection method. So the resistance of the wire becomes infinite. Thus potentiometer can be regarded as an ideal voltmeter.

Determination of Internal Resistance of a cell:

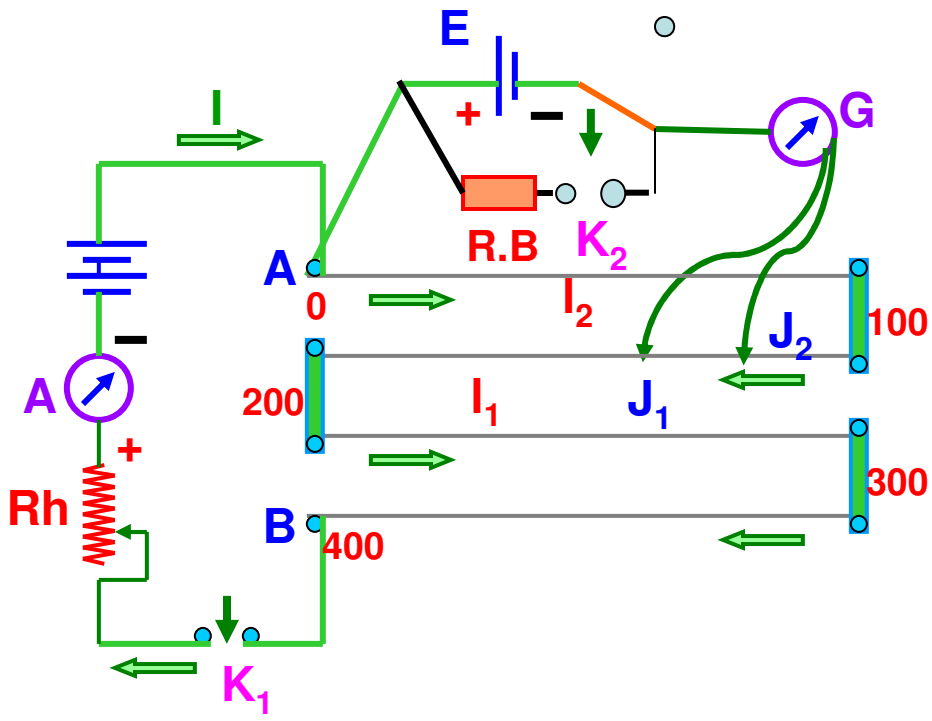
First the experimental cell is balanced in open circuit i.e. when key K_2 is open.

$$E = V_{AJ_1} = I \rho l_1 / A$$

Now key K_2 is closed and the terminal voltage V of the cell is balanced

$$V = V_{AJ_2} = I \rho l_2 / A$$

$$E/V = l_1/l_2$$



$$\text{Hence } r = \left(\frac{E}{V} - 1\right) R = \left(\frac{l_1}{l_2} - 1\right) R$$

Note:

The balance point will be obtained at smaller length i.e. $l_2 < l_1$ when experimental cell is in closed circuit.