Current Electricity

Current

Drift Velocity of Electrons

$$I = nev_dA$$

$$v_d = a\tau = \frac{eE}{m_e}\tau$$

$$I = \frac{e^2n\tau}{m_e}AE = \sigma AE = \frac{\sigma A}{\ell}V$$

τ is time between collision of free electron and atoms

Ohm's Law

$$I = \frac{\sigma A}{\ell}V \Rightarrow V = I\frac{\ell}{\sigma A} = I\frac{\rho\ell}{A} = IR$$

Electric Power

$$P = VI$$

Electromotive Force (e.m.f.)

$$\varepsilon = \frac{E}{q} \quad (\text{E is work done by non} - \text{electric field force})$$

Cells in series

$$\varepsilon_{total} = \sum \varepsilon$$

Cells in Parallel

$$\varepsilon_{total} = \varepsilon_1 = \varepsilon_2 = \ldots = \varepsilon_n$$

Internal Resistance

$$\varepsilon = V + Ir = I(R + r)$$

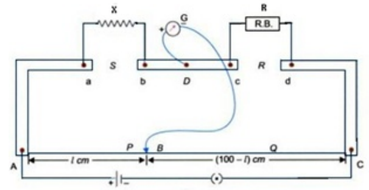
$$V = \frac{\varepsilon}{R + r}R$$

$$P = \left(\frac{\varepsilon}{R + r}\right)^2 R \quad when \ \frac{dP}{dR} = 0 \Rightarrow R = r$$

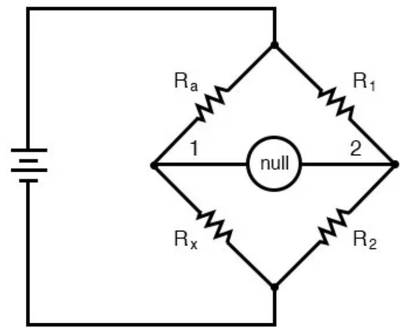
Applications

Metre Bridge

$$X = R\frac{l}{(100 - l)}$$



Wheatstone Bridge

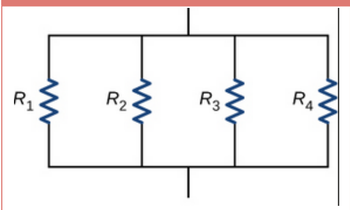


Bridge circuit is balanced when:

$$\frac{R_a}{R_x} = \frac{R_1}{R_2}$$

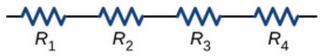
Circuits

Resistors in Parallel



$$R_{total}^{-1} = (\sum R^{-1})^{-1}$$

Resistors in Series



$$R_{total} = \sum R$$

Kirchoff's Laws

Spherical Symmetry

$$\sum I_{in} = \sum I_{out}$$

In any closed loop, the total voltage drop is equal to the total emf. (Conservative fields)

First Law - Junction Theorem

$$\sum I_{in} = \sum I_{out}$$

Total current flowing into the junction is equal to the total current flowing out of it.

Potential Divider

$$V_1 = \frac{R_1}{R_1 + R_2}V = \frac{R_1}{R_1 + R_2 + r}\varepsilon$$