Chapter # 26: "Current & Resistance"

scalar quantity current → $i = \frac{dq}{dt}$

- charge is conserved so if current splits at junction then original current is:

$$i_0 = i_1 + i_2$$

- current arrows shows only direction (or sense of) of flow along a conductor (not direction in space)
  ↳ i.e. bending or reorienting the wires in space does not changes the validity of above equations.

↳ current arrow show where +ve charges are moving.

- 1A = 1ampere
- $1A = \frac{1C}{1s}$

- **current density ($\vec{J}$)** → flow of charge through some cross-section of area of conductor ~~at point~~

derivation/mathematically:

$$i = \int J\,dA$$

$$i = JA$$

$$\boxed{J = \frac{i}{A}}$$

- **Drift Velocity (V_d):**

$$i = \frac{q}{t} \qquad (q = nALe)$$

$$i = \frac{nALe}{L/V_d} \qquad (\because t = L/V_d)$$

$$i = neAV_d$$

$$V_d = \frac{i}{neA} = \boxed{\frac{J}{ne}} \qquad \left(\because J = \frac{i}{A}\right)$$

unit = m^{-3}
n = no. of free charge carriers per unit volume

- Relation b/w J & V_d:

$$\boxed{V_d = \frac{J}{ne}}$$

- **Resistance:** → depends upon temperature & Length & Area of conductor & resistivity (material)

$$V = iR$$

$$\boxed{R = \frac{V}{i}} \qquad \boxed{R = \frac{\rho L}{A}} \qquad \rho = \text{resistivity}$$

- **Resistivity:** $\boxed{\vec{E} = \rho \vec{J}}$ → vector form of ohm's Law, $\boxed{E = \frac{V}{L}}$

$$\boxed{\rho = E/J} \qquad \boxed{\rho = \frac{RA}{L}} \qquad \boxed{J = \frac{i}{A}}$$

Conductivity (σ) reciprocal of resistivity:

i.e.

$$\boxed{\sigma = \frac{1}{\rho}}$$

Ohm's Law $\Rightarrow$ $\boxed{V = IR}$