$$I = \frac{\Delta Q}{\Delta t} = \frac{Q_2 - Q_1}{t_2 - t_1}$$

→ moving positive charges

1 Ampere (A) = 1 C/s

$$I = \frac{dQ}{dt}$$ → If flow of charge is not uniform

$$I = \frac{\Delta Q}{\Delta t} = n\, q\, V_d\, A$$

A → cross sectional area of conductor

V_d → drift speed (m/s)

q → charge (1.6×10^{-19})

n → no. of charge carriers / m^3

$I = 125\ \mu A$

$\Delta t = 23\ s$

$$\Delta Q = I \cdot \Delta t = 125 \times 10^{-6} \times 23$$

$$= 2.875 \times 10^{-3}\ C$$

$$n = \frac{\Delta Q}{e} = \frac{2.875 \times 10^{-3}}{1.6 \times 10^{-19}} = 1.8 \times 10^{16}$$

$A = 3.31 \times 10^{-6}\ m^2$

$I = 10\ A$

$n = 8.46 \times 10^{28}$

$$I = n q V_d A$$

$$V_d = \frac{I}{n q A}$$

$$= \frac{10}{8.46 \times 10^{28} \times 1.6 \times 10^{-19} \times 3.31 \times 10^{-6}}$$

$$= \underline{2.23 \times 10^{-4} \text{ m/s}}$$

$$\frac{I}{A} = nqv_d = J$$

↳ Current Density (A/m^2)

Ohm's Law

$$\frac{J}{E} = \sigma$$

↳ conductivity

E ↓ Electric Field

Ohmic Material → $\frac{J}{E}$ is constant

Non-ohmic materials → $\frac{J}{E}$ is variable

$$R = \frac{\Delta V}{I} \quad \frac{\text{Voltage}}{\text{Current}}$$

R ↓ Resistance (Ω)

$$I = \frac{\Delta V}{R} = \frac{1}{10} = 0.1 \text{ A}$$

$$I = \frac{\Delta Q}{\Delta t} \Rightarrow \Delta Q = 0.1 \times 20 = \underline{2C}$$

$$I = \frac{dq}{dt} = 12t^2 + 5$$

at $t = 1$

$I = 17\ A$

$$J = \frac{I}{A} = \frac{17}{2\times10^{-4}} = 8.5\times10^{4}\ A/m^2$$

$J = 6\times10^{-13}\ A/m^2$

$E = 100\ V/m$

$$\sigma = \frac{J}{E} = \frac{6\times10^{-13}}{100} = 6\times10^{-15}$$

$$\underset{\text{Resistivity}}{\rho} = \frac{1}{\underset{\text{Conductivity}}{\sigma}} = \frac{RA}{l} \implies R = \frac{\rho l}{A}$$

l → length of the wire

A → Cross sectional area

$$R = \frac{V}{I} = \frac{120}{9.25} = 12.97\ \Omega$$

$$R = \frac{\rho l}{A}$$

$$l = \frac{RA}{\rho}$$

$$= \frac{12.97\times \pi\times(2.5\times10^{-3})^2}{1.5\times10^{-6}}$$

$$= \underline{169.78\ m}$$

$J = nqv_d$

$$v_f = \underbrace{v_i}_{0} + at$$

$$v_f = \underbrace{a}_{\frac{qE}{m_e}}t$$

$$v_f = \frac{qEt}{m_e}$$

$$J = nq\left[\frac{qEt}{m_e}\right]$$

$$= \frac{nq^2Et}{m_e}$$

$$\frac{J}{E} = \frac{nq^2t}{m_e} = \sigma$$

$$\rho = \frac{1}{\sigma} = \frac{m_e}{nq^2t}$$

$$\rho = \underbrace{\rho_0}_{\text{Reference Resistivity at } T_0}[1 + \underbrace{\alpha}_{\text{Temperature coefficient}}(T - T_0)]$$

Temperature coefficient C^{-1} $= \frac{1}{\rho_0}\frac{\Delta\rho}{\Delta T}$

characteristic of material

OR

$$\frac{1}{R_0}\frac{\Delta R}{\Delta T}$$

$$R = R_0[1 + \alpha(T - T_0)]$$

$R_0 = 6\Omega$

$T_0 = 20^\circ C$

$\alpha = 3.8 \times 10^{-3}$

$T = 34°C$

$R = R_0[1 + \alpha(T - T_0)]$

$= 6[1 + (3.8 \times 10^{-3} \times 14)]$

$= 6.3192$

$R_0 = 19\,\Omega$

$T_0 = 20\,C$

$R = 140\,\Omega$

$\alpha = 4.5 \times 10^{-3}$

$140 = 19[1 + 4.5 \times 10^{-3}(T - 20)]$

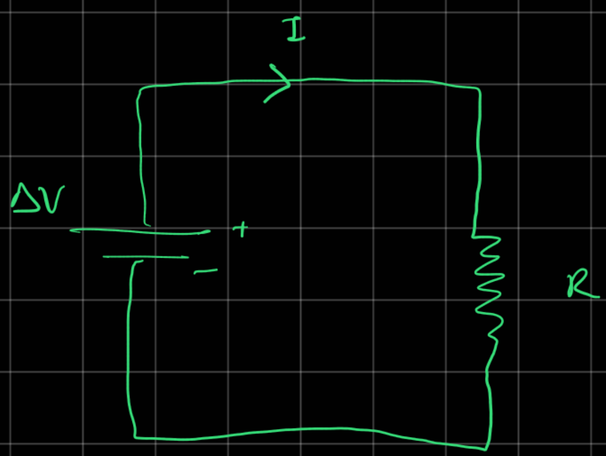
$\frac{140}{19} = 1 + 4.5 \times 10^{-3}(T - 20)$

$\frac{140 - 19}{19} = 4.5 \times 10^{-3}(T - 20)$

$= 1435.20°C$

$\text{Power} = \frac{\Delta U}{\Delta t}\ \frac{J}{s} = \text{Watts (W)}$

$\text{Power} = \Delta V I = \frac{\Delta V^2}{R} = I^2 R$



$P = \Delta V I$

$I = \frac{P}{\Delta V} = \frac{\cancel{1500}^{3} \times 0.8}{\cancel{2000}_{4}} \times 746 = \underline{447.6\ A}$

$$I = \frac{P}{\Delta V} = \frac{1000}{120} = \underline{8.33 \text{ A}}$$

$$R = \frac{\Delta V}{I} = \frac{120 \times 3}{25} = 14.4$$

$P = 500$ W

$\Delta V = 110$ V

$$R = \frac{(\Delta V)^2}{P} = \frac{110^2}{500} = \underline{24.2\ \Omega}$$

$$l = \frac{RA}{\rho} = \frac{24.2 \times \pi \times (0.5 \times 10^{-3})^2}{1.5 \times 10^{-6}}$$

$$\underline{l = 12.67 \text{ m}}$$

$$R = R_0 \left[1 + \alpha (T - T_0)\right]$$

$$= 24.2 \left[1 + (0.4 \times 10^{-3})(1200 - 20)\right]$$

$$= 35.6224\ \Omega$$

$$P = \frac{V^2}{R}$$

$$= \frac{(110)^2}{35.6224}$$

$$= 339.67 \text{ W}$$