Summary of chapter 27

I. Objective:

1. Define the electric current and the current density.

2. Calculate the resistance of a conductor using **Ohm's law** and based on the physical characteristics of a conductor.

3. Calculate the variation of resistance with **temperature**.

4. Calculate **the power dissipated** in a resistor.

II. Summary of major points:

1. The electric current is defined as:

$$I = \frac{dQ}{dt}$$

The current is the rate of flow of charge. It has units of Coulomb per second or **Ampere** (A).

It is also given by:

$$I = nqv_d A$$

Where n is number of charge carriers, q is charge, v_d is drift velocity and A is cross-sectional area.

The current density is defined as:

$$\vec{J} = \frac{\vec{I}}{A} nq\vec{v}_d = \sigma\, \vec{E}$$

Where σ is conductivity and E is electric field. It has units of **A/m^2**.

2. The resistance R of a conductor is defined as

$$R = \frac{V}{I}$$

This relation is called Ohm's law.

Where V is potential difference across a conductor and I is current in the conductor.
The unit of the resistance R is volt per ampere or **Ohms**.

Also:

$$R = \rho \frac{L}{A} = \frac{L}{\sigma A}$$

where L is length and A is area of the conductor, ρ is resistivity and σ is conductivity.

3. The resistivity of a conductor varies with temperature as:

$$\rho_f = \rho_o[1+\alpha(T_f - T_o)]$$

where ρ_f is final resistivity, ρ_0 is initial resistivity and α is temperature coefficient of resistivity.

Similarly;

$$R_f = R_o[1+\alpha(T_f - T_o)]$$

Note: α given in the problem is given **in general** at the reference temperature (20°C)

4. The **power dissipated** in a resistor is given by;

$$P = VI = RI^2 = \frac{V^2}{R} \quad \text{(watts)}$$