Summary of chapter 28

I. Objective:

1. Learn how to calculate the equivalent resistance for a group of resistor.
2. Use **Ohm's** and **Kirchhoff's** laws to solve multi-loop circuits.
3. Study the R-C circuit (charging and discharging effects).

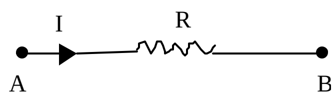
II. Summary of major points:

1. For a series combination of resistors: $R_{eq} = R_1 + R_2 + R_3 + \cdots\cdots\cdots$

   For a parallel combination of resistors: $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots\cdots\cdots$

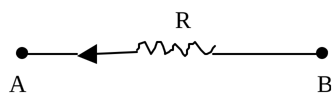
2. **IMPORTANT**:

* $V_B - V_A = -IR < 0$



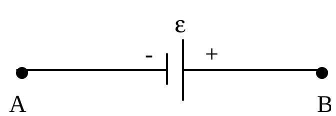
When you move in the **same direction** as the current the potential drops (ΔV is **negative**).

* $V_B - V_A = +IR > 0$



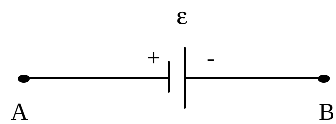
When you move in the **opposite** direction of the current the potential increases (ΔV is **positive**).

* $V_B - V_A = +\varepsilon > 0$



When you cross the power supply from **– to +** the potential increases (ΔV is **positive**).

* $V_B - V_A = -\varepsilon > 0$



When you cross the power supply from **+ to –** the potential drops (ΔV is **negative**).

Kirchhoff's Law # 1:

The sum of the currents at a junction must be **zero**. This is the law of conservation of charge.

Kirchhoff's Law # 2:

The sum of the changes in potential around a loop equal **zero**. This is the law of conservation of energy.

3.

* When a potential difference is applied across an **uncharged** capacitor then the capacitor will charge up.

The current in the circuit varies in time according to;

$$I(t) = \frac{\varepsilon}{R} e^{-\frac{t}{RC}}$$

The charge on the capacitor plate varies in time according to

$$Q(t) = C\varepsilon(1 - e^{-\frac{t}{RC}})$$

And the potential difference across the capacitor can be calculated from

$$V = Q/C = \varepsilon(1 - e^{-\frac{t}{RC}})$$

Where ε is the potential difference across the battery in Volts, R is the resistance in the circuit in Ohms, and C is the capacitance in Farad The product **RC** is called the ***time constant*** and has unit of time.

* When a **charged** capacitor is connected across a resistance **R** then the capacitor will discharge into the resistance.

The current in the circuit varies according to the expression:

$$I(t) = \frac{Qo}{RC} e^{-\frac{t}{RC}}$$

The charge on the plate of the capacitor varies in time according to the expression:

$$Q(t) = Qo\, e^{-\frac{t}{RC}}$$

And the potential difference across the capacitor varies in time according to the expression:

$$V = Q/C = \frac{Qo}{C} e^{-\frac{t}{RC}}$$