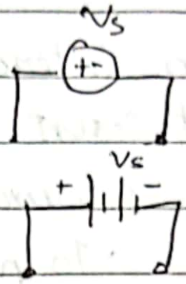
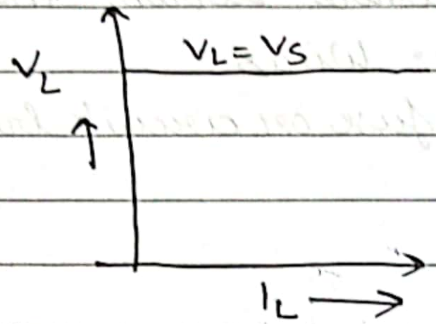
ACTIVE ELEMENTS

Voltage Source

→ Ideal : Constant

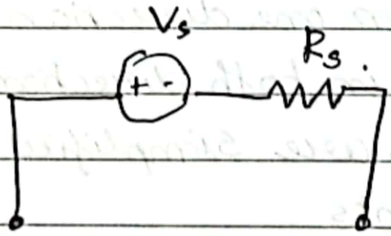
- maintains constant terminal voltage irrespective of current load.
- Internal Resistance $R_s = 0$.

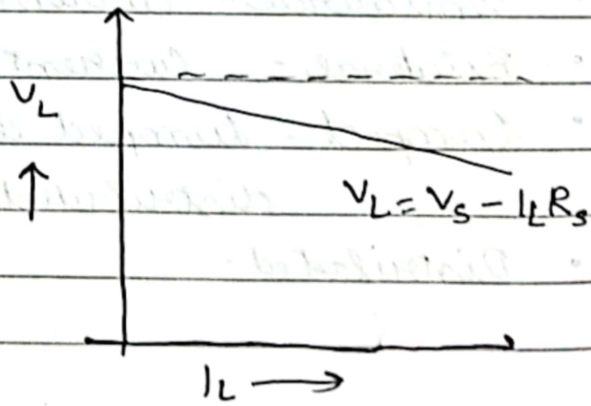




→ Practical : Real.

- Terminal voltage changes based on connected load.
- Internal Resistance $R_s \neq 0$

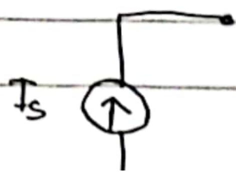


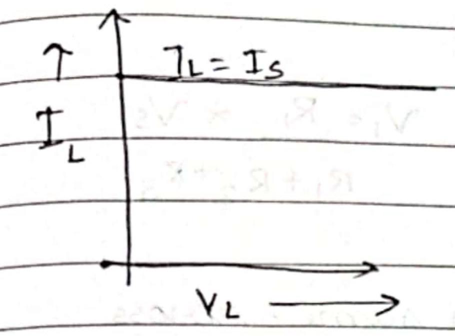


Current Source.

→ Ideal: Constant.

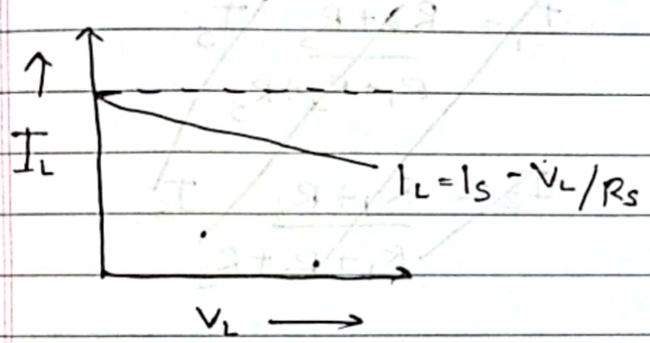
- Maintains constant current irrespective of load connected.
- Internal Resistance $R_s = \infty$

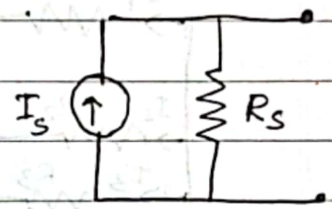




→ Practical : Real.

- Output current changes based on connected load.
- Internal Resistance $R_S < \infty$.





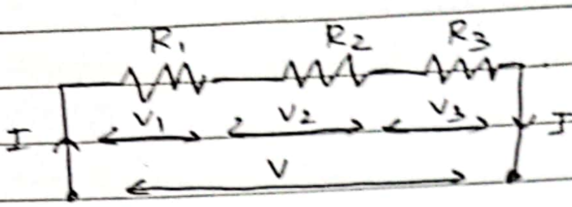
PASSIVE ELEMENTS.

RESISTOR.

- Passive electric device that dissipates energy.
- Resistance
  - Symbol : R
  - Unit : Ω
  - Power consumed : I^2R.

- Conductance.
  - Reciprocal of resistance
  - Symbol - G.
  - Unit : S, ℧

Series Resistance.



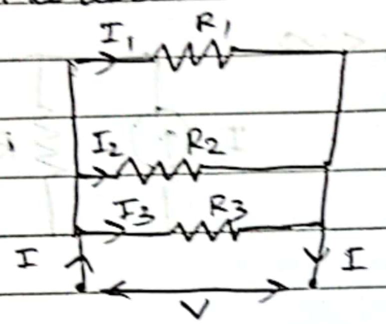
$$V_1 = \frac{R_1}{R_1 + R_2 + R_3} \times V_S$$

I is same across

$V = V_1 + V_2 + V_3$

$R_{eq} = R_1 + R_2 + R_3$

Parallel Resistances.



$$\cancel{I_1 = \frac{R_2 + R_3}{R_1 + R_2 + R_3} I_S}$$

$$\cancel{I_2 = \frac{R_1 + R_3}{R_1 + R_2 + R_3} I_S}$$

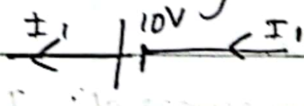
V is same

$I = I_1 + I_2 + I_3$

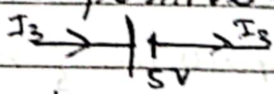
$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

DELIVERING AND ABSORBING POWER BY A SOURCE

- A battery is discharging (delivering power/energy)
  - if current is coming out through +ve terminal.



- A battery is charging (absorbing power/energy)
  - Current flowing into positive (+ve) terminal.



- When current flows through a resistor,
  - Power is dissipated.

Scanned with CamScanner

- Horizontal plane and vertically plane of symmetry for solving resistance circuits.

INDUCTOR.

Stores ~~electri~~ energy in magnetic field when current flows through it. A coil of wire wound around a core.
Inductance - property opposing rate of change of current.
Symbol: L
Unit: Henry (H).

Voltage across ~~induced~~ inductor $\propto$ rate of change of current

$$V_L = L \frac{dI}{dt}.$$

Inductive circuit.

$$L = \frac{\mu_0 A N^2}{l}.$$ (Self inductance of air core inductor)

l = length of the magnetic circuit in m.
A = cross sectional area in sq m.
μ_0 = Permeability of air = $4\pi \times 10^{-7}$
N = number of turns in the coil.

Series.

$$L_{eq} = L_1 + L_2 + L_3.$$

Parallel.

$$\cancel{L_{eq}} \; \frac{1}{L_{eq}} = \frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3}.$$

Scanned with CamScanner

- Instantaneous Power.
$$p = v_L i = L i \frac{di}{dt}.$$

- Energy absorbed in dt time
$$dw = L i di$$

- Energy absorbed when current inc from 0 to I (by the magnetic circuit)
$$W = \int_0^I L i di = \frac{1}{2} L I^2.$$

CAPACITOR.

Stores energy in the electric field.

Capacitance: Property opposing rate of change of voltage.
Symbol: C
Unit: Farad (F)

Capacitive current ∝ rate of change of voltage.
$$i_c = C \frac{dV_c}{dt}.$$

Charge stored where plates are at const voltage.
$$Q = CV$$

- Electric field strength.
$$E = \frac{V}{d} \quad V/m.$$

- Capacitance of ∥ plate capacitor.
$$C = \frac{\varepsilon_0 \varepsilon_r A}{d}.$$

- Electric flux density
$$D = \frac{C}{A} \quad C/m^2$$

- $\varepsilon_0 = 8.854 \times 10^{-12}$ F/m.

Series.

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

Parallel

$$C_{eq} = C_1 + C_2 + C_3$$

- Instantaneous Power.

$$p = v_c \times i = C v_c \frac{dv_c}{dt}.$$

- Energy supplied during 'dt' time.

$$dW = C v_c \, dv_c.$$

- Energy stored when potential rises from 0 to V

$$W = \int_0^V C v_c \, dv = \frac{1}{2} C V^2 \text{ joules.}$$