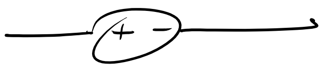
Lecture 5

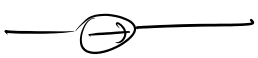
Wednesday, February 16, 2022 6:41 PM

Passive & Active Circuit Components

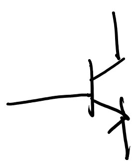
R V_s I_s

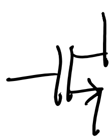
Active Component → Can supply power to circuit.

 → Voltage Source

 → Current Source

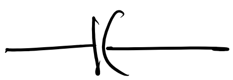
 → Diode

 → Transistor

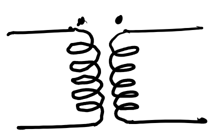
 → MOSFET

Passive Component → Only consumes/dissipates/stores power.

 → Resistor

 → Capacitor (Stores charge)

 → Inductor (Stores magnetic energy)

 → Transformer

Component Equations

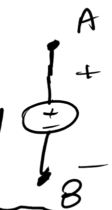
T.B

Rules
1. 1 Node → 1 Voltage ⟹ 1 equation
2. 1 Component → 1 Current ⟹ 1 equation

Component Equations

1. Voltage Source

ex. → 10 V



$V_A - V_B = 10$

$\Delta V = 10$

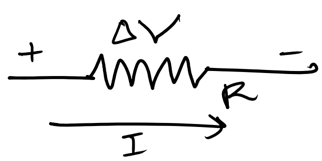
x V

→ $\boxed{\Delta V = x}$ → Nodal Analysis

2. Current Source

→ $\boxed{I = y}$ → Mesh Analysis

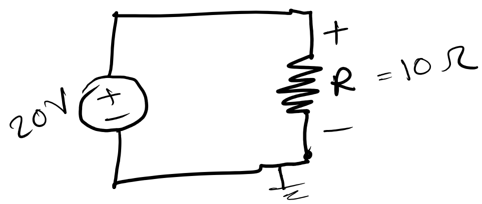
3. Resistane



→ $\boxed{\Delta V = IR}$ → Mesh Analysis

→ $\boxed{I = \frac{\Delta V}{R}}$ → Nodal Analysis

Passive Sign Convention : Power

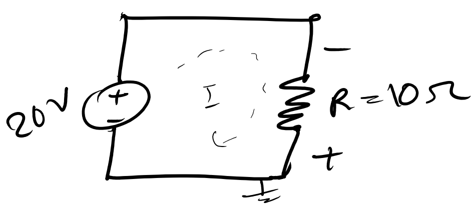


$$P = \frac{V^2}{R} = 40\ W$$

or, $\Delta V = 20\ V$

$$I = \frac{20}{10}\ A = 2A$$

$$\therefore P = 2 \times 20 = \Delta V I$$
$$= 40\ W$$



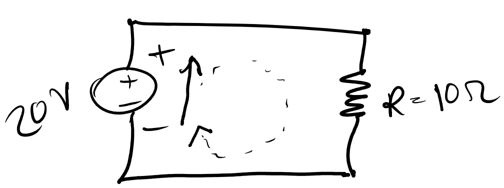
$$\Delta V = 0 - 20 = -20\ V$$

$$I = \frac{-20}{10}\ A = -2A$$

$$\therefore P = (-2) \times (-20)\ W$$
$$= 40\ W$$

∴ Same, in case of Resistance. Power consumption

When the component is voltage source



$$\Rightarrow \Delta V = (20 - 0)\ V$$
$$= 20\ V$$

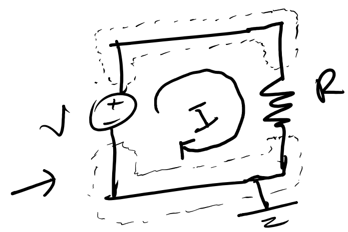
$$I = -2A$$

$$P = 20 \times (-2)\ W$$
$$= \boxed{-40\ W}$$

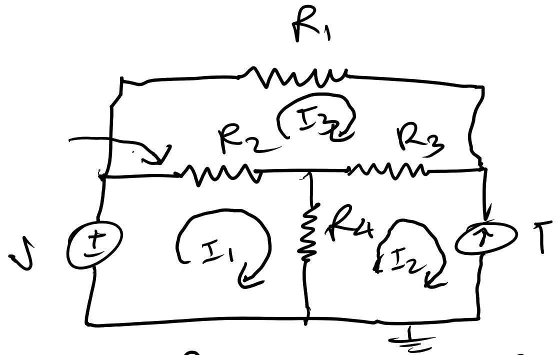
Significance

- + Power → Consumption of Power
- − Power → Supply of Power.

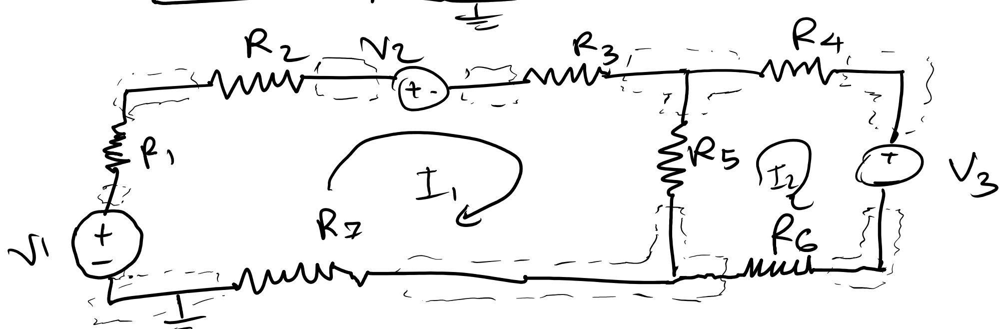
Mesh



$\longrightarrow$ Loop/Mesh $\rightarrow$ 1



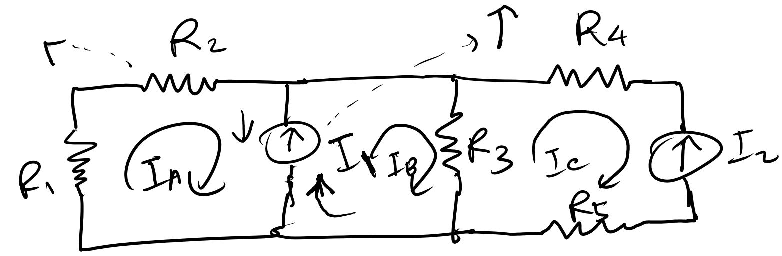
$\longrightarrow$ Loop/Mesh $\rightarrow$ 3



$\longrightarrow$ Loop/Mesh $\rightarrow$ 2

Supermesh

$\Delta V = I_A R_2$



$\boxed{I_c = -I_2}$

Not Supermesh

$$\boxed{I_1 = I_B - I_A}$$

Supermesh

↳ When there is current source between two loops.

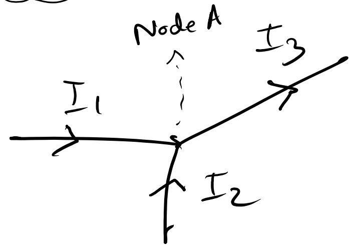
Those two loops/mesh

⇓

Supermesh

KCL

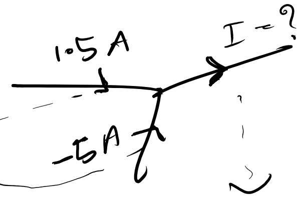
Kinshoff's Current Low



$\rightarrow$ Total current In = Total current out

$\Downarrow$

KCL $\rightarrow$ $I_1 + I_2 = I_3$

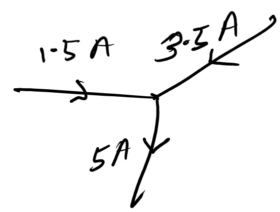


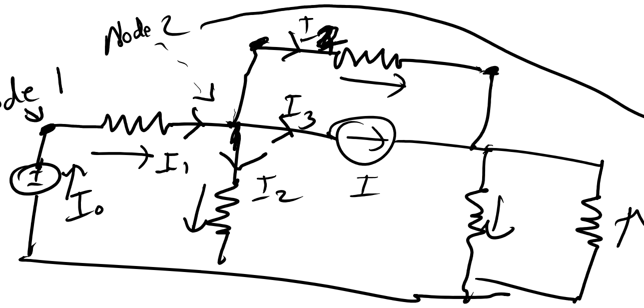
Current in

current out

$I = 1.5 + (-5)\ A$

$= -3.5\ A$

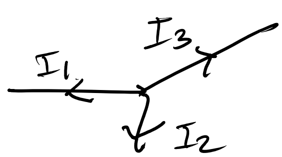




KCL $\rightarrow$ $I_1 = I_2 + I_3 + I_4$

Node 1

$\rightarrow I_0 = I_1$ (KCL)

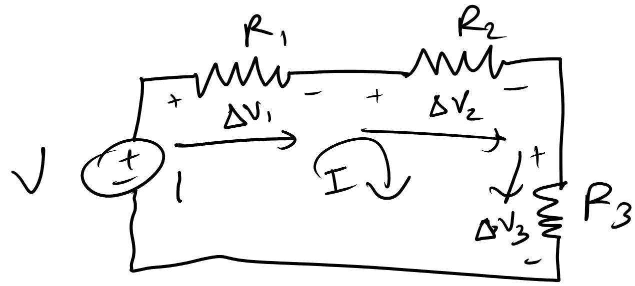


$\rightarrow$ KCL $\rightarrow$ $I_1 + I_2 + I_3 = 0$

$\rightarrow$ $\boxed{\sum I = 0}$

KVL

KVL $\rightarrow$ $\sum \Delta V = 0$ in a loop



$\Delta V_1 + \Delta V_2 + \Delta V_3 = V$

$\boxed{\Delta V_4 = -V}$

$\Rightarrow \Delta V_1 + \Delta V_2 + \Delta V_3 - V = 0$

$\therefore$ Total voltage drop = ~~Total~~ 0 in a loop.