Memos

Reminder from last year :-

- Thevenin's Theorem :-

Goal : Replace a complex network by a ~~...~~ simple one

* Finding R_{th}

— Remove R^*

— Remove all the sources

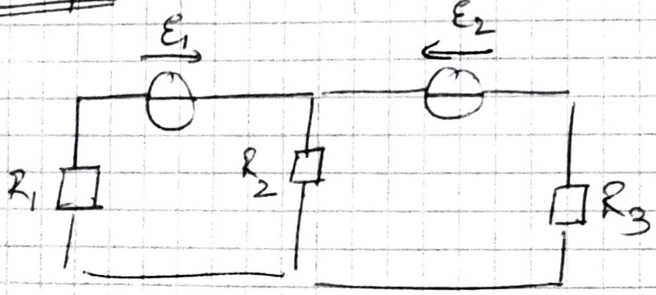
— $R_{th} = R_{eq}$

* Finding E_{th}

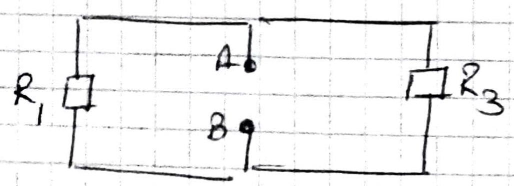
— ~~R.~~ Put back sources

— $E_{th} = U_{AB}$

Example :



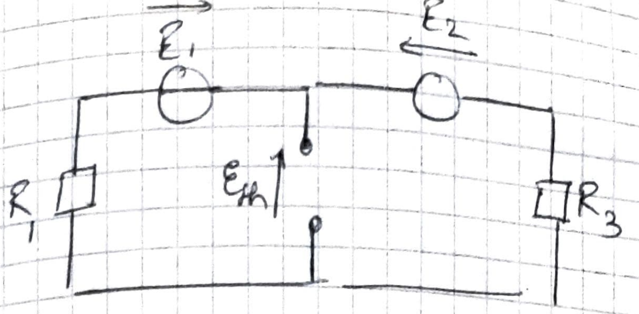
— R_{th}



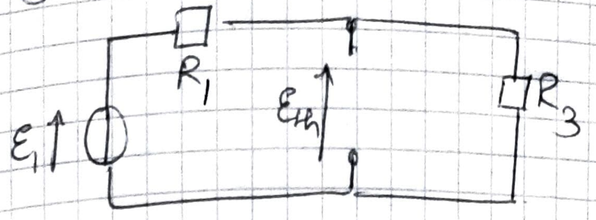
We assume A and B are two terminals

$$R_{th} = \frac{R_1 \times R_3}{R_1 + R_3}$$

- E_{th}



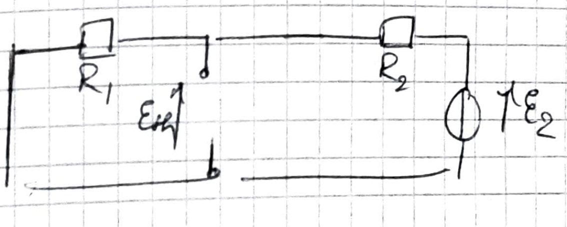
Using superposition:



$E_{th} = U_3$ (both are in parallel)

(By calculation)

$$U_3 = \frac{E_1 R_3}{R_1 + R_3} = E_{th_1} \quad \text{———} \ (I)$$



$E_{th} = U_1$

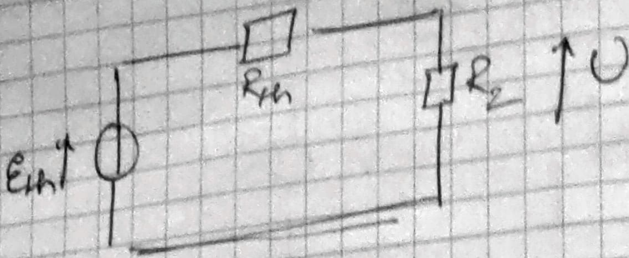
$$U_1 = \frac{E_2 R_1}{R_1 + R_3} = E_{th_2} \quad \text{———} \ (II)$$

Add (I) and (II)

$E_{th} = E_{th_1} + E_{th_2}$

$$\boxed{E_{th} = \frac{1}{R_1 + R_3}\left(E_2 R_1 + E_1 R_3\right)}$$

Thevenin generator across R_2



$$U = \frac{E_{th} R_2}{R_{th} + R_2}$$

$$U = \frac{E_2 R_1 + E_1 R_3}{R_1 + R_3} \times \frac{R_2}{\frac{R_1 R_3}{R_1 + R_3} + R_2}$$

$$= \frac{E_2 R_1 + E_1 R_3}{\cancel{R_1 + R_3}} \times \frac{R_2 \cancel{(R_1 + R_3)}}{R_1 R_3 + R_2 (R_1 + R_3)}$$

$$\boxed{U = \frac{R_2 (E_2 R_1 + E_1 R_3)}{R_2 (R_1 + R_3) + R_1 R_3}}$$

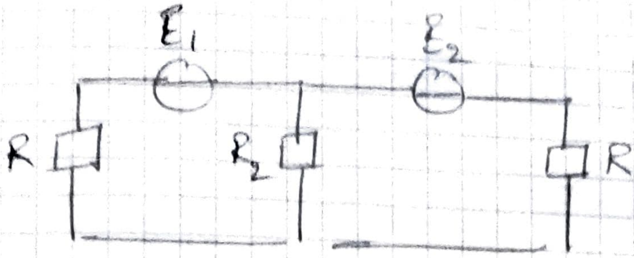
- Norton Theorem :-

Goal : Same as Thevenin

* Finding R_N
- Remove R *
- Remove all the sources
- $R_{eq} = R_N$

* Finding I_N
- Put back sources
- Short circuit the branch

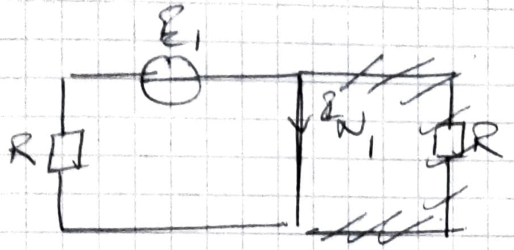
Ex :



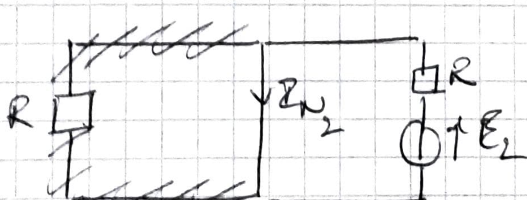
- R_N

$$R_{th} = R_N = \frac{R}{2}$$

- I_N

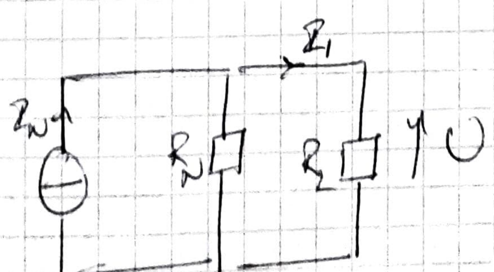


$$I_{N_1} = \frac{E_1}{R} \quad \text{— (1)}$$



$$I_{N_2} = \frac{E_2}{R} \quad \text{— (2)}$$

$$I_N = \frac{E_1}{R} + \frac{E_2}{R} = \frac{E_1 + E_2}{R}$$



$$I_1 = \frac{I_N R_N}{R_N + R_2}$$

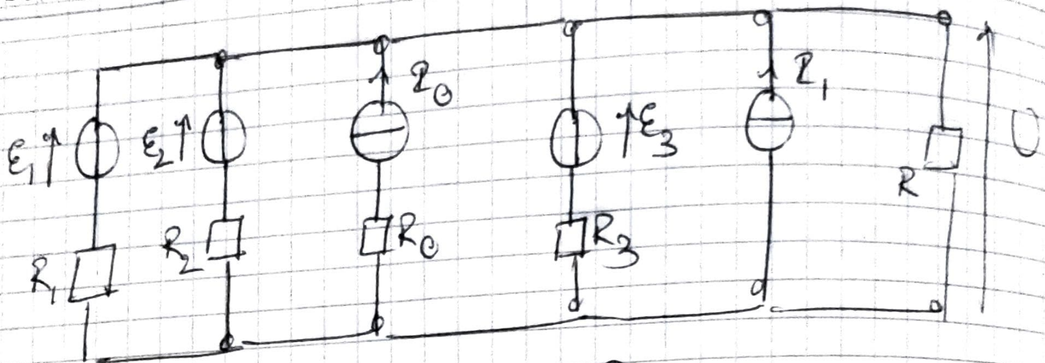
$$\boxed{U = \frac{I_N R_N \times R_2}{R_N + R_2}}$$

- Norton and Thevenin equivalence

$$E_{th} = I_N \times R_N \qquad (R_{th} = R_N)$$

$$I_N = \frac{E_{th}}{R_{th}}$$

- Millman Theorem



$$V = \frac{\sum_{i=1}^{n} \frac{E_i}{R_i} + \sum_{i=1}^{p} I_k}{\sum \frac{1}{R_i}}$$

$$U = \frac{\frac{E_1}{R_1} + \frac{E_2}{R_2} + \frac{E_3}{R_3} + I_0 + I_1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R}}$$

(Include all the resistances except the one which are in series with current source)

Tip: Use millman when the components are in parallel.
By parallel, what I mean is, every branch having equal voltage