
CCA

EEA · Dipôles Actifs : génér^R / D. passif : Résistance.

· Circuit électriq : ens dipôles actifs dp, interupteurs, fils

$$\boxed{I = \frac{q}{t} = \frac{n.e}{t}}$$

Ⓐ : série : $R_I \approx 0$.

Ⓥ : dérivaθ : $R_I = \infty$

Loi d'Ohm : $\boxed{U = R.I = \frac{1}{G}}$ $\boxed{R = \rho . \frac{L}{S}}$

ρ : Ω.m

S : Siemens

Conducta : $\boxed{G = \sigma . \frac{S}{L}}$

1° loi Kirchoff : $\boxed{\sum I_e = \sum I_s}$

Loi de maille : $\boxed{\sum U_{maille} = 0}$

Divi^R Tension : $U_{Req_2} = R_{eq_2} . I_1 = \frac{R_e}{R_1 - R_2} . E$

Divi^R Courant : $U = E . \frac{R_1}{R_1 + R_2}$ & $I_1 = I \frac{R_1}{R_1 + R_2} = \frac{G_1}{G_1 + G_2} I$.

$\boxed{\text{SÉRIE} : R_{eq} = \sum_{i=1}^{n} R_i}$ $\boxed{\text{Dérivaθ} : \frac{1}{R_{eq}} = \sum_{i=1}^{n} \frac{1}{R_i}}$

$\boxed{P = U.I}$ $\boxed{E = P.t}$ $\boxed{P = G.U^2}$

Série : même I, $U = \sum U_i$

Dériv : même U, $I = \sum I_i$

- $U_{AB} = V_A - V_B$

⚠ Relié tension à masse vaut 0.
Si nœud : on pt le mettre n'importe où.

$$R_e = \frac{R_1 \cdot R_2}{R_1 + R_2} \quad \& \quad R_e = \frac{R_1 \times R_2 \times R_3}{R_1 \times R_2 + R_1 \times R_3 + R_2 \times R_3}$$

Diviseur Tension

$$\boxed{U = E \cdot \frac{R_2}{R_1 + R_2}}$$

Diviseur Courant

$$\boxed{I_1 = I \cdot \frac{R_2}{R_1 + R_2}}$$

• $U_{AB} = V_A - V_B$

⚠ | Relié tension à masse vaut 0.
| Si noeud : on pt le mettre n'importe où.

$$R_e = \frac{R_1 . R_2}{R_1 + R_2} \quad \& \quad R_e = \frac{R_1 \times R_2 \times R_3}{R_1 \times R_2 + R_1 \times R_3 + R_2 \times R_3}$$

Divsr Tension

$$\boxed{U = E . \frac{R_2}{R_1 + R_2}}$$

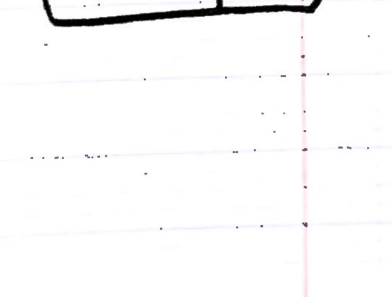
Divsr Courant

$$\boxed{I_1 = I . \frac{R_2}{R_1 + R_2}}$$

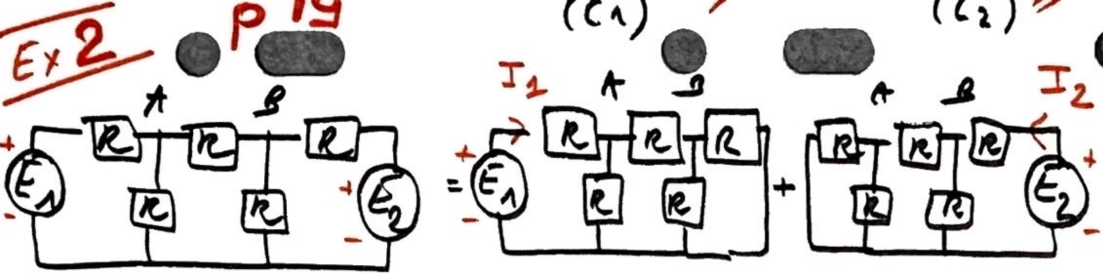
<u>Source Tension :</u> $U = E - rI$

<u>Source Courant :</u> $I = J - GU$ avec $J = I_{ma}$

<u>Lois de Superposit°</u> : $U = R_3 . \dfrac{E_1 . R_2 - E_2 . R_1}{R_1 R_2 + R_2 R_3 + R_1 R_3}$



Ex 2 P 19



(C_1) : $R_{eq} = R + \left(R \,//\, \frac{3R}{2}\right) = R + \frac{R(3/2\,R)}{R + 3/2\,R} = \frac{8}{5} R$

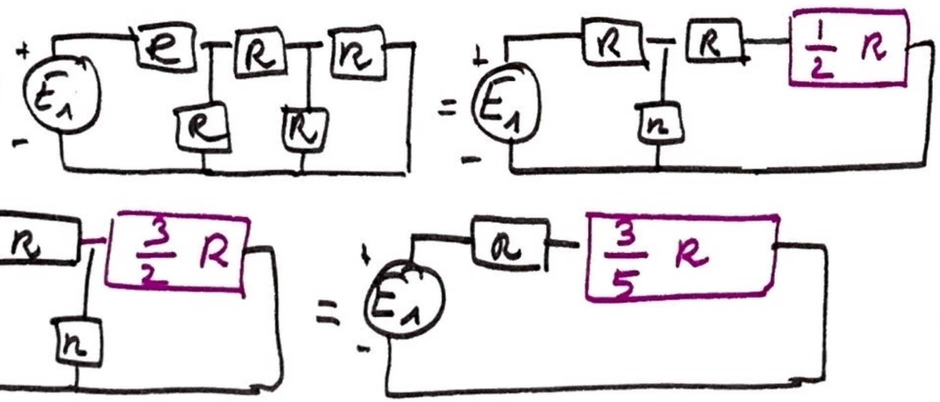
$I'_{A3} = I_1 \cdot \frac{R}{R + 3/2\,R} = \frac{2}{5} I$.

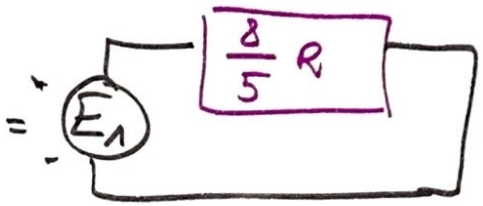
Ohm : $\boxed{E_1 = R_{eq_1} \cdot I_1}$ $\quad I_1 = \frac{E_1}{R_{eq_1}} = \frac{5}{8} \cdot \frac{E_1}{R} = \frac{2}{5} \cdot \frac{5}{8} \cdot \frac{E_1}{R}$

$I_1 = \frac{E_1}{4R}$.

Par symétrie, $I_2 = \frac{E_2}{4R}$ $\Rightarrow I = I_1 - I_2 = \frac{E_1 - E_2}{4R}$.

cf (C_1)

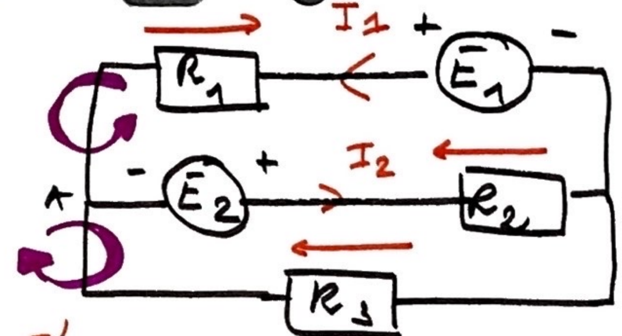




cf $\cdot\ R_1 - I_1 R_1 + R_2 - I_2 R_2 = 0$

(1) $\cdot\ R_1 + R_2 = I_1 R_1 + I_2 R_2$

Ex 1 p 19



Lois
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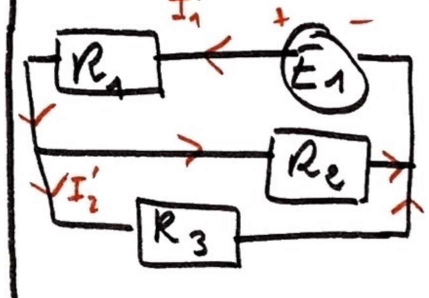

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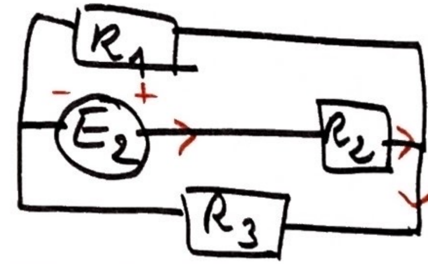


Lois
Su
per
pos
i

a) Lois Kirchhoff $\qquad$ Loi noeuds : $I = I_1 + I_2$

Loi mailles : (1) $R_1 - E_1 + R_2 - E_2 = 0$

(2) $E_2 - R_2 I_2 + R_3 I = 0$

D'après (2) : $\boxed{I = \frac{R_2 I_2 - E_2}{R_3}}$

D'après (1) : $E_1 + E_2 = R_1 I_1 + R_2 I_2$ $\quad$ cf

$E_1 + E_2 = R_1 (I_2 + I) + R_2 I_2$

$E_1 + E_2 = I_2 (R_1 + R_2) + R_1 \cdot I$

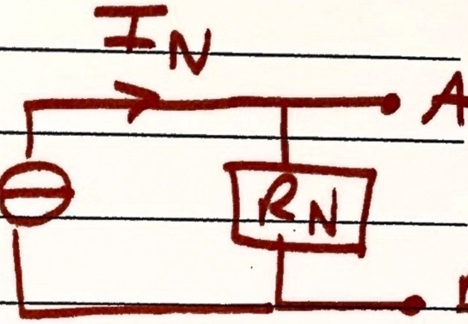
(3) $\boxed{I_2 = \frac{E_1 + E_2 - R_1 I}{R_1 + R_2}}$

TH. THÉVENIN

E_{th} — R_{th}

Diviseur de tension — Débrancher générateur

TH. NORTON



R_N — I_N

Débrancher génératR — Court-circuiter ap fil connexion

$U = R.I$

TH. MILMAN

$$\boxed{U_{AB} = \frac{\sum_{i=0}^{i} \frac{E_i}{R_i}}{\sum_{i=0}^{i} \frac{1}{R_i}}}$$

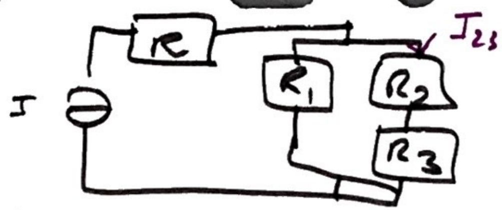
Suite ex I p19

(3) ds (2) $$I = \left[R_2\left(\frac{E_1+E_2-R_1 I}{R_1+R_2}\right) - E_2\right]\times\frac{1}{R_3}$$

$$I = \left[\frac{-E_2(R_1+R_2)+R_2(E_2+E_1)}{R_1+R_2}\right]\times\frac{1}{R_3}$$

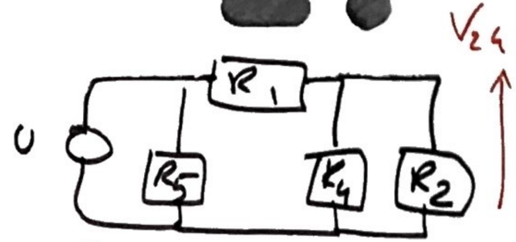
$$\boxed{I = \frac{E_1 . R_2 - E_2 . R_1}{R_3(R_1+R_2)+R_1R_2}}$$

AN $I = -1\,A$ sens posé à inverser



Génit^R ten° & courant

$$I_{23} = I . \frac{R_1}{R_1+(R_2+R_3)}$$



Génit^R ten° & courant

$$V_{24} = \frac{U \times \frac{R_2R_4}{R_2+R_4}}{R_1 + \frac{R_2R_4}{R_2+R_4}}$$

b) Ppe Superposit°

(C1) : $I = I_2' - I_2''$ (sens opposé)

$$I_2' = I_1' . \frac{R_2}{R_2+R_3}$$

$$R_{eq} = R_1 + \frac{R_2R_3}{R_2+R_3}$$

Puis $E_1 = I_1' . R_{eq} \Leftrightarrow I_1' = \frac{E_1}{R_{eq}}$

$$I_2' = \frac{E_1}{R_1 + \frac{R_2R_3}{R_2+R_3}} \times \frac{R_2}{R_2+R_3}$$

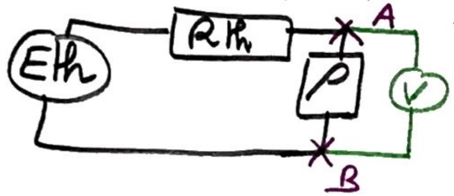
$$I_2' = \frac{E_1(R_2+R_3)}{R_1(R_2+R_3)+R_2R_3} \times \frac{R_2}{R_2+R_3} = \frac{E_1 . R_2}{R_1(R_2+R_3)+R_2R_3}$$

Par symétrie, $$I_2'' = \frac{E_2 . R_1}{R_1(R_2+R_3)+R_2R_3}$$

$$\Rightarrow I = \frac{E_1R_2 - E_2R_1}{R_3(R_1+R_2)+R_1R_2}$$

DC : $$I_x = I . \frac{\text{Résist° en //}}{\Sigma \text{ Résist°}} .$$

2) Diff'nce potentiel ↔ A & B mesurée à (V) de résistce ρ. Qlle conditi° ρ pr Δ (V) ne perturbe mesure de + 1% ?



$$\frac{E_{th} - U_{AB}}{E_{th}} < 1\%$$

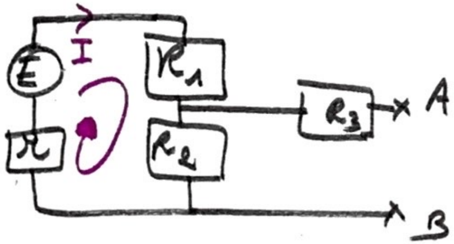
$$\Leftrightarrow 1 - \frac{U_{AB}}{E_{th}} < 0{,}01 \Leftrightarrow 1 - \frac{\rho . I}{E_{th}} < 0{,}01 \Leftrightarrow 1 - \frac{\rho . I}{I(R_{th}+\rho)} < 0{,}01$$

$$\Leftrightarrow 1 - \frac{\rho}{R_{th}+\rho} < 0{,}01 \Leftrightarrow \frac{R_{th}+\rho-\rho}{R_{th}+\rho} < 0{,}01 \Leftrightarrow \frac{R_{th}}{R_{th}+\rho} < 0{,}01$$

$$\Leftrightarrow R_{th} < 0{,}01\,(R_{th}+\rho) \Leftrightarrow 100\,R_{th} < R_{th}+\rho \Leftrightarrow \rho > 99\,R_{th}$$

⚠ GT & GC ⟹ $R_{th} \neq R_N$.

TH Norton → user loi de mailles



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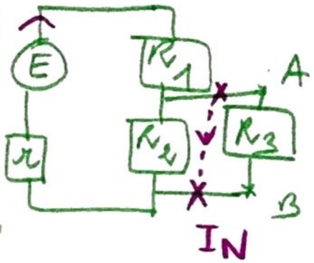
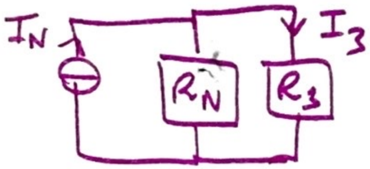


$$R_{eq1} = \frac{R_2 R_3}{R_2+R_3} \;;\; E + (-R_1 - R_{eq1} - r)I = 0$$

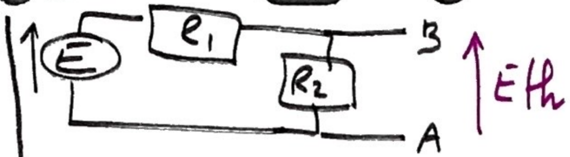
$$\Leftrightarrow I = E/(R_{eq1} + R_1 + r).$$



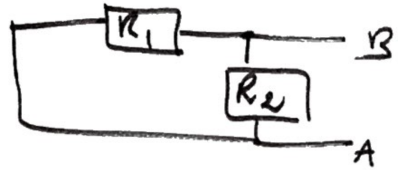
$$I_N = \frac{I R_2}{R_2+R_3} = \frac{E(R_2)}{(r+R_1)(R_2+R_3)+R_2R_3}$$

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

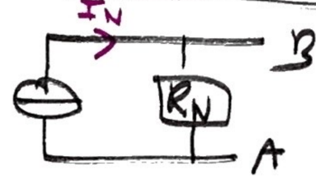
Ex2



$$E_{th} = \frac{E R_2}{R_2+R_1}$$

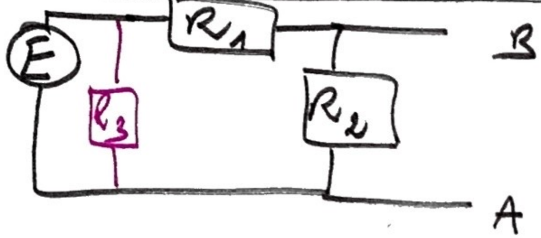


$$R_{th} = \frac{R_1 R_2}{R_1+R_2}$$



$$R_{th} = R_N = \frac{R_1 R_2}{R_1+R_2}$$

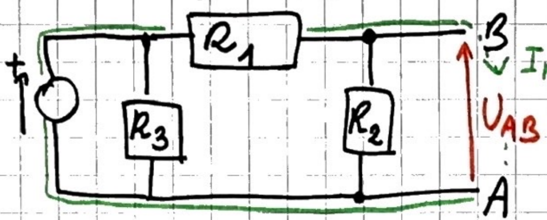
$$I_N = \frac{E_{th}}{R_N} = \frac{E R_2}{R_2+R_1} \cdot \frac{(R_1+R_2)}{R_1 R_2} = \frac{E}{R_1}$$



m raisonnement que précédemment.

R_3 : est en court-circuit.

Ex 2



Calcul Rth

Court-circuit R_3 de ∆ n'influe pas Rth

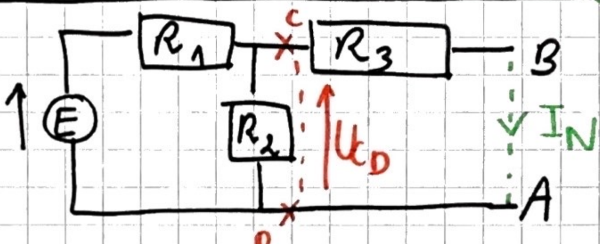
$$R_{th} = \frac{R_1 R_2}{R_1 + R_2}$$

Calcul Eth :

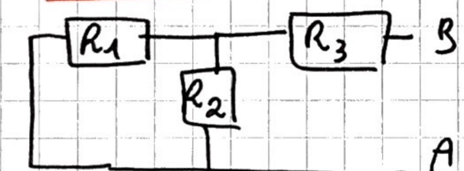
$$E_{th} = \frac{E R_2}{R_1 + R_2}$$

Loi de mailles

• $E - R_1 I_N = 0 \iff \boxed{I_N = \frac{E}{R_1}}$



Calcul Rth



$$R_{th} = R_3 + \frac{R_1 R_2}{R_1 + R_2}$$

Calcul Eth

$$E_{th} = \frac{E R_2}{R_1 + R_2}$$

• $R_{th} = R_N$ (1 s1 G)

• $E - R_1 I_N - R_3 I_N = 0 \Rightarrow \boxed{I_N = \frac{E}{R_1 + R_3}}$

Calcul Rth :

$$R_{th} = \frac{G_1 + G_2}{G_1 \cdot G_2}$$

Calcul Eth (LDM) :

$$E_{th} - \frac{I}{G_1} = 0 \iff E_{th} = \frac{I}{G_1}$$

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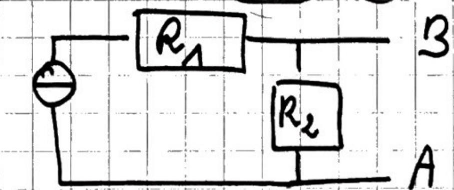
⇓
$R_N = R_{th}$

$I_N = \dfrac{E_{th}}{R_{th}}$ ⊛

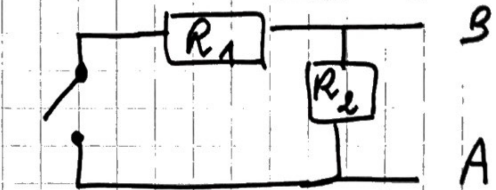
$$I_N = \frac{I G_2}{G_1 + G_2}$$

⊛ cas GC ⊖

①



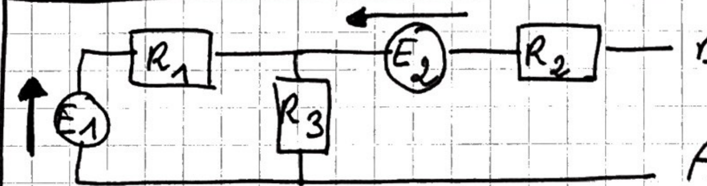
Calcul Rth



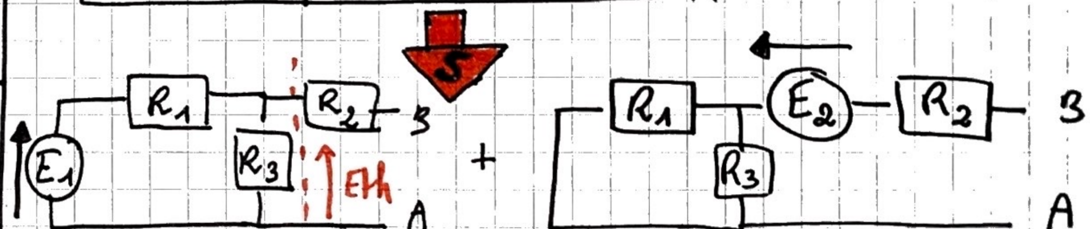
$R_{th} = R_2$.

Calcul Eth :

$E_{th} = R_2 I$ & $R_{th} = R_N$ & $I_N = \dfrac{E_{th}}{R_{th}} = I$



Th S n'est pas valable ds circ. ouvert



Calcul Rth

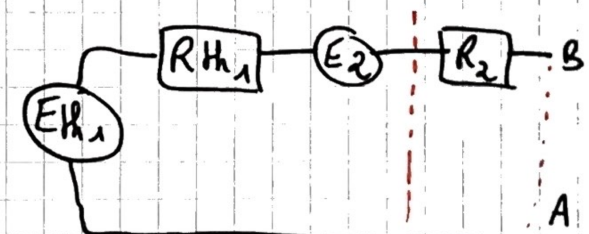
$$R_{th} = \frac{R_1 R_3}{R_1 + R_3} + R_2$$

$$I_N = \frac{E_{th}}{R_{th} \text{ (intrinsèque)}}$$

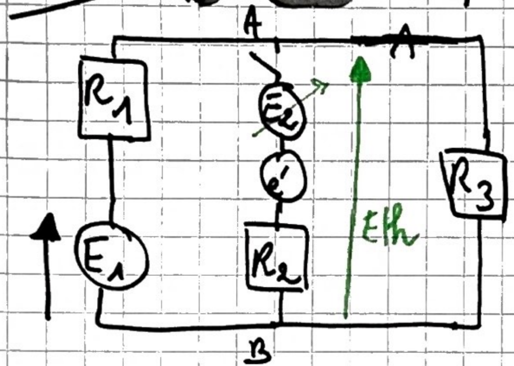
$$I_N = \frac{E R_3}{R_2 (R_3 + R_1) + R_3 R_1}$$

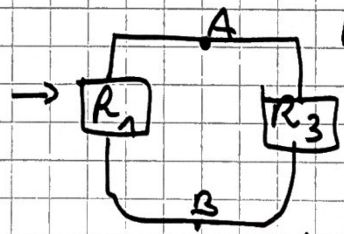
$$E_{th_1} = \frac{E_1 R_3}{R_3 + R_1}$$

$$E_{th_1} - E_2 = 0$$



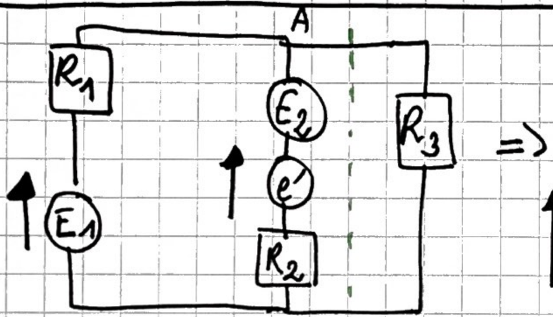
Ex3 Récepteur non polarisé

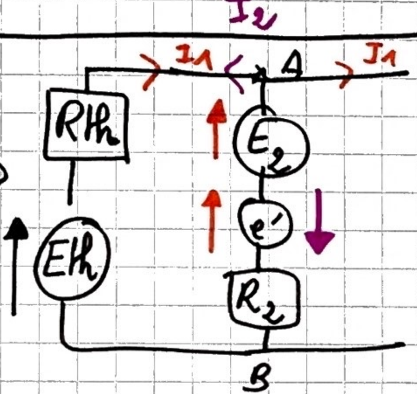




$$R_{th} = \frac{R_1 R_3}{R_1 + R_3}$$

$$E_{th} = \frac{E_1 R_3}{R_1 + R_3}$$





E2 faible / E1 domine :

$$E_{th} - R_2 I_1 - E_2 - e' - R_{th} . I_1 = 0$$

$$E_{th} - E_2 - e' - I_1 (R_2 + R_{th}) = 0$$

$$I_1 = \frac{E_{th} - E_2 - e'}{R_2 + R_{th}}$$

$\boxed{I_1 = 0}$ $E_2 = E_{th} - e'$

$\boxed{I_1 > 0}$ $E_{th} - E_2 - e' > 0 \iff E_2 < 8V$

E2 forte : $E_2 - R_2 I_2 - E_{th} - e' - R_{th} I_2 = 0$

$\boxed{I_2 = 0}$ $E_2 = 16\,V$ et $\boxed{I_2 > 0}$: $E_2 > 16V$

Moteur mis en route entre 8V & 16V.

Loi Superposiθ : Pr un circuit de n générateurs remplacer par n circuits avec 1 générateur.

- TH Thévenin : isoler / $R_{TH} = R_{eq}$ / E_{TH}
  ↳ remplacer générateur par fils connexions
- TH Norton : générateur courant.

a) Lois Kirchhoff : Loi noeuds + Loi maille
b) Principe Superposiθ.

Puissance & Énergie

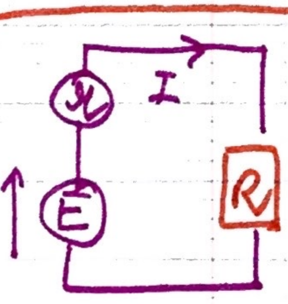
$\boxed{P = UI}$ → W

- $\boxed{E = P.t = U.I.t}$

$\boxed{1\ J = 1\ W \text{ pdt } 1\ s}$

$\boxed{P = R.I^2 = \frac{U^2}{R} = U^2.G}$

$1\ Wh = 1\ W \text{ pdt } 1\ h = 3600\ J$
$1\ kWh = 3{,}6.10^6\ J$



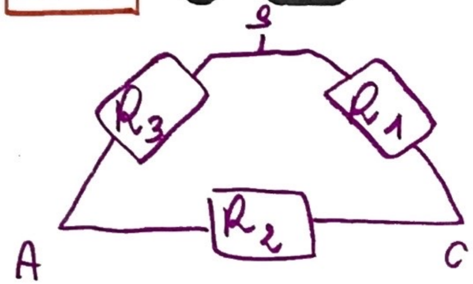
Générateur	Récepteur
$P_E = E.I$	$P_R = P_{fournie}$
$P_{perte} = r I^2$	$P_R = EI - rI^2$

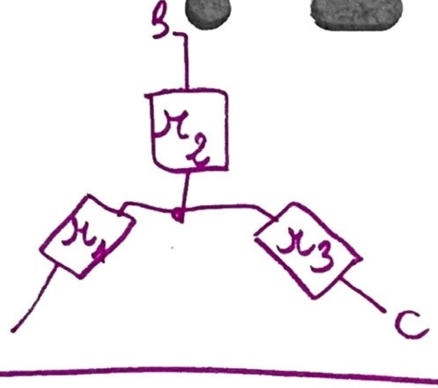
$P_{fournie} = P_E - P_{perte} = EI - rI^2$

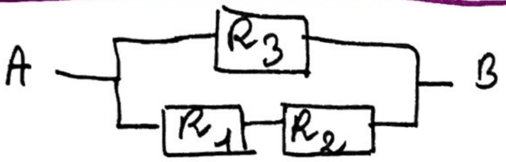
$P_R = \frac{U^2}{R} = R.I^2$

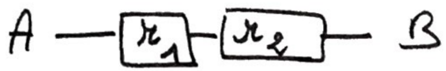
- Pont de Wheastone
- Th Kenelly & $\Delta \Rightarrow$ ☆

Ex 4









$$R_{AB} = \frac{R_3(R_1+R_2)}{R_1+R_2+R_3} \qquad R_{BC} = \frac{R_1(R_2+R_3)}{R_1+R_2+R_3} \qquad R_{AC} = \frac{R_2(R_1+R_3)}{R_1+R_2+R_3}$$

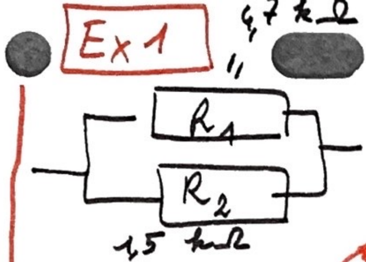
$$R_{AB} = r_1 + r_2 \qquad R_{BC} = r_2 + r_3 \qquad R_{AC} = r_1 + r_3$$

$$R_{AB} + R_{AC} - R_{BC} = r_1 + \cancel{r_2} + r_1 + \cancel{r_3} - \cancel{r_2} - \cancel{r_3} = 2r_1$$

$$R_{AB} + R_{AC} - R_{BC} = \frac{R_3(R_1+R_2) + R_2(R_1+R_3) - R_1(R_2+R_3)}{R_1+R_2+R_3}$$

$$r_1 = \frac{R_2 R_3}{R_1+R_2+R_3} \qquad r_2 = \frac{R_1 R_3}{R_1+R_2+R_3} \qquad r_3 = \frac{R_1 R_2}{R_1+R_2+R_3}$$

Ex 1



$$P = UI = \frac{U^2}{R}$$

1) Dissipe puiss ce + élevée : $\frac{U^2}{R \searrow} \Rightarrow P \nearrow$.

2) Tension $\boxed{max}$ applicable à l'ensemble :

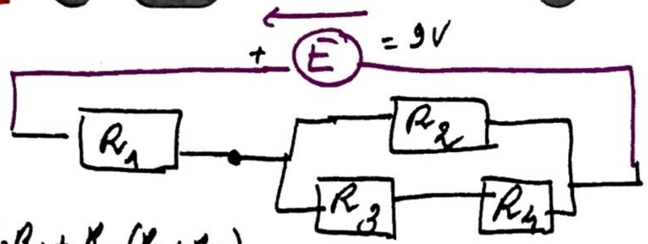
$U^2 = P \cdot R_1 \iff U_{max} = \sqrt{4{,}7 \cdot 10^3 \times 0{,}5} = 48{,}47\ V.$

3) $P_{dissipée}(R_1) = \frac{U^2_{max}}{R_1} = \frac{48{,}47^2}{4{,}7 \cdot 10^3} \approx 0{,}5\ W.$

$P_{dissipée}(R_2) = \frac{U^2_{max}}{R_2} = \frac{48{,}47^2}{1{,}5 \cdot 10^3} \approx 0{,}156\ W.$

$P_{tot} = P_{dissipée}(R_1) + P_{dissipée}(R_2) = 0{,}656\ W$

Ex 2



$$R_{eq} = \frac{R_3R_4 + R_2(R_3+R_4)}{R_3+R_4} + R_1 \qquad E = R_{eq}.I \iff I = \frac{E}{R_{eq}} = \frac{9}{6} = 1{,}5\,A$$

→ R_{eq} & R_1 st passés par m̂ courant I.

→ $I_{Req} = I = 1{,}5\,A$ & $I_3 = I_1 - I_{2} = 0{,}5\,A.$

→ $U_{AB} = R_1 I = 4 \times 1{,}5 = 6\,V$

→ $E = R_1 I + R_{eq2} I \iff I R_{eq2} = 3\,V$

→ $U_{BC} = 3V = R_2 I_2 \iff I_2 = \frac{U_{BC}}{R_2} = \frac{3}{3} = 1\,A.$

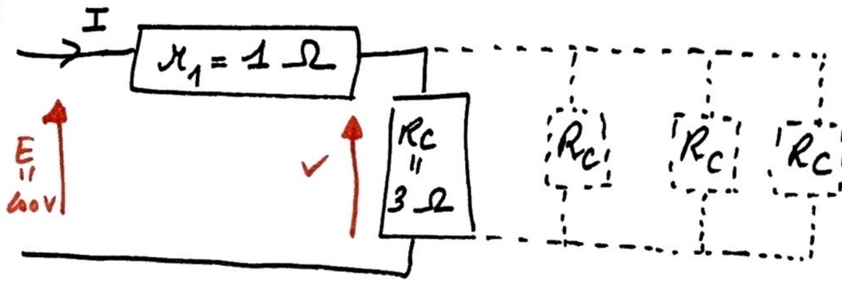
3) $P = UI = RI^2 = \frac{U^2}{R}$

$P(R_1) = \frac{U_{AB}^2}{R_1} = 9\,W$ | $P(R_2) = R_2 I_2^2 = 3\,W$

$P(R_3) = R_3 I_3^2 = 0{,}5\,W$ | $P(R_4) = R_4 I_3^2 = 1\,W$

Puissance fournie = Σ Puissances dissipées.
$= 13{,}5\,W.$

Ex 3



1) LOM $E = r_1 I + R_c I \iff I = \frac{E}{r_1 + R_c} = 50\,A.$

$$U_{RC} = \frac{E R_c}{R_c + r_1} = \frac{200 \times 3}{3} = 150\,V$$

$P(R_c) = R_c I^2 = 3 \times 50^2 = 7500\,W$

2) $R_{eq} = \frac{R_c R_c R_c}{3 R_c} = \frac{R_c^3}{3 R_c} \Rightarrow R_{eq} = \frac{R_c^{n-1}}{n}$

AN $R_{eq} = \frac{R_c}{n} = \frac{3}{n}$

$I = \frac{E}{r_1 + R_{eq}} = \frac{200n}{n+3}$ | $U = \frac{E\,R_{eq}}{R_{eq} + R_c}$

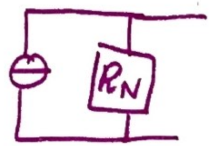
$P = U.I = 200 \times \frac{200n}{n+3}.$

→ Puissance instantannée : pdt 1 s.

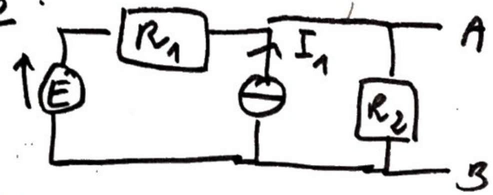
$\boxed{IE}$ $V_{BM} = R_2 I_2 = R_3 I_3$ & $V_{AB} = R_1 I_1$ & $P = UI$.

$R_N = R_{th}$ & $I_N = \frac{E_{th}}{R_{th}}$ & (DT) $E_{th} = \frac{E R_2}{R_1 + R_2}$

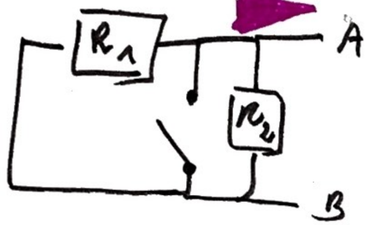
→ Passage Thévenin - Norton :

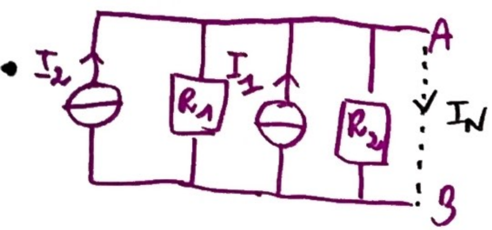
& I 

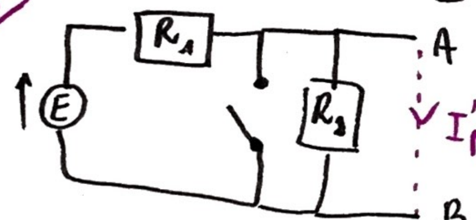
Ex 3 :



→

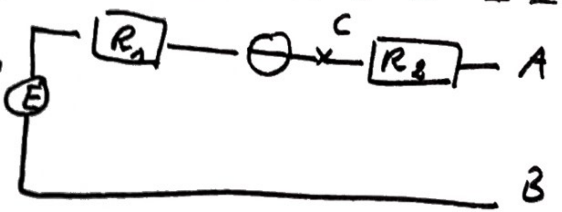






• $I_N' = \frac{E R_2}{R_1 + R_2}$ & $E_{R_2} = E_{th} = \frac{E R_2}{R_1 + R_2}$

• $E - R_1 I_N' = 0 \iff I_N' = \frac{E}{R_1}$



$E - IR_1 - E_2 - IR_2 = 0$

$-I(R_1 + R_2) = E_1 - E_2$

$\boxed{I = \frac{E_1 - E_2}{R_1 + R_2}}$

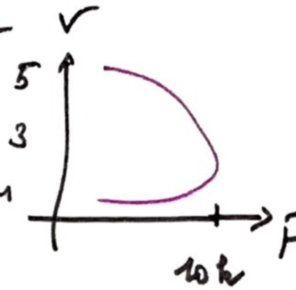
$P = UI$ & $P = \frac{E.n.R_c}{(r_1 + R_c)^2}$

$n = 1$, $V = 150\ V$ & $P = UI = 7\,500\ W$

$n = 2$, $V = \frac{200.3}{2+3} = 120\ V$ & $P = 9600\ W$

$n = 3$, $V = 100\ V$ & $P = 10\ kW$

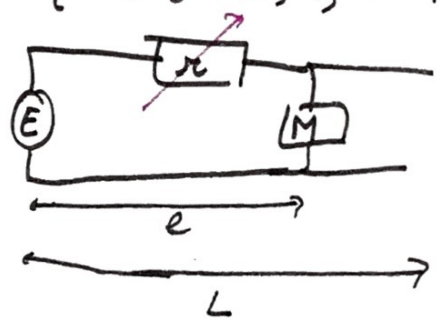
$n = 5$, $V = 75\ V$ & $P = 9375\ W$



$P = V.I$ où $I = \frac{E}{r}$

$P = V\left(\frac{E - V}{r}\right) = \frac{E.R_{eq}\,(E(r_1 + R_{eq}) - E R_{eq})}{r_1\,(r_1 + R_{eq})^2}$

Ex 4 : $\eta = \frac{P_{utile}}{P_{fournie}}$ → η en f E, r, I ?



$\boxed{P_f = E.I}$

$\boxed{P_u = EI - rI^2 = I(E - rI)}$

$\eta = 1 - \frac{rI}{E}$

$r = \frac{e}{L} \cdot R$

→ + proche ⇒ on perd ⊖ de puissances.

→ $r <<$ ⇒ $\eta_{max} \simeq 1$