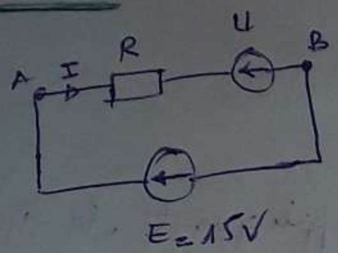
Correction

Exercice 1

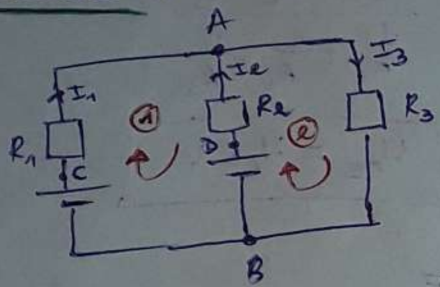


1) En appliquant la loi des mailles :

$$E = U + RI \Rightarrow I = \frac{E-U}{R}$$

AN : $I =$

Exercice 2 :



1) Le sens des courants étant inconnus, choisissons-les arbitrairement.

- On a 3 inconnues (I_1, I_2, I_3), il nous faut donc 3 éq. indépendantes.

- La loi des Noeuds :

  Au noeud A : $I_1 + I_2 = I_3$ ①

- La loi des mailles :

→ 1ère maille - ADBCA : $R_1 I_1 - E_1 + E_2 - R_2 I_2 = 0 \Rightarrow E_2 - E_1 = R_2 I_2 - R_1 I_1$

$\Rightarrow 5I_2 - 2I_1 = 50$ ②

→ 2ème maille - ABDA : $R_3 I_3 + R_2 I_2 - E_2 = 0 \Rightarrow E_2 = R_2 I_2 + R_3 I_3 \Rightarrow 5I_2 + 10 I_3 = 70$ ③

Regroupons les 3 éq. :

$$\begin{cases} I_1 + I_2 = I_3 & ① \\ 5I_2 - 2I_1 = 50 & ② \\ 5I_2 - 10 I_3 = 70 & ③ \end{cases} \Rightarrow \begin{cases} I_1 = \\ I_2 = \\ I_3 = \end{cases}$$

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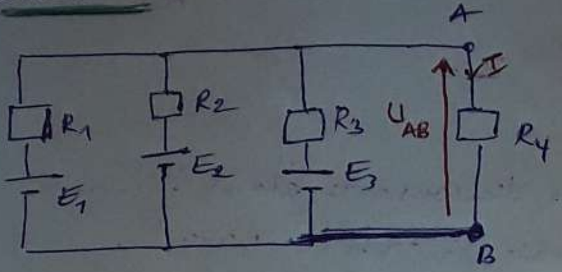
Exercice 3 :



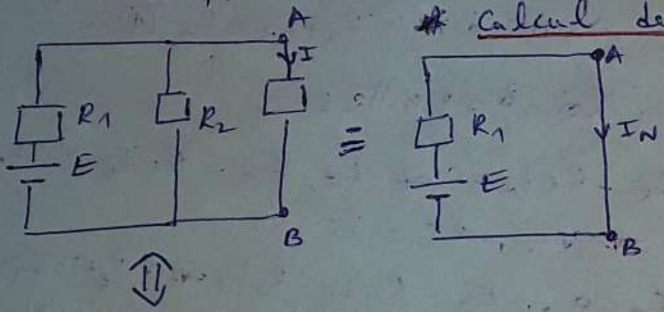
1) En appliquant le théorème de Millman :

$$U_{AB} = \frac{\frac{E_1}{R_1} + \frac{E_2}{R_2} + \frac{0}{R_3}}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$$

2) AN : $\boxed{U_{AB} = 7{,}5\,V}$

3) On a : $U_{AB} = R_4 \cdot I$ $\Rightarrow I = \frac{U_{AB}}{R_4} =$

Exercice 4 :



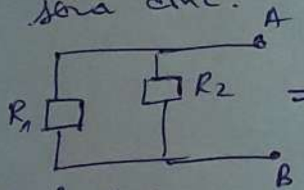
* Calcul de I_N :

On débranche la résistance R_3 et on c-c les bornes A et B.

$$\Rightarrow \boxed{I_N = \frac{E}{R_1} = \frac{8}{4} = 2\,A}$$

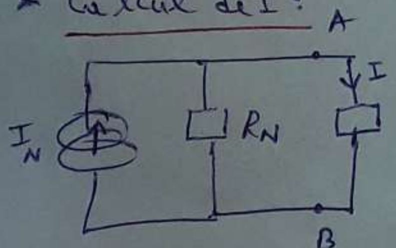
* Calcul de R_N :

R_3 étant toujours débranchée, on c-c E, la configuration sera donc :



$$\Rightarrow \boxed{R_N = \frac{R_1 R_2}{R_1 + R_2} = 3\,\Omega}$$

* Calcul de I :



$$\Rightarrow \boxed{I = \frac{R_N}{R_N + R_3} I_N = 0{,}5\,A}$$

(diviseur de courant)

Exercice 5 :

Détermination de E_{Th} par la méthode de superposition :

→ On court-circuite E_1 premièrement : $E_1 = 0$ donc $U_{CB} = 0$ c-à-d $C \equiv B$

le schéma se transforme à celui de la deuxième figure.

• Diviseur de tension : $E'_{Th} = U'_{AB} = \dfrac{(R_1 // R_2)}{(R_1 // R_2) + (R_3 // R_4)} E_2$

$$= \frac{E_2 R_1 R_2 (R_4 + R_3)}{R_3 R_4 (R_2 + R_1) + R_1 R_2 (R_4 + R_3)}$$

→ On court-circuite E_2 : $E_2 = 0$ donc $U_{AD} = 0$ c-à-d $A \equiv D$, le schéma se transforme comme il est illustré à la 4ème figure.

• Diviseur de tension : $E''_{Th} = U''_{AB} = \dfrac{(R_1 // R_4)}{(R_1 // R_4) + (R_2 // R_3)} E_1$

$$= \frac{E_1 R_1 R_4 (R_3 + R_2)}{R_1 R_4 (R_3 + R_2) + R_2 R_3 (R_4 + R_1)}$$

En fin : $\boxed{E_{Th} = U_{AB} = U'_{AB} + U''_{AB} = E'_{Th} + E''_{Th} = 6{,}48\,V}$

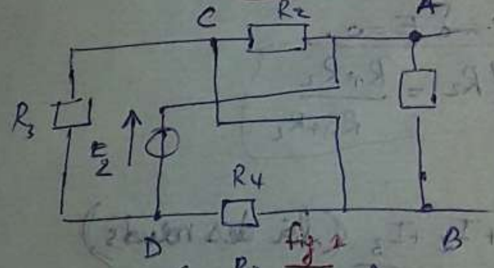


fig. 1

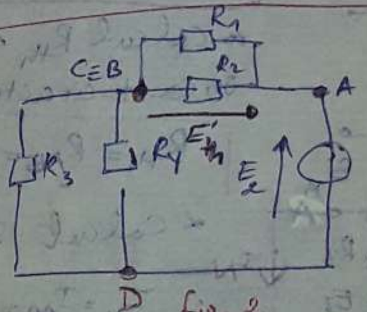


fig. 2

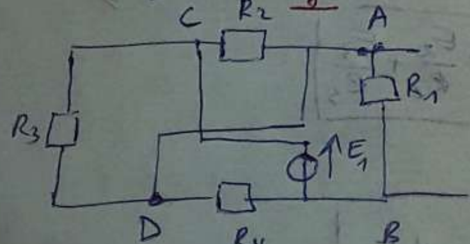


fig. 3

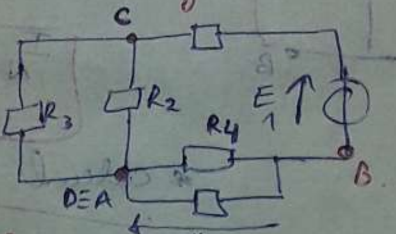
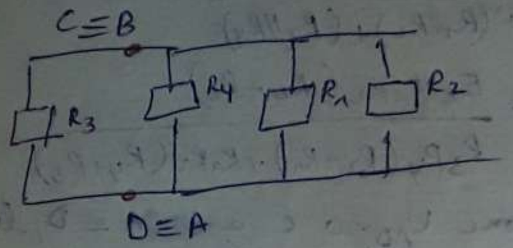


fig. 4

Calcul R_{th} :

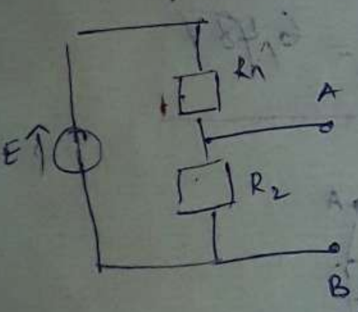
On court-circuite les 2 sources de tension puis on calcule $R_{AB} = R_{th}$. Il faut noter que $C \equiv B$ et que $A \equiv D$ car $E_1 = 0$ et $E_2 = 0$:



$$R_{th} = R_1 \,//\, R_2 \,//\, R_3 \,//\, R_4 .$$

AN : $\boxed{R_{th} = 480\ \Omega}$

Exercice 7 :



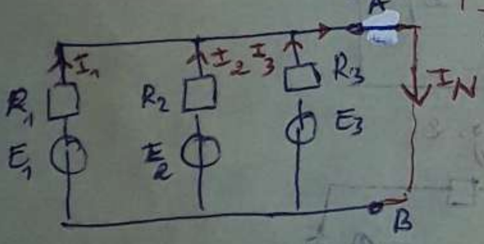
* Calcul E_{th} ?

$$\boxed{E_{th} = U_{AB} = \frac{R_2}{R_1 + R_2} E}$$ (Diviseur de tension)

* Calcul R_{th} ?

On court-circuite E c.à.d $E = 0$.

$$\boxed{R_{th} = R_{AB} = R_1 \,//\, R_2 = \frac{R_1 R_2}{R_1 + R_2}}$$



* Calcul I_N ?

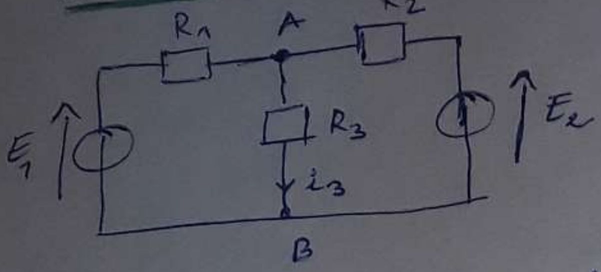
$$I_N = I_{AB} = \frac{I_1}{R_1} + I_2 + I_3$$ (loi des nœuds)

$$\boxed{I_N = \frac{E_1}{R_1} + \frac{E_2}{R_2} + \frac{E_3}{R_3}}$$

* Calcul R_N ?

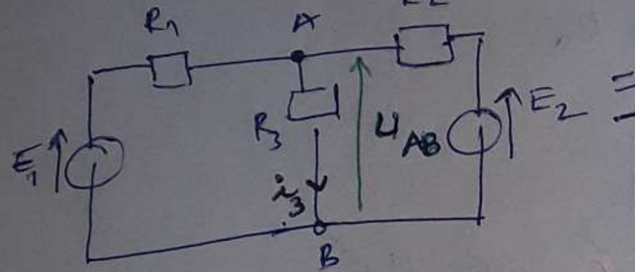
$$\boxed{R_N = R_1 \,//\, R_2 \,//\, R_3}$$

Exercice 8 :



1/ On veut exprimer i_3 en fonction de E_1, E_2, R_1, R_2 et R_3.

Pour ce faire, on peut appliquer le théorème de superposition.



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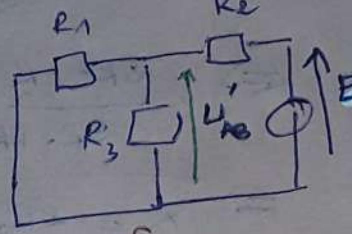


fig. 1

⊕

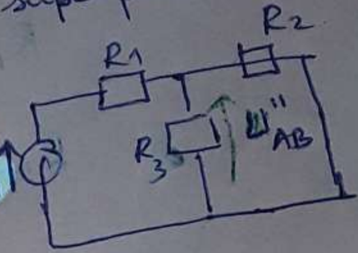


fig. 2

⇒ Calcul de U'_{AB} et U''_{AB} ?

- U'_{AB} ?

fig 1 : ⇒ $\boxed{U'_{AB} = \dfrac{(R_1 /\!/ R_3)}{(R_1 /\!/ R_3) + R_2} E_2}$

- U''_{AB} ?

fig. 2 : ⇒ $\boxed{U''_{AB} = \dfrac{(R_3 /\!/ R_2)}{(R_3 /\!/ R_2) + R_1} E_1}$

⇒ D'après le théorème de superposition :

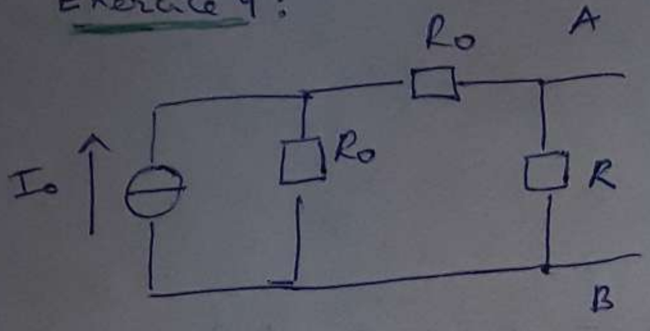
$\boxed{U_{AB} = U'_{AB} + U''_{AB}}$

⇒ la loi d'Ohm ⇒ $\boxed{i_3 = \dfrac{U_{AB}}{R_3}}$

AN : $i_3 =$

AN : i_3

Exercice 9 :



1) Calcul R_N ?

$$R_N = 2R_0 // R = \frac{2R_0 \cdot R}{2R_0 + R}$$

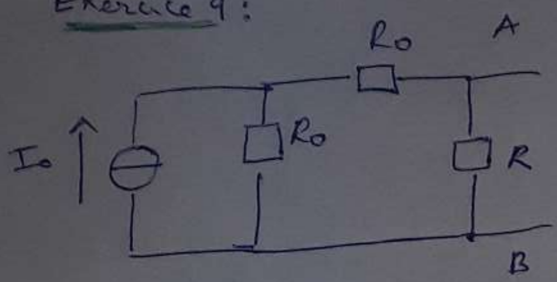
- $R_N = R_0 \Leftrightarrow \frac{2R_0 \cdot R}{2R_0+R} = R_0$.

$$\Rightarrow \boxed{R = 2R_0}$$

2) $\Rightarrow \boxed{R_N = \frac{2R_0 \cdot R}{2R_0+R}} = (2R_0 // R)$

$\Rightarrow \boxed{I_N = \frac{R_0}{R_0+R_0} I_0}$ (Diviseur de courant)

Exercice 9 :



1) Calcul R_N ?

$$R_N = 2R_o \,//\, R = \frac{2R_o \cdot R}{2R_o + R}$$

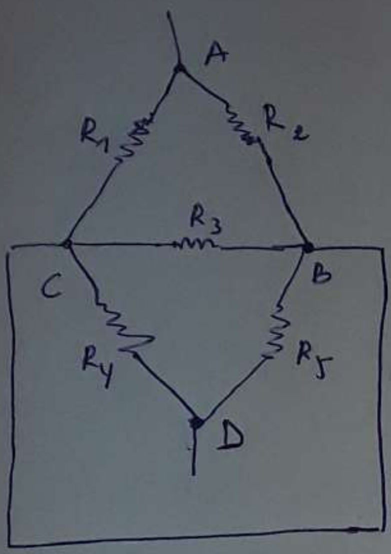
- $R_N = R_o \Leftrightarrow \dfrac{2R_o \cdot R}{2R_o + R} = R_o$.

$$\Rightarrow \boxed{R = 2R_o}$$

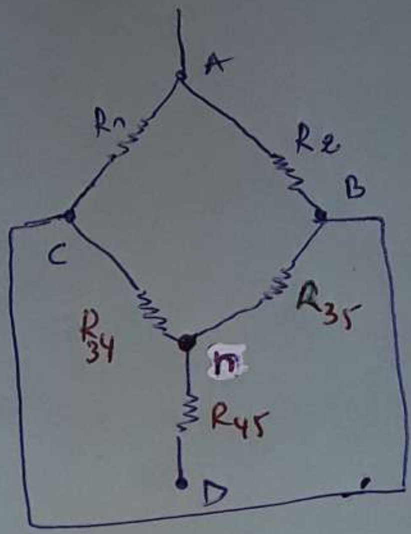
2) $\Rightarrow \boxed{R_N = \dfrac{2R_o \cdot R}{2R_o + R}} = (2R_o \,//\, R)$

$\Rightarrow \boxed{I_N = \dfrac{R_o}{R_o + R_o} I_o}$ (Diviseur de courant)

Exercice 6 :



Kennelly $\Longrightarrow$



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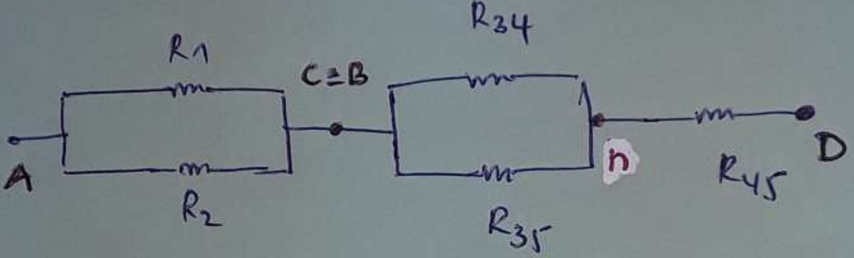
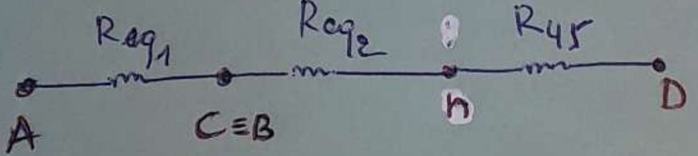
$\Longrightarrow$



$\Longrightarrow$



$$\boxed{R_{eq} = R_{AD} = R_{eq_1} + R_{eq_2} + R_{45}}$$

avec :

$$\left\{\begin{aligned} R_{34} &= \frac{R_3 \cdot R_4}{R_3 + R_4 + R_5} \\ R_{45} &= \frac{R_4 R_5}{R_3 + R_4 + R_5} \\ R_{35} &= \frac{R_3 \cdot R_5}{R_3 + R_4 + R_5} \end{aligned}\right.$$

et

$$\left\{\begin{aligned} R_{eq_1} &= R_1 \parallel R_2 \\ R_{eq_2} &= R_{34} \parallel R_{35} \end{aligned}\right.$$

AN : $R_{eq} = R_{AD} = \dots$