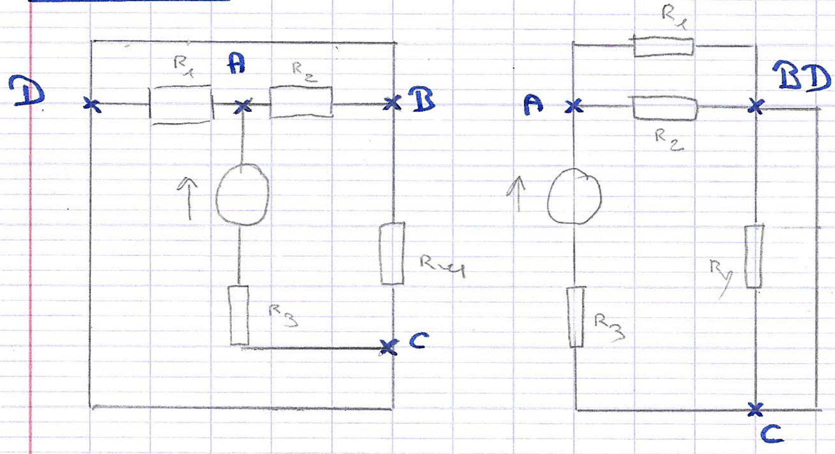
Correction TD — TD électrocinétique : dipôles en courant continu

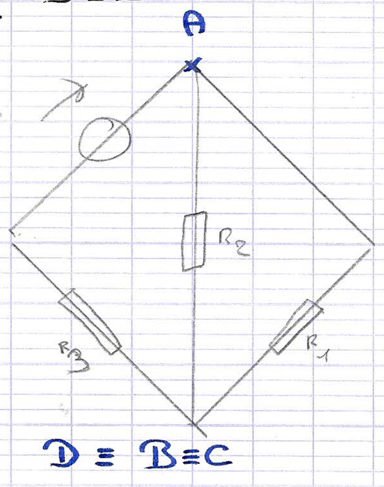
Exercice 1



A : R1, R2, g+R3
B : R1, R2, R4
C : R4, R3+g, R2, R1

Deux circuits sont équivalents si les intensités et les potentiels électriques sont équivalents.
On peut dire aussi que 2 circuits sont équivalents si :
- même nœuds principaux
- branches identiques

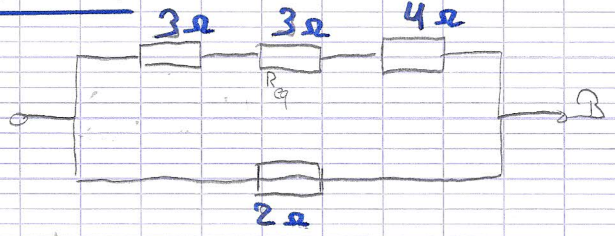
1) B ≡ D



2) a n'est pas équivalent à b (sens du générateur E_2)

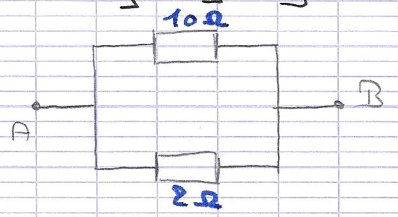
Exercice 2 :

AB =



$$R_{eq} = \frac{1}{\frac{1}{3} + \frac{1}{3} + \frac{1}{3}} = 3$$

=



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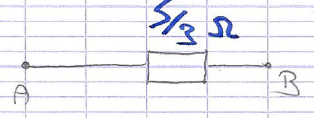
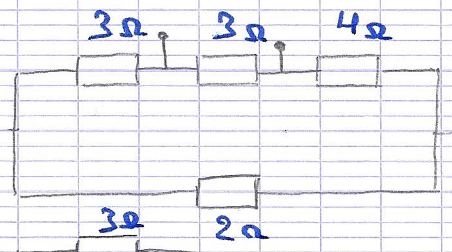


CD =



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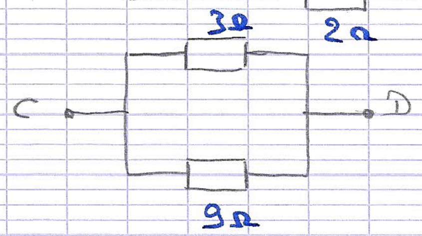
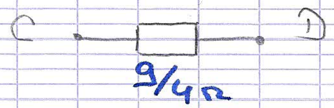


$$R = \frac{1}{\frac{1}{3} + \frac{1}{9}} = \frac{9}{4}$$

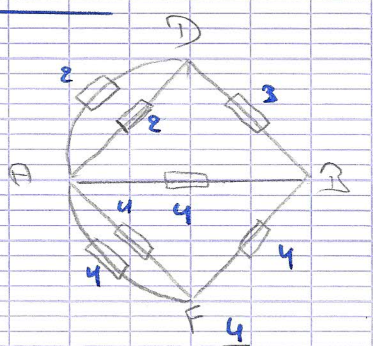
=



$$\frac{3}{6} + \frac{1}{6} = \frac{4}{6} \qquad \frac{6}{4} = \frac{3}{2}$$

Exercice 3 :

1)



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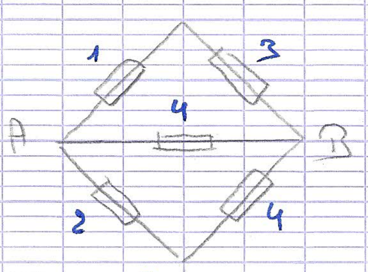

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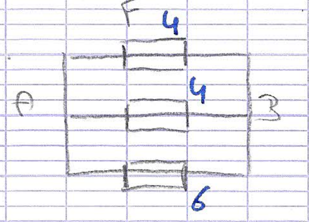

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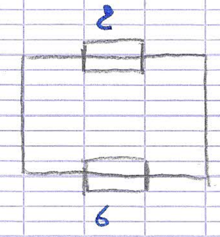

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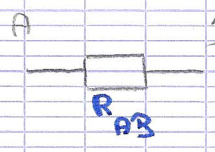
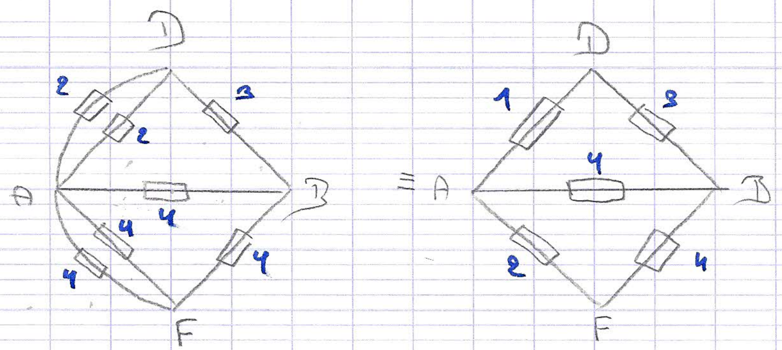


$$R_{AB} = \frac{1}{\frac{1}{2} + \frac{1}{6}}$$

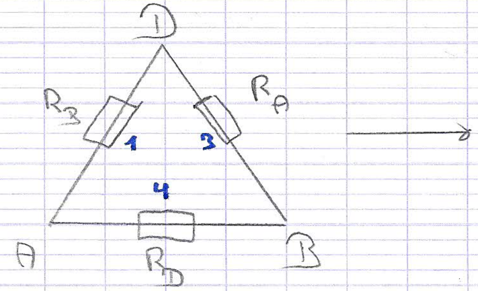
$$= \frac{6}{4} = \frac{3}{2}\ \Omega$$

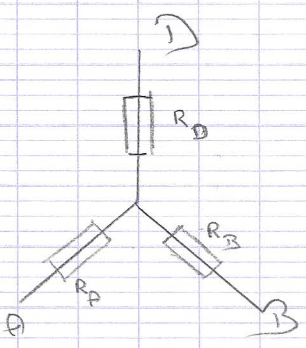
Correction TD.

2)



Transformation $\Delta \rightarrow Y$



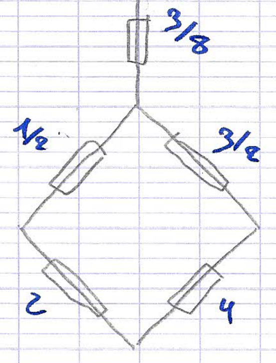


$$R_A = \frac{R_B \times R_D}{R_A + R_B + R_D} = \frac{4}{8} = \frac{1}{2}\ \Omega$$

$$R_B = \frac{R_A \times R_D}{R_A + R_B + R_D} = \frac{12}{8} = \frac{3}{2}\ \Omega$$

$$R_D = \frac{R_A \times R_B}{R_A + R_B + R_D} = \frac{3}{8}\ \Omega$$

≡



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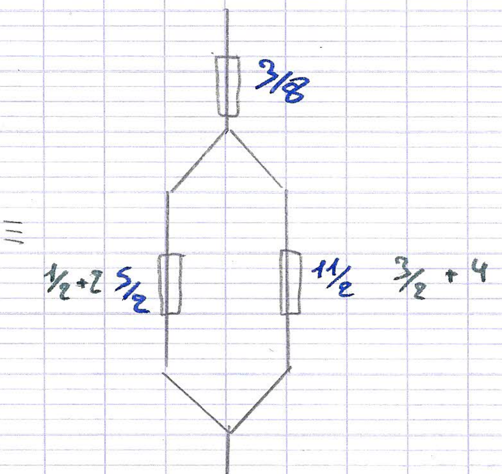

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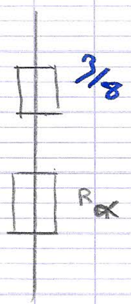
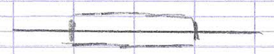


$$R_\alpha = \frac{1}{\frac{1}{\frac{5}{2}} + \frac{1}{\frac{11}{2}}} = \frac{55}{32}\ \Omega$$

$$3/8 + 55/32 = 67/32\ \Omega$$

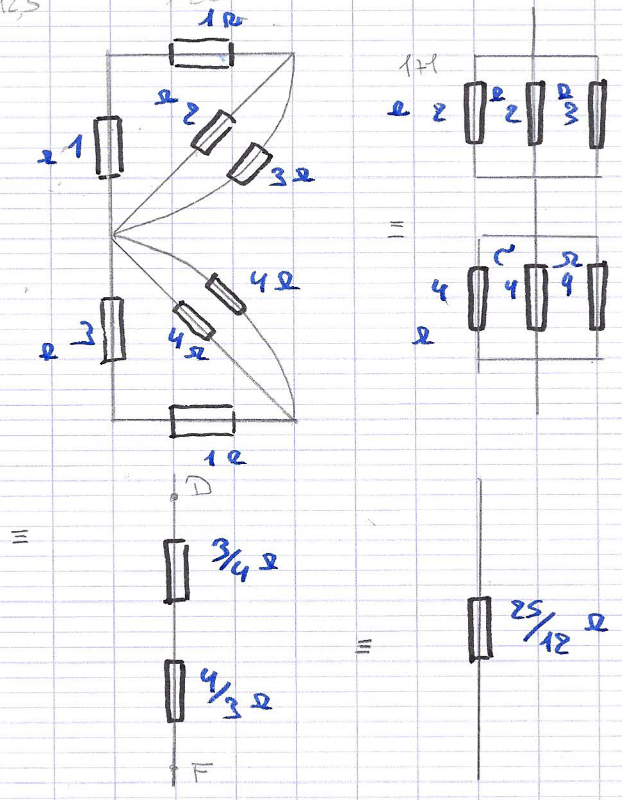
≡



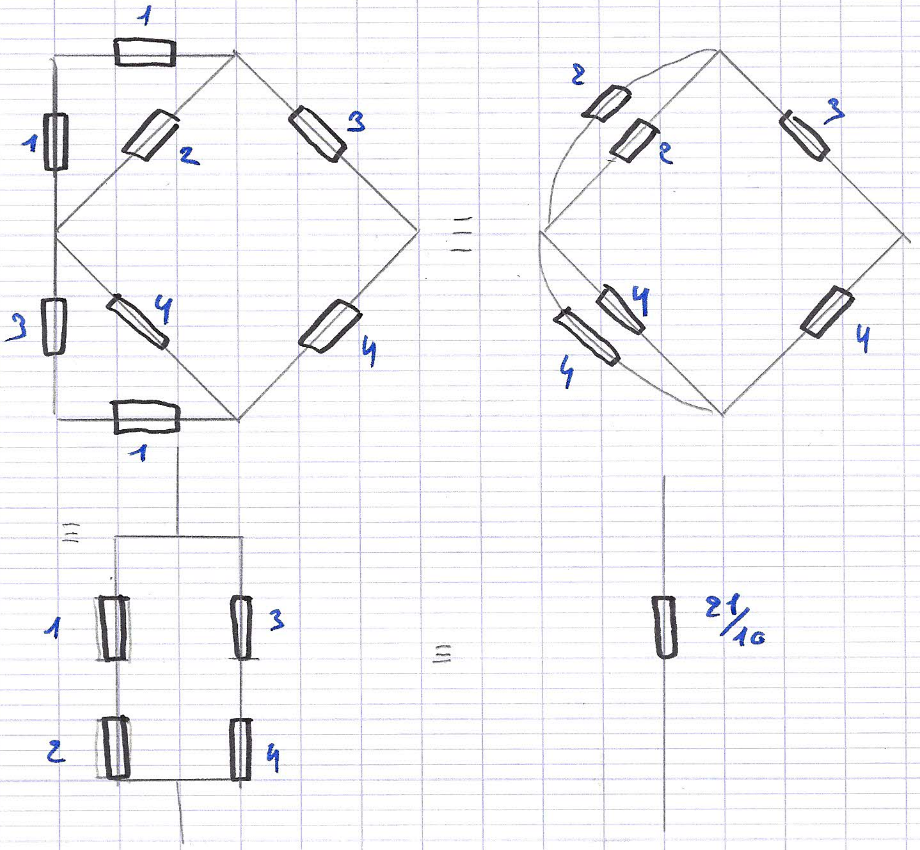
5% 20% 3,05 25%
11 12,5 20

3) a)

5,5 · 10

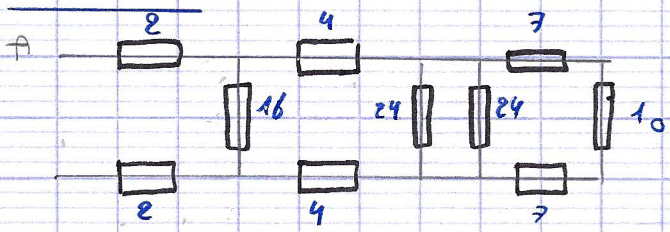


b)



Correction TD électro

Exercice 4



$R_{AB} = 12\,\Omega$

Exercice 5 :

$U_{BC} = R \cdot I_{BC} = 4V \Rightarrow P_{BC} = U_{BC} \cdot I_{BC} = 8W$

$U_{CD} = E = 4V \Rightarrow P_{CD} = 8W$

$U_{DA} = R \cdot I_{DA} = 6V \Rightarrow P_{DA} = 12W$

$U_{BA} = U_{BC} + U_{CD} + U_{DA} = 14V \Rightarrow P_{BA} = -28W$

$U_{BC} = R \cdot I_{BC} = 4V \ , P_{BC} = 8W$

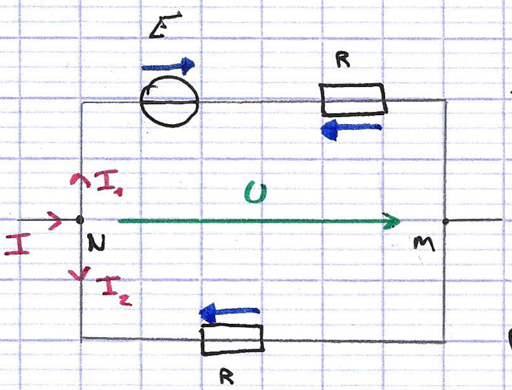
$U_{CD} = -E = -4V \ , P_{BC} = -8W$

$U_{DA} = R \cdot I_{DA} = 6V \ , P_{BC} = 12W$

$U_{BA} = U_{BC} + U_{CD} + U_{DA} = 6V \ , P_{BA} = U_{BA} \times -I_0 = -12W$

Exercice 6 :

1)



1^re loi de Kirchhoff

$I = I_1 + I_2$

pour I_1 :

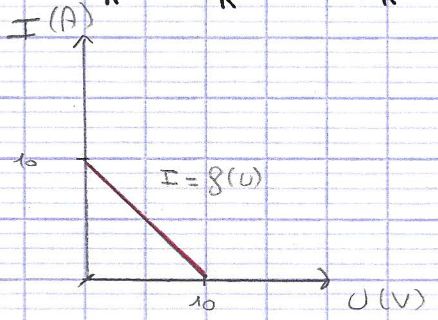
$U = E - R \cdot I_1 \Rightarrow I_1 = \frac{E - U}{R}$

pour I_2 :

$U = -R \cdot I_2 \Rightarrow I_2 = -\frac{U}{R}$

$I = \frac{E-U}{R} - \frac{U}{R} = \frac{E - 2U}{R} \Rightarrow I = E/_R - 2U/_R$

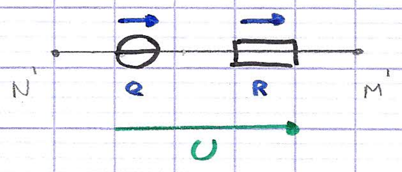
$= 10 - U$



2) a) $I = 0,5A$. Puissance du dipôle M'N' :

$P = U_{M'N'} I_{M'N'} = U_{N'M'} I_{N'M'}$

un moteur est 1 dipôle passif.



$P = (e + R.I).I$

$= 2,2\ W$

$R = \frac{\text{Puissance utile}}{\text{Puissance totale}}$ $\quad R = \frac{e.I}{U.I} = 0,91 = 91\%$

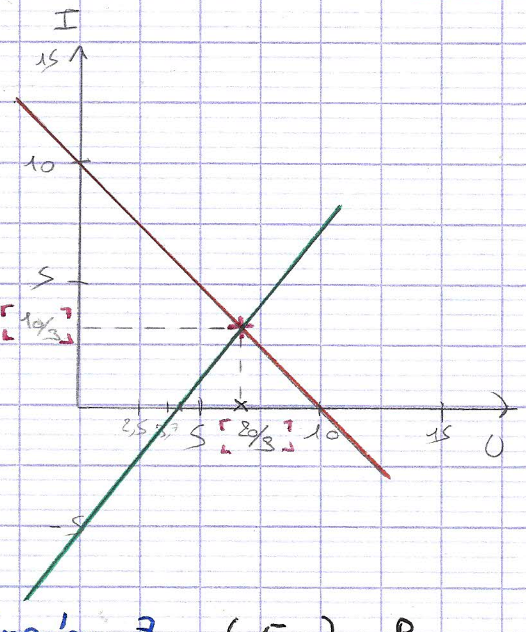
$P = \frac{W}{\Delta t} \Rightarrow W = P.\Delta t$

$= 26\,400\ J = 26,4\ kJ$

$= 2,2\ (3 + 1/3)$

$= 7,3\ Wh$.

b) $U = 4 + 0,8I \Rightarrow I = -5 + 1,25U$.

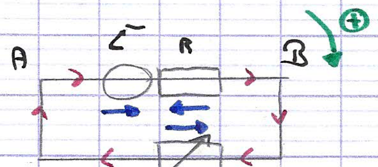


$10 - U = 1,25U - 5$

$U = 20/3$

$I = 10/3$

Exercice 7 (E, R), R



$P = U_R.I_R$ On dit que R est adapté au montage quand P est maximale. On a : $U_R = R.I_R \Rightarrow P_R = R.I_R^2$

$P_R = P(R)$

On pose $R = x \Rightarrow P(R) = f(x)$

$\frac{196}{15}$

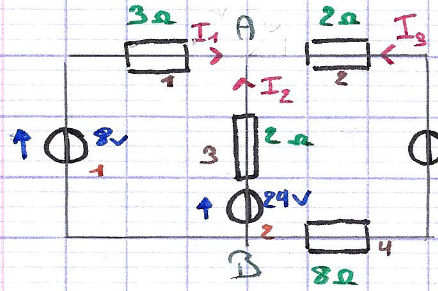
③

Correction ~~Prépa~~ TD électro

Exercice 2 :

Sommation ②+④ $= \frac{1}{R_2+R_4}$

Noeud : $G_1(E_1+U_{BA}) + G_3(E_2+U_{BA}) + (G_4+G_2)(-E_3+U_{BA}) = 0$



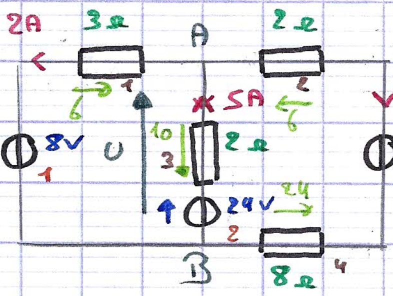
$$\frac{1}{3}(8+U_{BA}) + \frac{1}{2}(24+U_{BA}) + \frac{1}{10}(-16+U_{BA}) = 0$$

$$\frac{8}{3} + \frac{1}{3}U_{BA} + 12 + \frac{1}{2}U_{BA} - \frac{16}{10} + \frac{1}{10}U_{BA} = 0$$

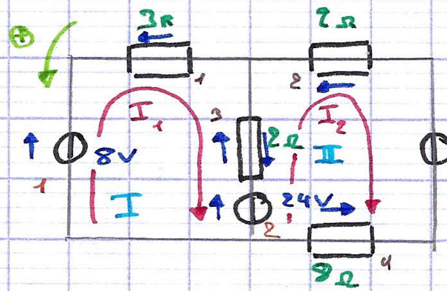
$$\frac{14}{15}U_{BA} = -\frac{196}{15} \Rightarrow U_{BA} = -14\ V$$

30'

$I_1 = -2\ A$; $I_2 = 5A$; $I_3 = -3\ A$



Mailles :



Maille I : $R_1 \cdot I_1 - E_1 + R_3 \cdot I_1 - R_3 \cdot I_2 + E_2 = 0$

$3I_1 - 8 + 2 \cdot I_1 - 2 \cdot I_2 + 24 = 0$

45'

$5I_1 - 2I_2 = -16$

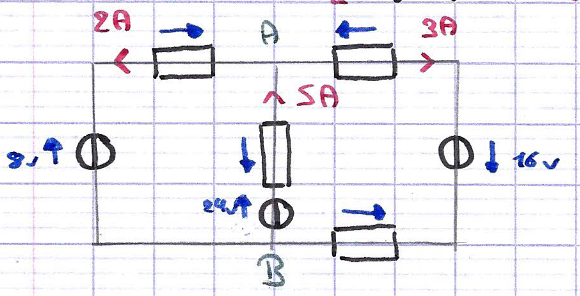
Maille II : $R_3 \cdot I_2 - R_3 \cdot I_1 - E_2 + R_4 \cdot I_2 - E_3 + R_2 \cdot I_2 = 0$

$2 \cdot I_2 - 2 \cdot I_1 - 24 + 8 \cdot I_2 - 16 + 2 \cdot I_2 + \cancel{8 I_2} = 0$

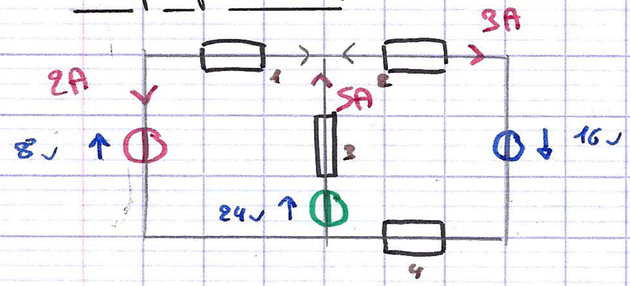
$12 \cdot I_2 - 2 \cdot I_1 = 40$

On résout : $\begin{cases} 5I_1 - 2I_2 = -16 \\ 12 I_2 - 2I_1 = 40 \end{cases} \Rightarrow \begin{cases} 30 I_1 - 12 I_2 = -96 \\ 28 I_1 = -56. \end{cases}$

$\Rightarrow \begin{cases} I_2 = 3A \\ I_1 = -2A \end{cases}$



Superposition :



① : $\frac{1}{3}(8+U_{BA}) + \frac{1}{2} U_{BA} + \frac{1}{10} U_{BA} = 0$

$U_{BA} = -20/7 \text{ V}$

$I_1 = 12/7$, $I_2 = -6/7$, $I_3 = -2/7$

② : $\frac{1}{3} U_{BA} + \frac{1}{2}(24+U_{BA}) + \frac{1}{10} U_{BA} = 0$

$U_{BA} = -90/7$

$I_1 = -30/7$, $I_2 = 39/7$, $I_3 = -9/7$

③ : $\frac{1}{3} U_{BA} + \frac{1}{2} U_{BA} + \frac{1}{10}(-16+U_{BA}) = 0$

$\frac{14}{15} U_{BA} = 16/10$ $\quad 12/7 \text{ V} = U_{BA}$

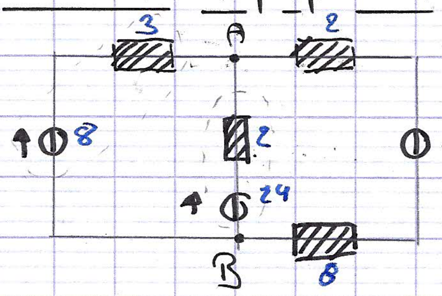
$I_1 = 4/7$, $I_2 = 6/7$, $I_3 = -10/7$

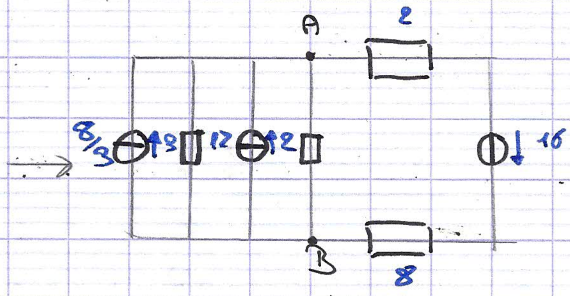
Ainsi : $I_1 = -2A$

$I_2 = 5A$

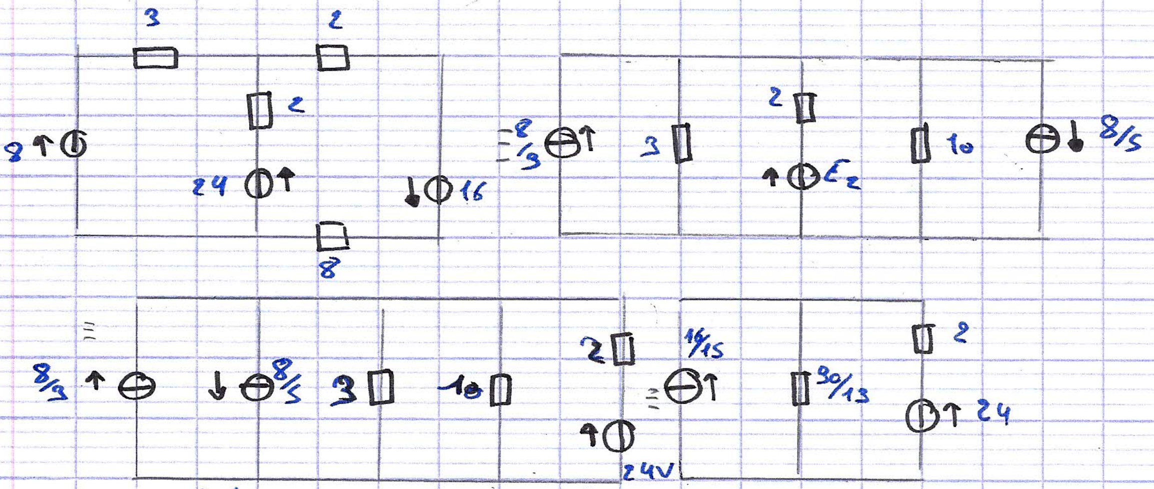
$I_3 = -3A$

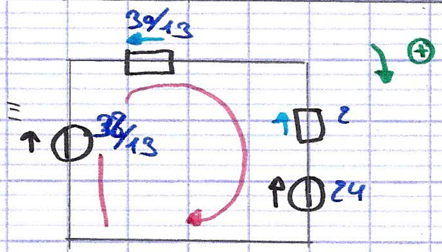
~~Thévenin~~ Superposition





Correction E
TD electro





$$\frac{32}{13} - \frac{30}{13} I - 2I - 24 = 0$$

$I = -5A$

$U_{AB} = U_{BC} + U_{CB} = -10 + 24 = 14V$

Exercice 3 :

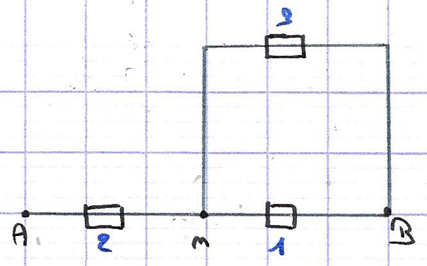
Théorème de thévenin : rendre passif le circuit

gt → f.P

gc → décommecte

- $R_{TH} = R_{AB}$
- $E_{TH} = U_{AB}$ (à vide)

$U = R \cdot I$ $\quad I = \frac{R}{U}$

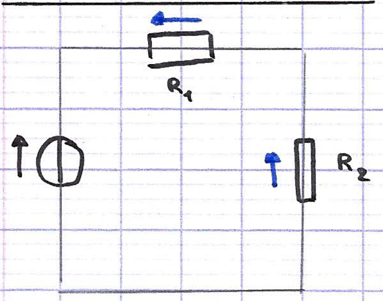


$R_{AB} = 2 + \frac{3}{4} = \frac{11}{4}\ \Omega$

$4 - 3I_1 - I_1 = 0$ $\qquad U_{mB} = 1V$

$I_1 = 1A$

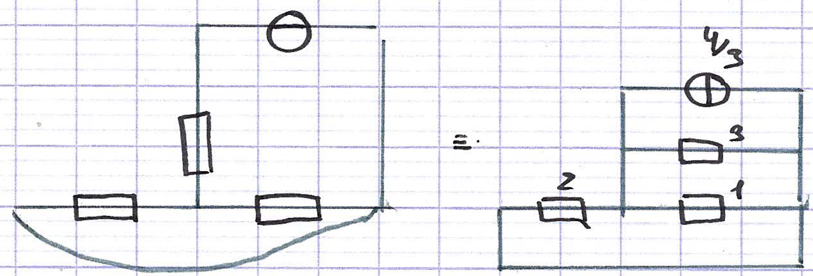
Diviseur de tension : un gt en série avec 2 résistances R_1 ∧ R_2

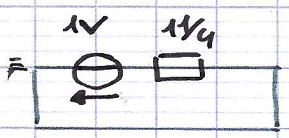


$U_{R_1} = \frac{R_1}{R_1 + R_2} E$ ∨ $U_{R_2} = \frac{R_2}{R_1 + R_2} E$

Théorème de Norton

- $R_N = R_{AB}$ (circuit passif) $= 11/4\ \Omega$
- I_N = Rajouter un fil entre A ∧ B (parcouru par Icc) puis calculer Icc





$= I_{cc}$ (méthode mailles) $= 4/11$ A.

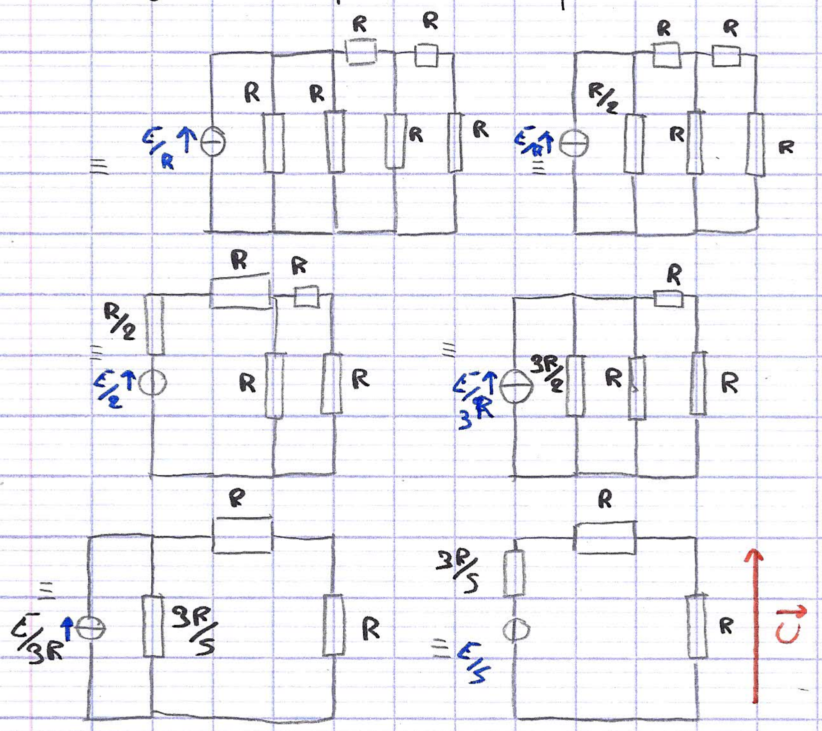
Correction TD électro

Exercice 4 :

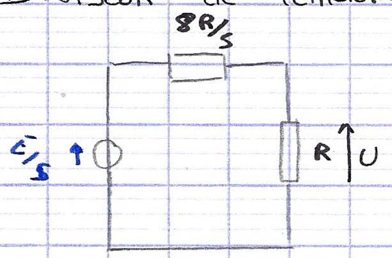
Trouver une relation entre U et E

méthode gt ↔ gc

Transformation possible uniquement avec des générateurs réels



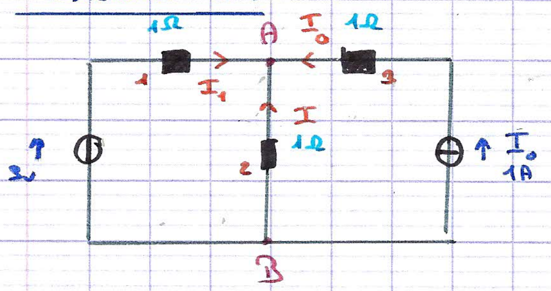
Diviseur de tension :



$$U = \frac{R}{\left(\frac{3R}{5} + R + R\right)} \frac{E}{5}$$

$$U = \frac{E}{13}$$

Exercice 5 :



Au point A : $G_2(E+U_{BA}) + G_3 U_{BA} + I_0 = 0$

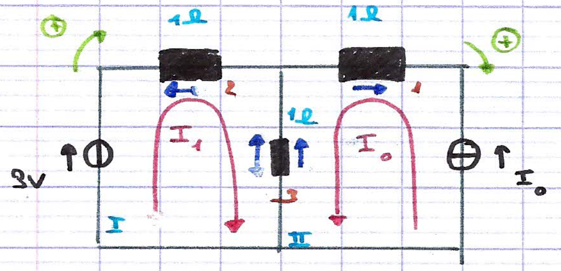
$\Rightarrow 2U_{BA} = -4$

$U_{BA} = -2V$

$I = -2A$

$I_1 = 1A$

$I_0 = 1A$



Maille I : $E - R_2 I_1 - R_3 I_1 - R_3 I_0 = 0$

$3 - 2I_1 - I_0 = 0 \Rightarrow I_1 = 1A$

Maille II : $I_0 = 1A$

$I = I_{AB}^{(1)} + I_{AB}^{(1)}$

$= I_1 + I_0 = 2A$

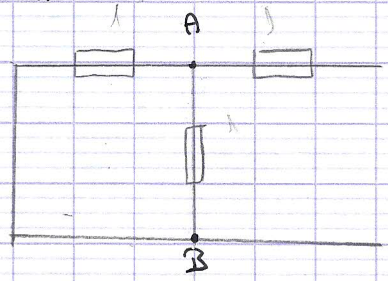
R_1 mul $\Rightarrow I_0 = 0$

R_2 mul $\Rightarrow E - 2I_1 - I_0 = 0$

il faut que $I_1 = 0$

$\Rightarrow I_0 = 3A$

R_m :



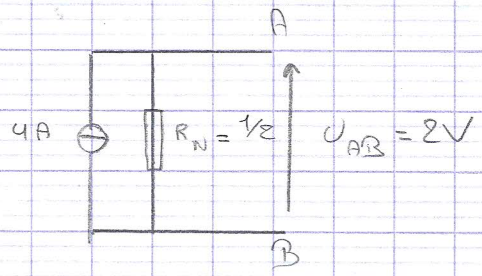
$R_{AB} = 1/2\ \Omega$

Au noeud A :

$\frac{E + U_{BA}}{1\Omega} - I_{cc} + I_0 = 0$

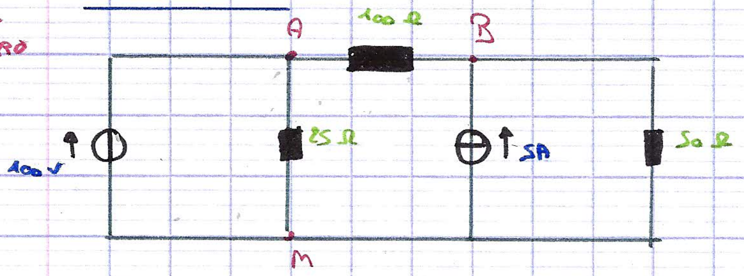
$\Rightarrow I_{cc} = E + I_0$

$= 4$



Correction TD electro

Exercice 6 :



Au noeud B :

$$\frac{1}{10}(U_{AM} + U_{MB}) + 5 + \frac{1}{50} U_{MB} = 0$$

$$\frac{1}{10}(100 + U_{MB}) + 5 + \frac{1}{50} U_{MB} = 0$$

$U_{AM} = 100$ $U_{MB} = -125\ V$

$I_{AM}^{(1)} = 4A$

$U_{AB} = U_{AM} + U_{MB} = -25\ V \Rightarrow I_{AB} = 2,5\ A$

$I_{AM}^{(2)} = 1,5\ A$