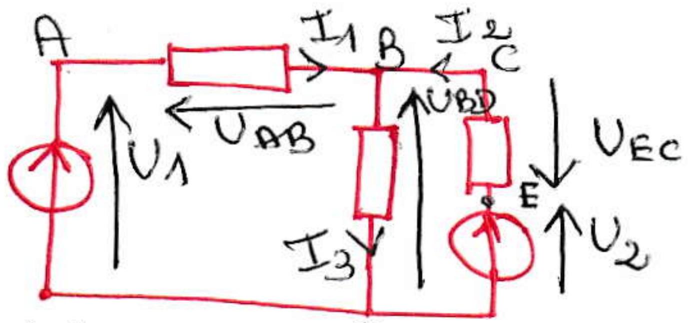
Correction TD : Loi des noeuds et loi des mailles

Exercice 1



1°) I_2 ? Loi des noeuds au point B :

$$I_1 + I_2 = I_3 \Longrightarrow I_2 = I_3 - I_1$$

$$I_2 = 5 - 8 = -3A \qquad \boxed{I_2 = -3A}$$

$I_2 < 0 \Longrightarrow$ le vrai sens du courant est le contraire par rapport à celui indiqué.

2°) U_{AB} ?

Loi des mailles ABDA : $-U_{AB} - U_{BD} + U_1 = 0$

$$\Longrightarrow U_{AB} = U_1 - U_{BD} = 120 - 80 = 40V$$

$$\boxed{U_{AB} = 40V}$$

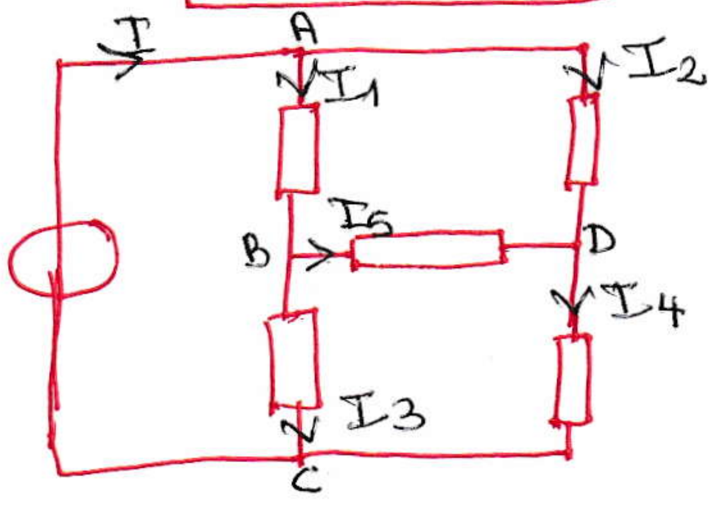
U_{EC} ?

on applique la loi des mailles le long des branches : BCDB : $+U_{EC} - U_2 + U_{BD} = 0$

$$\Longrightarrow U_{EC} = U_2 - U_{BD} = 50 - 80 = -30V$$

$$\boxed{U_{EC} = -30V}$$

Exercice 2



1°) I, I_3 et I_4 ?

Loi des noeuds au point A :

$I = I_1 + I_2 = 6 + 4 = 10A$ $\boxed{I = 10A}$

Loi des noeuds au point B :

$I_1 = I_3 + I_5 \Rightarrow I_3 = I_1 - I_5$

$I_3 = 6 - 2 = 4A$ $\boxed{I_3 = 4A}$

Loi des noeuds au point C :

$I_3 + I_4 = I \Rightarrow I_4 = I - I_3$

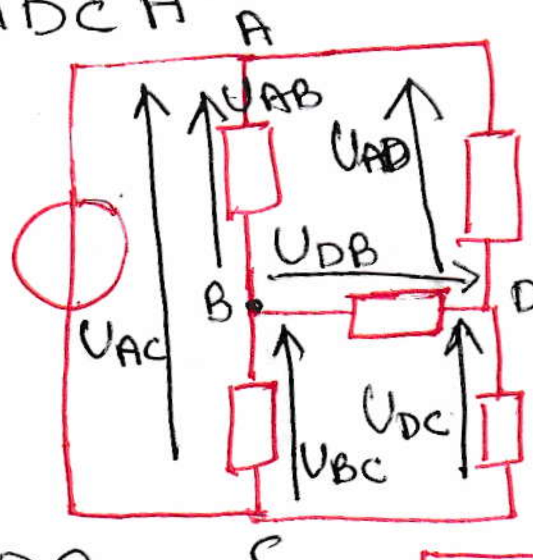
$I_4 = 10 - 4 = 6A$ $\boxed{I_4 = 6A}$

autre méthode : Loi des noeuds au point D :

$I_2 + I_5 = I_4 \Rightarrow I_4 = 4 + 2 = \underline{\underline{6A}}$

2°) U_{AD}, U_{AB}, U_{DB} ?

Loi des mailles : ADCA



$U_{AC} - U_{AD} - U_{DC} = 0$

$U_{AD} = U_{AC} - U_{DC}$

$U_{AD} = 150 - 30$

$\boxed{U_{AD} = 120V}$

$U_{AC} - U_{AB} - U_{BC} = 0$

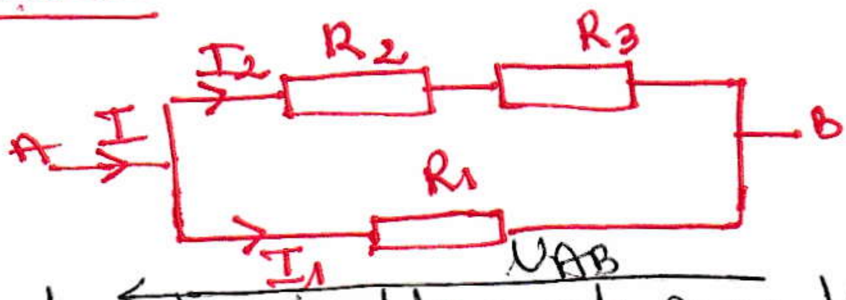
$U_{AB} = U_{AC} - U_{BC} = 150 - 50$ $\boxed{U_{AB} = 100V}$

mailles : ADBA : $-U_{AD} - U_{DB} + U_{AB} = 0$

$U_{DB} = U_{AB} - U_{AD} = 100 - 120 = -20V$

$\boxed{U_{DB} = -20V}$

Exercice 3



1°/ La tension U_{AB} est aux bornes de la résistance R_1 $\Longrightarrow$ $U_{AB} = R_1 \times I_1$

$$\Longrightarrow \quad I_1 = \frac{U_{AB}}{R_1} = \frac{96}{20} = 4{,}8\,A$$

$$\boxed{I_1 = 4{,}8\,A}$$

2°/ $$I_2 = \frac{U_{AB}}{R_2 + R_3} = \frac{96}{8+12} = 4{,}8\,A$$

$$\boxed{I_2 = 4{,}8\,A}$$

(tension U_{AB} est aux bornes de R_2 et R_3)

3°/ $$I = I_1 + I_2 = 4{,}8 + 4{,}8 = 9{,}6\,A$$

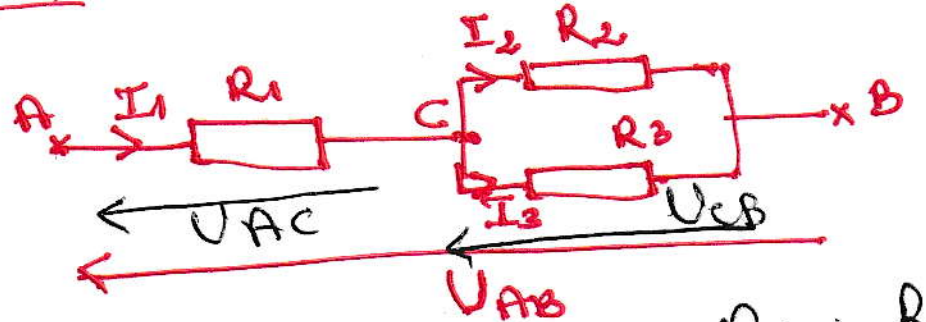
$$\boxed{I = 9{,}6\,A}$$

$$Req = \frac{U_{AB}}{I} = \frac{96}{9{,}6} = 10\,\Omega \qquad \boxed{R = 10\,\Omega}$$

4°/ $$Req = \underbrace{R_1}_{20} \parallel \underbrace{(R_2 + R_3)}_{20} = \frac{20 \times 20}{20 + 20} = 1$$

$$\boxed{Req = 10\,\Omega}$$

Exercice 4



1°/ $R = R_1 + (R_2 // R_3) = R_1 + \frac{R_2 \times R_3}{R_2 + R_3}$

$R = 76 + \frac{40 \times 60}{40+60} = 76 + 24 = 100\,\Omega$

$\boxed{R = 100\,\Omega}$

2°/ $I_1 = \frac{U_{AB}}{R} = \frac{120}{100} = 1{,}2\,A$

3°/ $U_{AC} = R_1 \times I_1 = 76 \times 1{,}2 = \underline{91{,}2\,V}$

4°/ $U_{CB} = R_{23} \times I_1 \qquad R_{23} = \frac{R_2 \times R_3}{R_2 + R_3}$

$R_{23} = \frac{40 \times 60}{40+60} = 24\,\Omega$

$U_{CB} = 24 \times 1{,}2 = \underline{28{,}8\,V}$

ou bien $U_{CB} = U_{AB} - U_{AC} = 120 - 91{,}2$

$\boxed{U_{CB} = 28{,}8\,V}$

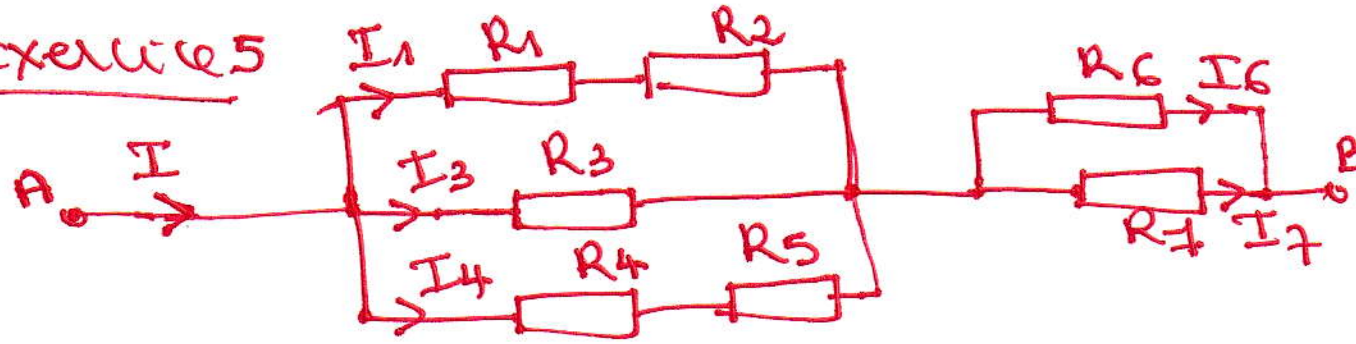
5°/ $I_2 = \frac{U_{CB}}{R_2} = \frac{28{,}8}{40} = 0{,}72\,A$

$I_3 = \frac{U_{CB}}{R_3} = \frac{28{,}8}{60} = 0{,}48\,A$

6°/ $I_1 = I_2 + I_3 = 0{,}72 + 0{,}48$

$\boxed{I_1 = 1{,}2\,A}$

Exercice 5

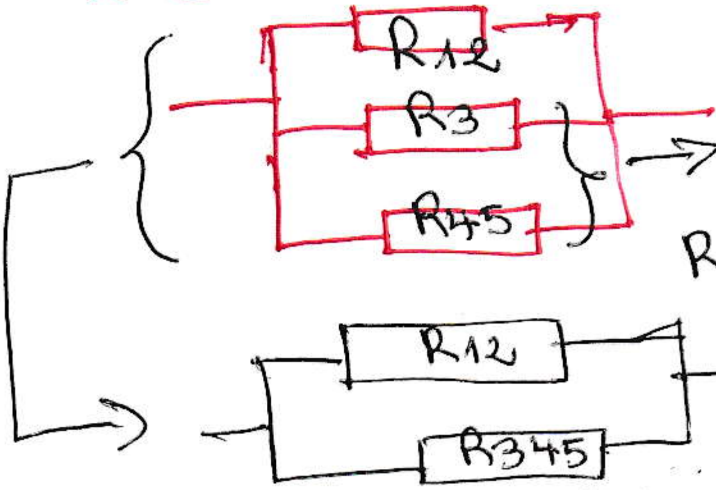


1°) R entre A et B ?

$$R_{AB} = (R_{12} \parallel R_3 \parallel R_{45}) + (R_6 \parallel R_7)$$

$$R_{12} = R_1 + R_2 = 60 + 40 = 100\,\Omega$$

$$R_{45} = R_4 + R_5 = 120 + 80 = 200\,\Omega$$



$$R_{345} = \frac{R_3 \times R_{45}}{R_3 + R_{45}}$$

$$R_{345} = \frac{80 \times 200}{80 + 200} = 57{,}14\,\Omega$$

$$R_{12345} = \frac{R_{12} \times R_{345}}{R_{12} + R_{345}}$$

$$R_{12345} = \frac{100 \times 57{,}14}{100 + 57{,}14} = 36{,}4\,\Omega$$

$$R_{67} = R_6 \parallel R_7 = \frac{R_6 \times R_7}{R_6 + R_7} = \frac{40 \times 60}{40 + 60} = 24\,\Omega$$

finalement : $R_{AB} = 36{,}4 + 24 = 60{,}4\,\Omega$

$$\boxed{R_{AB} = 60{,}4\,\Omega}$$

2°) $U_{AB} = R_{AB} \times I = 60{,}4 \times 10 = 604\,V$

$U_{R67} = R_{67} \times I = 24 \times 10 = 240\,V$

$U_{12345} = R_{12345} \times I = 36{,}4 \times 10 = 364\,V$

3°) $I_1 = \frac{U_{R12345}}{R_1 + R_2} = \frac{364}{100} = 3{,}64\,A$; $I_3 = \frac{U_{R12345}}{R_3} = \frac{364}{80} =$

$I_3 = 4{,}55\,A$; $I_4 = \frac{U_{R12345}}{R_{45}} = \frac{364}{200} = 1{,}82\,A$

$$I_6 = \frac{U_{R67}}{R_6} = \frac{240}{40} = 6A$$

$$I_7 = \frac{U_{R67}}{R_7} = \frac{240}{60} = 4A$$

On vérifie que $I_1 + I_3 + I_4 = I_6 + I_7$

$$\underbrace{3{,}64 + 4{,}55 + 1{,}82}_{10{,}01A} = \underbrace{6 + 4}_{10A}$$