SOLUTION SET I

EXERCISE I.1 : KIRCHHOFF'S LAW (1)

By applying Kirchhoff's law for voltages, we obtain :

$$-12+4\,I+2\,U_0-4+6\,I=0 \qquad (1)$$

Ohm's law applied to the resistance of 6 Ω gives :

$$U_0=-6\,I \qquad (2)$$

Substituting in (1) :

$$-16+10\,I-12\,I=0 \quad \Rightarrow \quad \boxed{I=-8\ \text{A}} \quad \Rightarrow \quad \boxed{U_0=48\ \text{V}}$$

EXERCISE I.2 : EQUIVALENT RESISTANCE

The two resistors of 3 Ω and 6 Ω are in parallel because they are both connected between the points 2 and 3. Their equivalent resistance is therefore :

$$3\,\Omega \parallel 6\,\Omega=\frac{3\times 6}{3+6}=2\,\Omega \qquad (1)$$

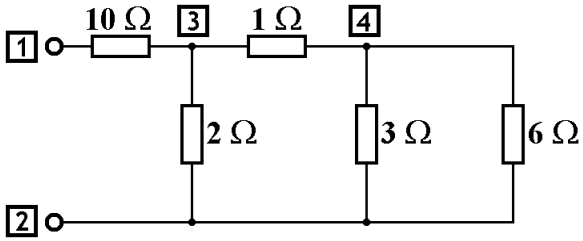
Similarly for the resistors of 12 Ω and 4 Ω which are both connected between the points 2 and 4. Their equivalent resistance is :

$$12\,\Omega \parallel 4\,\Omega=\frac{12\times 4}{12+4}=3\,\Omega \qquad (2)$$

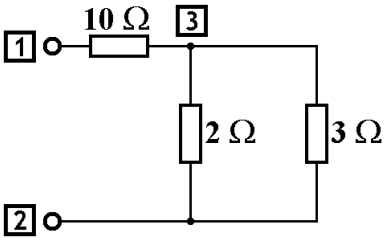
The resistor of 5 Ω is in series with a resistor of 1 Ω, between points 2 and 4, which gives an equivalent resistance of :

$$1\Omega+5\,\Omega=6\,\Omega \qquad (3)$$

We can redraw the initial diagram by means of these three partial equivalent resistances, which gives the simplified diagram opposite.



In this simplified diagram, the resistors of 3 Ω and 6 Ω are in parallel between the points 2 and 4. Their equivalent resistance is therefore 2 Ω [as equation (1)]. The latter is in series with the resistor of 1 Ω, which gives 3 Ω in total and makes it possible to further simplify the diagram as opposite.

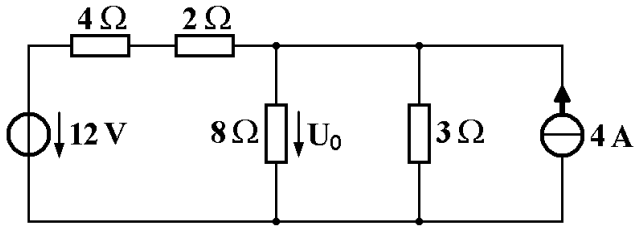


We have only two resistors in parallel of 2 Ω and 3 Ω, in series with 10 Ω, which finally gives :

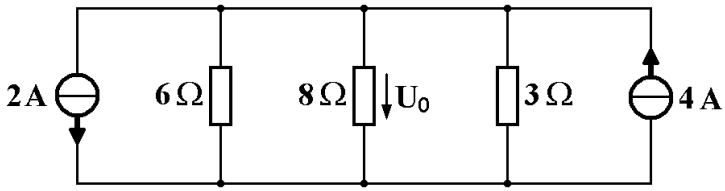
$$\boxed{R_{1-2}=11{,}2\,\Omega}$$

EXERCISE I.3 : SOURCE TRANSFORMATION

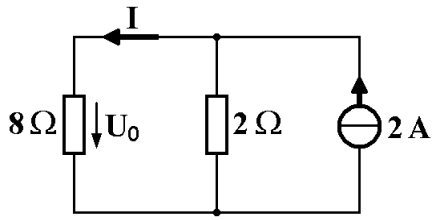
A. Transform the current and voltage sources, so as to obtain the diagram of the figure opposite.



B. Group the resistors in series of 4 Ω and 2 Ω, and transform the source of 12 V, to obtain the diagram of the figure below.



C. Group the resistors in parallel of 3 Ω and 6 Ω, as well as the two sources of current also in parallel, which gives the diagram of the figure opposite.



D. The current I is calculated by the relation of the current divider :

$$I = \frac{2}{2+8} \cdot 2\,A = 0{,}4\,A$$

By Ohm's law : $\boxed{U_0 = 8\,\Omega \cdot 0{,}4\,A = 3{,}2\,V}$