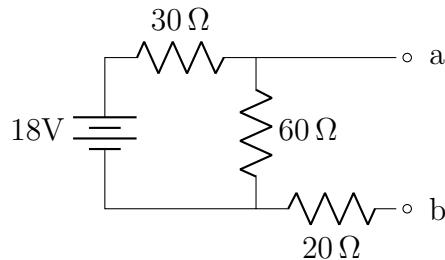


PHY 240: Basic Electronics

Homework Problem H7

October 7, 2024
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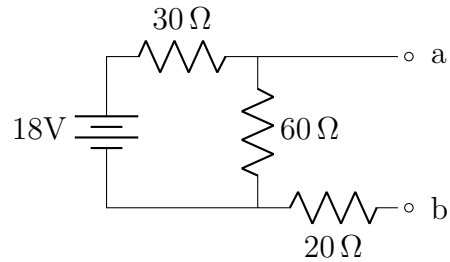
1. Monsieur Thévenin

Consider the circuit above, in which an unknown load may eventually be placed between the a and b terminals. We know that this circuit may be replaced by a Norton Equivalent Circuit consisting of a single current source in series with a single resistance.

- (a) Determine the Norton Equivalent Circuit for this circuit and draw it in the space below. Be sure to label the current source and resistance in your drawing, and include and indicate the terminals a and b.
- (b) Demonstrate that your equivalent circuit is correct by doing the following:
 - Attach a $20\ \Omega$ load between terminals a and b of the original circuit, and determine the current flowing through the load and the voltage.
 - Attach a $20\ \Omega$ load between terminals a and b of your equivalent circuit, and determine the current flowing through the load and the voltage.
 - Show that your results for the load current and voltage are the same for these two circuits across the load.

Solution:

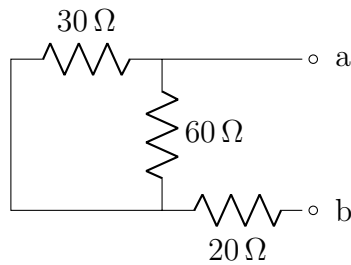
(a) Check the open circuit current.



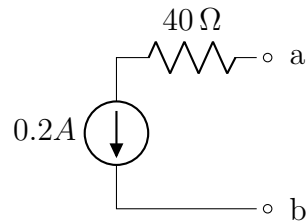
$$18V = I(90\Omega) = 0.2A$$

So the current is 0.2A from terminal a to b.

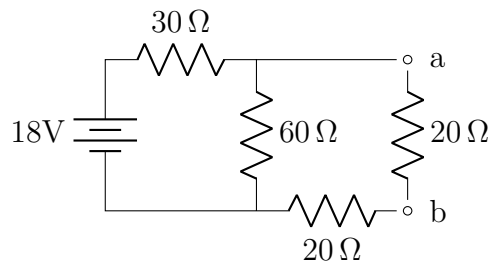
Now, we find the resistance...



$$R_{th} = \frac{1800\Omega}{90\Omega} + 20\Omega = 40\Omega$$



(b) • **Original Circuit**



$$18V = I(30 + \frac{2400 \Omega}{100 \Omega}) \approx 0.333A$$

$$V_1 = (0.333A)(30 \Omega) = 10V$$

$$V_2 = V_{load} + V_3$$

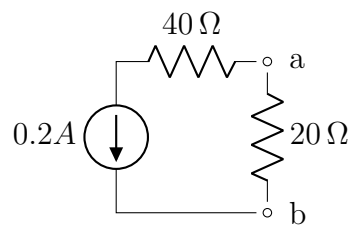
$$I_{load} = I_3$$

$$I_2 = \frac{8V}{60 \Omega} \approx 0.133A$$

So $I_{load} = 0.2A$

$$V_{load} = (0.2A)(20 \Omega) = 4V$$

• **Equivalent Circuit**



$$I_{load} = 0.2A$$

$$V = (0.2A)(20 \Omega) = 4V$$

They're both the same! woo!!!!