PHY 240: Basic Electronics
Homework Problem H6

September 23, 2024

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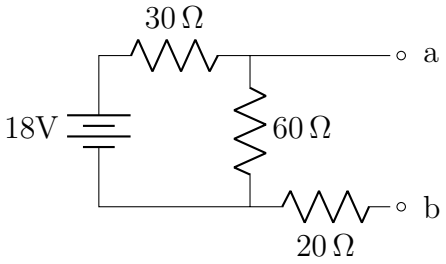


1. **Monsieur Thévenin**
   Consider the circuit above, in which an unkown load may eventually be placed between the a and b terminals. We know that this circuit may be replaced by a Thévenin Equivalent Circuit consisting of a single voltage source in series with a single resistance.

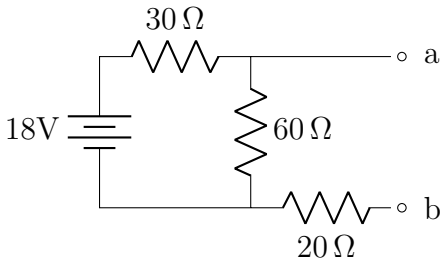
   (a) Determine the Thévenin Equivalent Circuit for this circuit and draw it in the space below. Be sure to label the voltage source and resistance in your drawing, and include and indicate the terminals a and b.

   (b) Demonstrate that your equivalent circuit is correct by doing the following:

   - Attach a 20 Ω load between terminals a and b of the original circuit, and determine the current flowing through the load and the voltage.
   - Attach a 20 Ω 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 voltage.

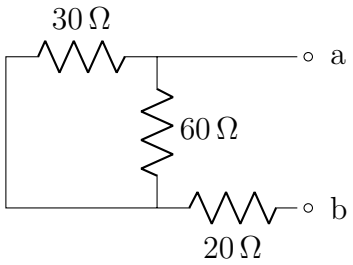


$$18V = I(90\,\Omega) = 0.2A$$

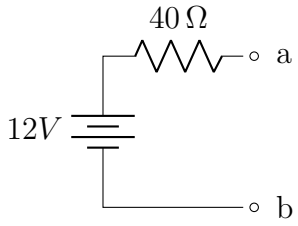
$$V_a = (0.2A)(30\,\Omega) = 6V$$

$$V_b = (0.2A)(60\,\Omega) = 12V$$

So the Voltage drop is 12V from terminal a to b.
Now, we check the short circuit current...

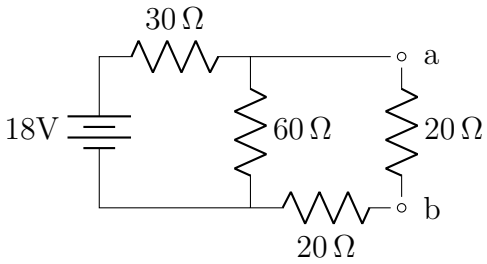


$$R_{th} = \frac{1800\,\Omega}{90\,\Omega} + 20\,\Omega = 40\,\Omega$$



(b)

- **Original Circuit**



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

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

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

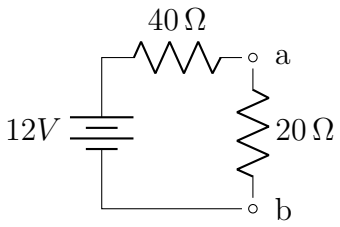
$$I_{load} = I_3$$

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

So $I_{load} = 0.2A$

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

- **Equivalent Circuit**



$$12V = I(60\,\Omega) = 0.2A$$

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

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