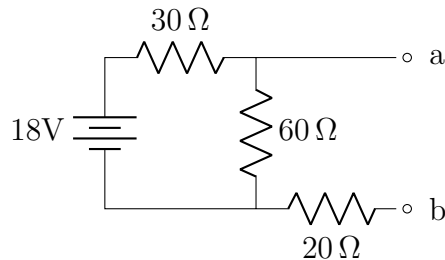


PHY 240: Basic Electronics

Homework Problem H6

September 23, 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 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 $20\ \Omega$ 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 voltage.

Let: $R_1 = 30\ \Omega$, $R_2 = 60\ \Omega$, $R_3 = 20\ \Omega$

$$R_{total} = R_1 + R_2 + R_3 = 110\ \Omega$$

$$V_{oc} = V_{source} \times \frac{R_1 + R_2}{R_{total}}$$

$$V_{oc} = 18V \times \frac{90\ \Omega}{110\ \Omega} \approx 14.727V$$

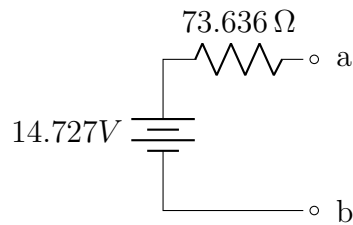
Now, we check the short circuit current...

$$I_{short} = \frac{18V}{90\ \Omega} = 0.2A$$

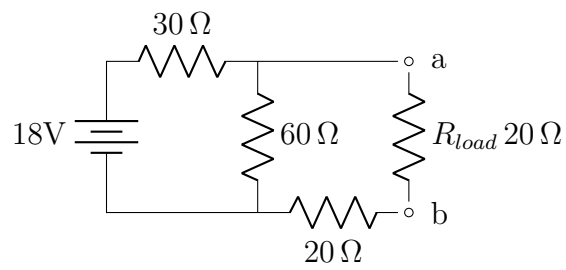
With $V_{open} = 14.727V$ and $I_{short} = 0.2A$

$$R_{th} = \frac{V_{open}}{I_{short}}$$

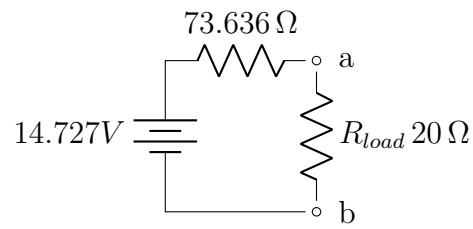
$$R_{th} = \frac{14.727V}{0.2A} \approx 73.636\ \Omega$$



(b) • **Original Circuit**



• **Equivalent Circuit**



Meowmeowmeow.