

task_erlctd760zmvox0t_with_calculation

Student Group

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network simplification, exam ee1 SS2023

Exercise E1 Pure Resistor Network Simplification I
(written test, approx. 14 % of a 60-minute written test, SS2023)

The circuit below should be given as $U_{\text{AB}} = 60 \text{ V}$. What is the value for R_{eq} the circuit?

Solution

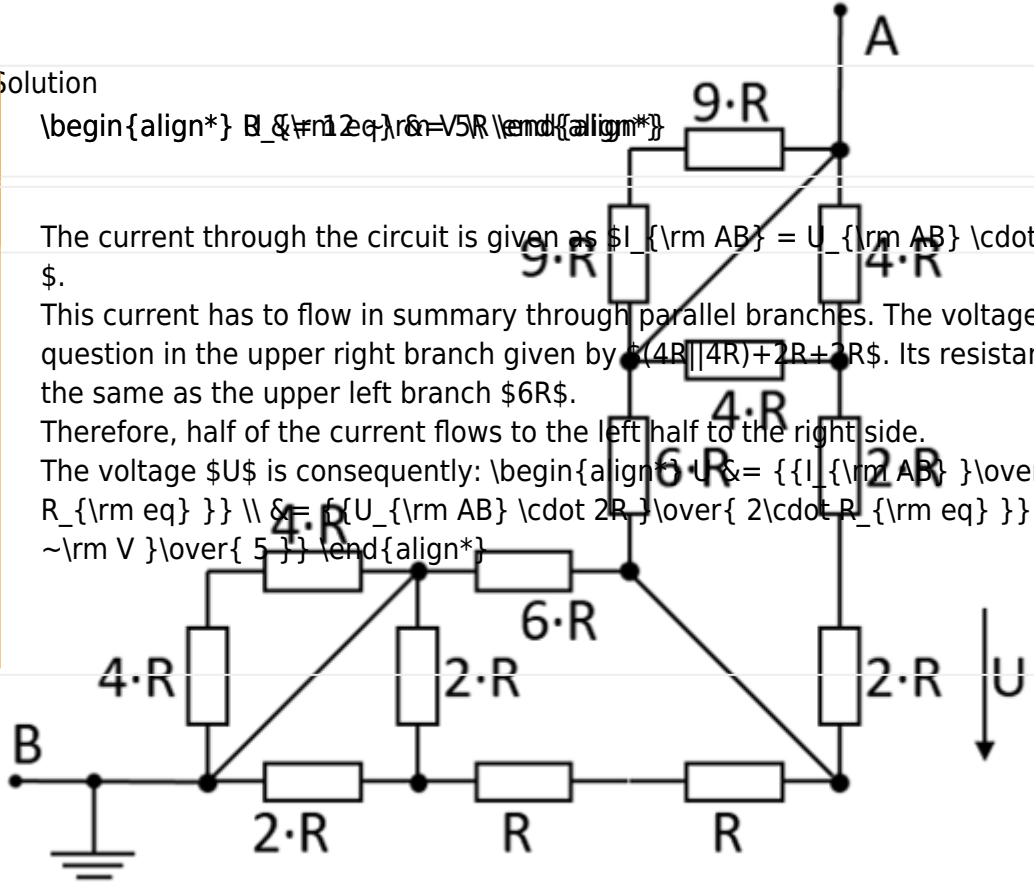
$$I_{\text{AB}} = \frac{U_{\text{AB}}}{R_{\text{eq}}} = 6 \text{ A}$$

The current through the circuit is given as $I_{\text{AB}} = U_{\text{AB}} \cdot R_{\text{eq}}$.

This current has to flow in summary through parallel branches. The voltage U in question in the upper right branch given by $(4R \parallel 4R) + 2R + 2R$. Its resistance is just the same as the upper left branch $6R$.

Therefore, half of the current flows to the left half to the right side.

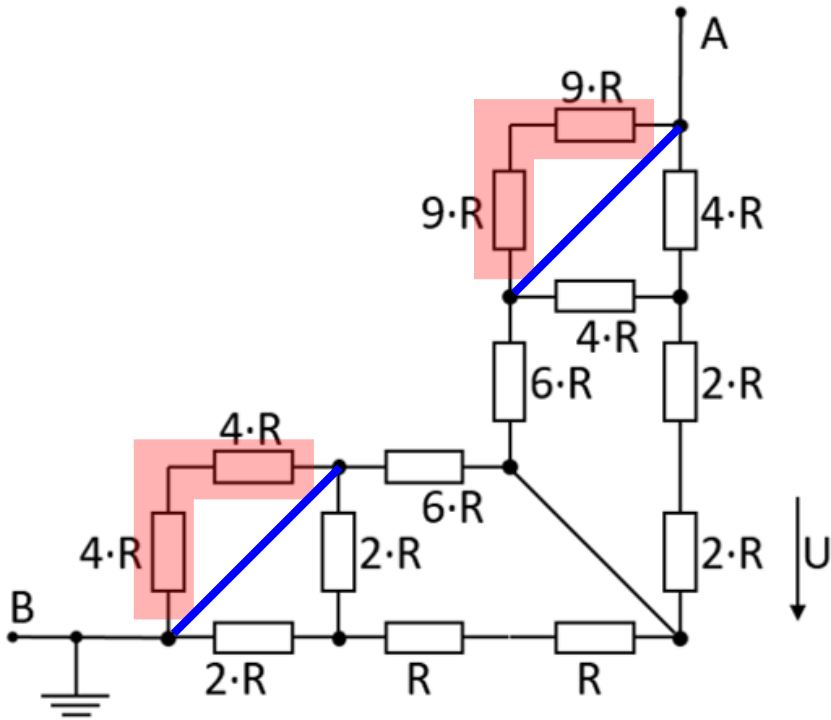
The voltage U is consequently:
$$U = \frac{I_{\text{AB}} \cdot 2R}{2 \cdot R_{\text{eq}}} = \frac{60 \text{ V}}{5}$$



1. What is the equivalent resistance R_{eq} ?

Solution

Part of the circuit is shorted. Here the resistors (marked in red) are shorted by the connections marked in blue:



The circuit can then be rearranged for better interpretation:

Therefore, R_{eq} is given as:
$$R_{\text{eq}} = (2R || 2R + R +$$

$$R \parallel 6R \ \&\&+ \ 6R \ \parallel (2R + 2R + 4R \parallel 4R) \ \parallel \ \&= \ (R + R + R) \parallel 6R \ \&\&+ \ 6R \ \parallel (2R + 2R + 2R) \ \parallel \ \&= \ 3R \parallel 6R \ \&\&+ \ 6R \ \parallel 6R \ \parallel \ \&= \ \left\{ \frac{3R \cdot 6R}{3R+6R} \right\} \ \&\&+ \ 3R \ \parallel \ \end{align*}$$

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Last update: **2023/07/24 19:33**

