

aufgabe_4.5.3

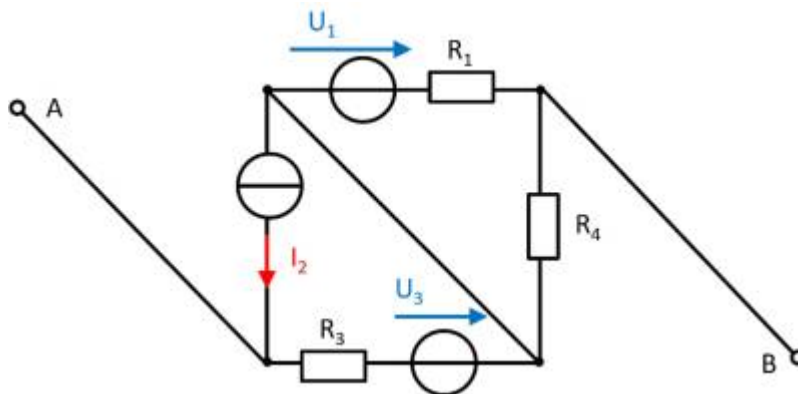
Student Group

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Exercise 4.5.3 -Variation: open circuit voltage via superposition (exam task, approx. 12 % of a 60-minute exam, WS2020)



A circuit is given with the following parameters

$$R_1 = 5 \, \Omega$$

$$U_1 = 2 \, \text{V}$$

$$I_2 = 1 \, \text{A}$$

$$R_3 = 20 \, \Omega$$

$$U_3 = 8 \, \text{V}$$

$$R_4 = 10 \, \Omega$$

Determine the open circuit voltage between A and B using the principle of superposition.

Solution

Case 1: For this case is $I_2 = 0 \, \text{A}$ and $U_3 = 0 \, \text{V}$. The voltage is at R_4 .



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$$\begin{aligned} U_{\text{AB},1} &= \frac{R_4}{R_1 + R_4} U_1 = \\ & \frac{10 \, \Omega}{5 \, \Omega + 10 \, \Omega} \cdot 2 \, \text{V} = 1.33 \, \text{V} \end{aligned}$$

Case 2: For this case is $U_1 = 0 \, \text{V}$ and $U_3 = 0 \, \text{V}$. The voltage is at R_3 .



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$$\begin{aligned} U_{\text{AB},2} &= R_3 I_2 = 20 \, \Omega \cdot 1 \, \text{A} = 20 \, \text{V} \end{aligned}$$

Case 3: For this case is $U_1 = 0 \, \text{V}$ and $I_2 = 0 \, \text{A}$. The voltage

comes from the source U_3 .



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$$U_{\text{AB},3} = 8 \text{ V}$$
 Superposition means adding the voltages of all three cases.
$$U_{\text{AB}} = U_{\text{AB},1} + U_{\text{AB},2} + U_{\text{AB},3} = 1.33 \text{ V} + 20 \text{ V} + 8 \text{ V}$$

Final value

$$U_{\text{AB}} = 29.333... \text{ V} \rightarrow 29.3 \text{ V}$$

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