

task_cgeyprm6oboukcci_with_calculation

Student Group

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Table of Contents

Exercise E1 Pure Resistor Network Simplification (written test, approx. 12 % of a 60-minute written test, SS2023) 2

network simplification, exam ee1 SS2023

Exercise E1 Pure Resistor Network Simplification (written test, approx. 12 % of a 60-minute written test, SS2023)

The circuit below has a voltage source \mathcal{E} and a resistor R_1 . Calculate the voltage at node K , when switch S is closed.

Result

The values in the circuit are

Solution

- $R_1 = 60 \text{ } \Omega$

The circuit is a simple series circuit with a voltage source \mathcal{E} and a resistor R_1 . The voltage at node K is the same as the voltage across R_1 .

$$R_1 = 60 \text{ } \Omega$$

$$R_2 = 40 \text{ } \Omega$$

$$R_3 = 10 \text{ } \Omega$$

The voltage divider formula states that the voltage across a resistor in a series circuit is proportional to its resistance. Therefore, the potential of node K is the same as for node K' . There will be no current flow through R_3 . The resistance does not create a voltage drop and therefore does not interfere with the circuit.

1. Calculate the voltage at node K , when switch S is open. It might be beneficial to redraw the circuit first.

Solution

Rearranging the circuit one can get:

Once the switch S is opened, the upper part is a parallel circuit. Therefore, R_{eq} is given as:

$$R_{\text{eq}} = (R_1 + R_2) \parallel (R_1 + R_2) + R_4 = \frac{1}{2} \cdot (R_1 + R_2) + R_4 = \frac{1}{2} \cdot (60 \Omega + 40 \Omega) + 100 \Omega$$

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