VINNITSA NATIONAL AGRARIAN UNIVERSITY

Department of Electric Power Engineering, Electrical Engineering and Electromechanics

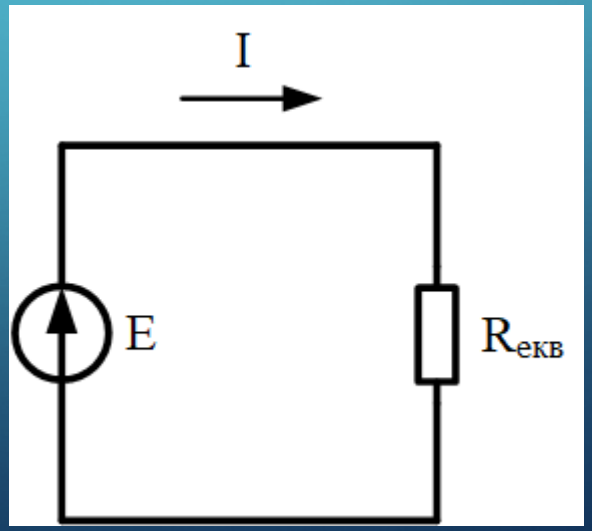
EQUIVALENT TRANSFORMATION OF AN ELECTRIC CIRCUIT

by Associate Professor V. Hraniak

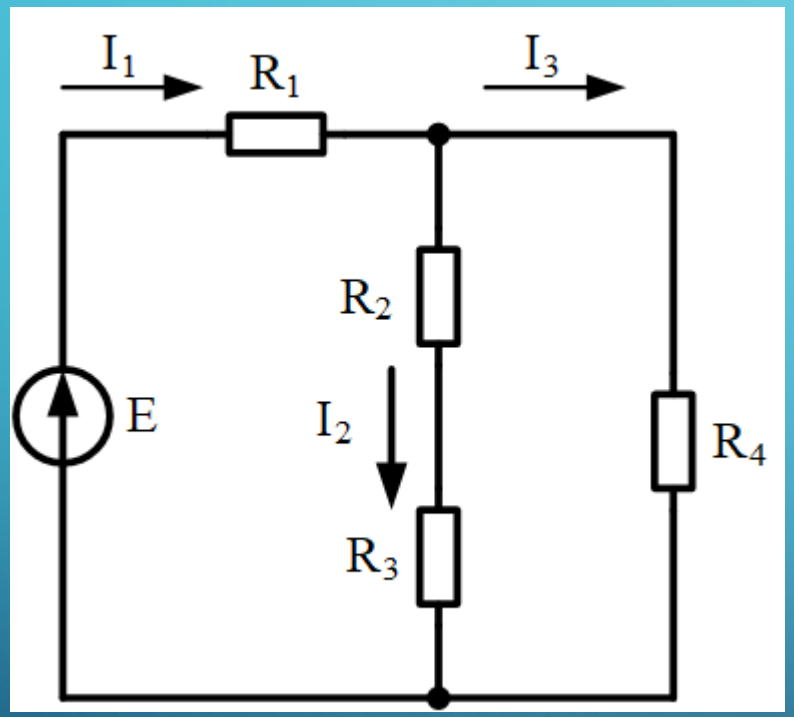
STAGE 1

We simplify the electric circuit to the simplest

The simplest is an electric circuit consisting of a power source with one equivalent resistance connected to its terminals

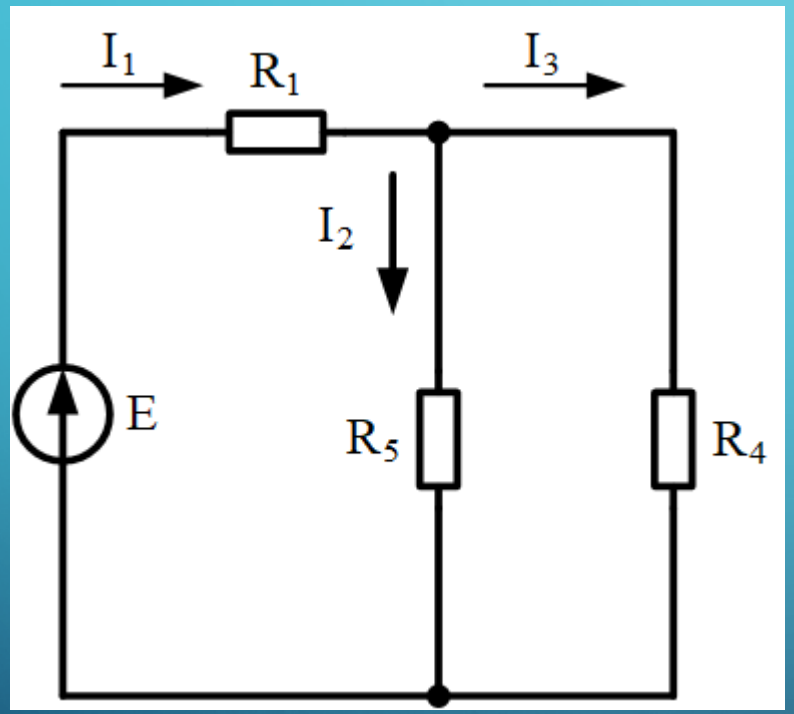


AN EXAMPLE OF SIMPLIFYING AN ELECTRIC CIRCUIT



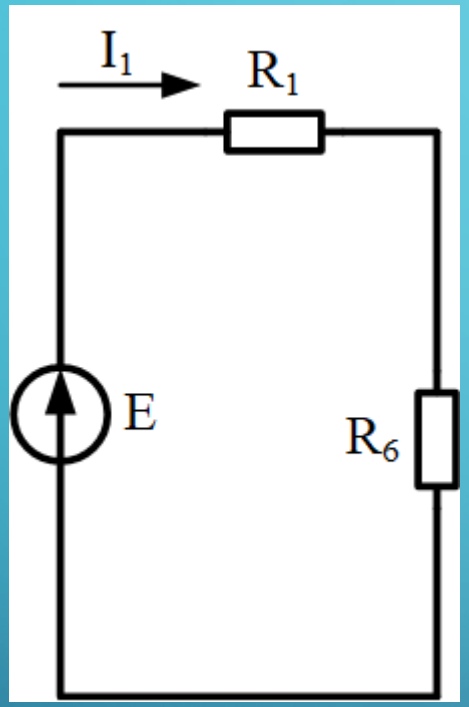
$$R_5 = R_2 + R_3$$

AN EXAMPLE OF SIMPLIFYING AN ELECTRIC CIRCUIT

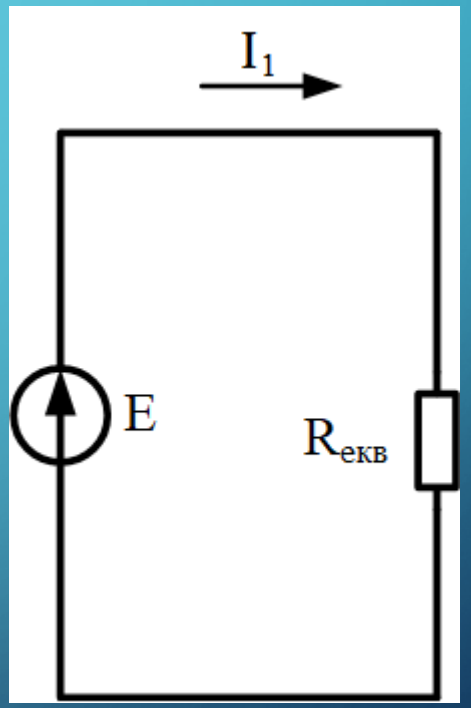


$$R_6 = \frac{R_5 \cdot R_4}{R_5 + R_4}$$

AN EXAMPLE OF SIMPLIFYING AN ELECTRIC CIRCUIT



$$R_{екв} = R_1 + R_6$$



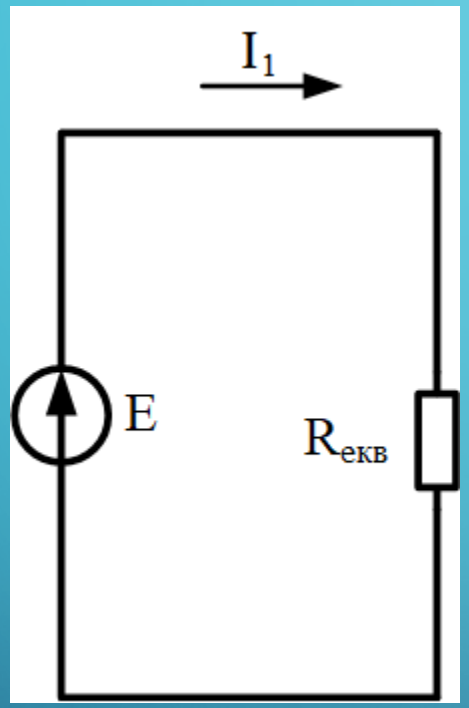
STAGE 2

Step by step we return to circles with an intermediate simplification

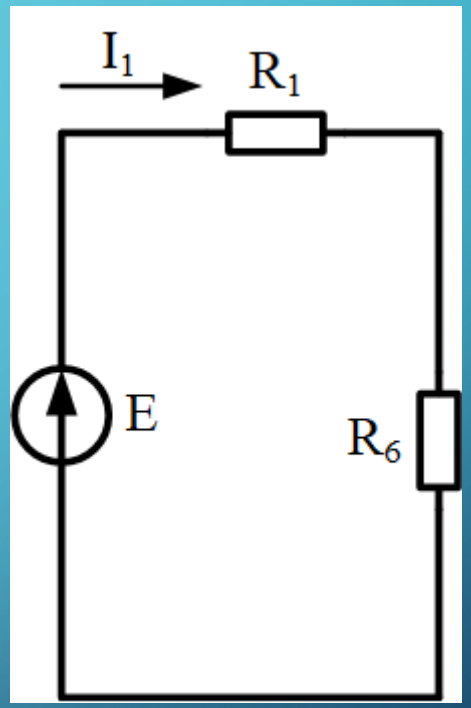
Importantly!!!

In each intermediate circuit, for all elements of the circuit in which the part of the circuit with unknown currents (voltages) is "hidden", it is necessary to have a known pair: the current through them and the voltage at their terminals.

AN EXAMPLE OF A STEP RETURN

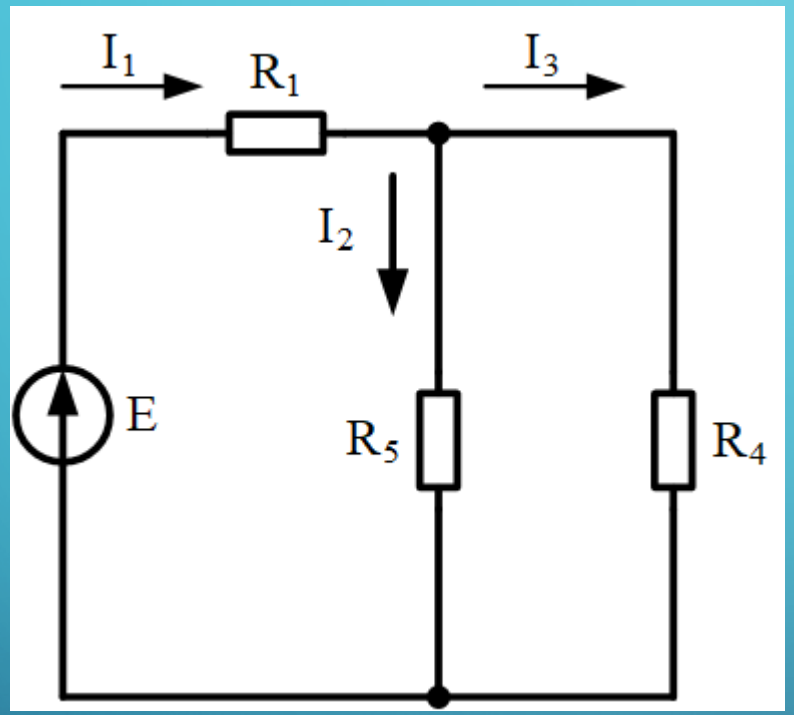


$$I_1 = \frac{E}{R_{екв}} \qquad U_{екв} = E$$



$$I_1 \qquad U_6 = I_1 R_6$$

AN EXAMPLE OF A STEP RETURN

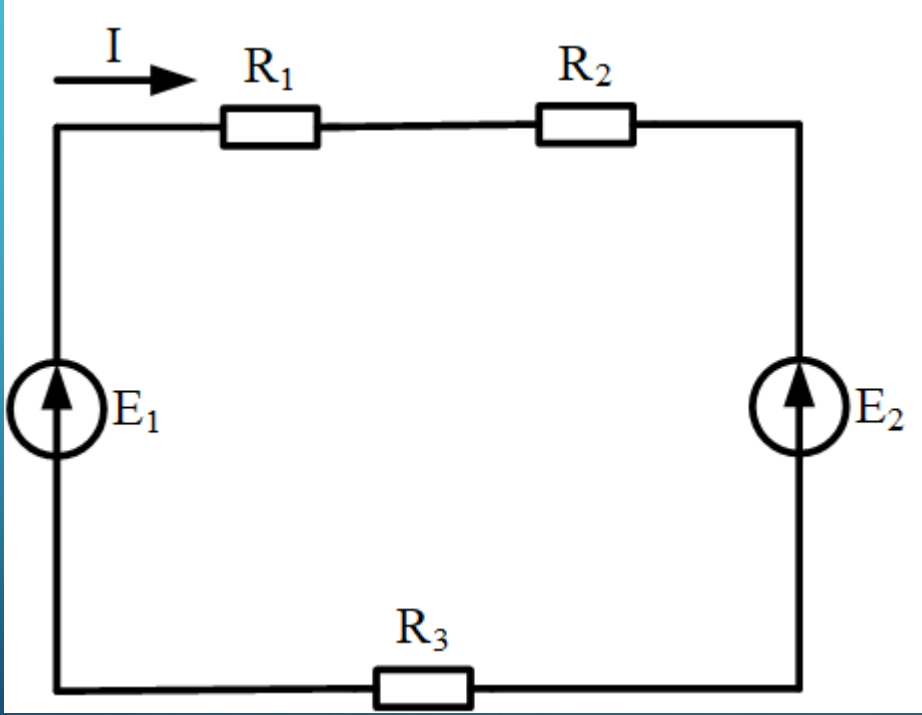


$$I_2 = \frac{U_6}{R_5}$$

$$I_3 = \frac{U_6}{R_4}$$

In some cases, if the condition of the task does not provide for it, the return can not be performed to the end!

AN EXAMPLE OF CALCULATING A CIRCUIT WITH TWO POWER SOURCES



Example

Calculate currents into circuit, if:

$R_1 = 5$ Om

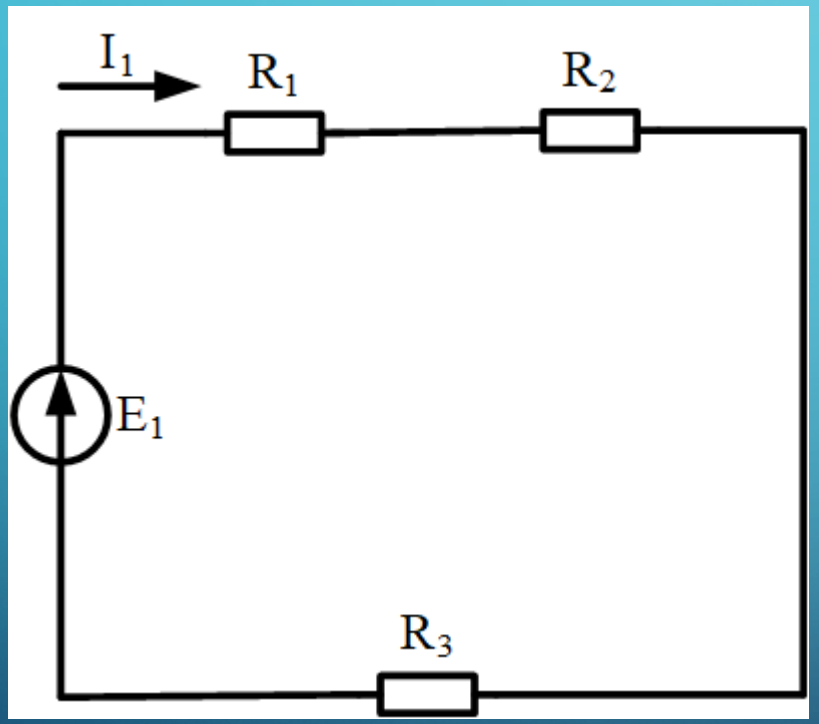
$R_2 = 10$ Om

$R_3 = 15$ Om

$E_1 = 60$ V

$E_2 = 30$ V

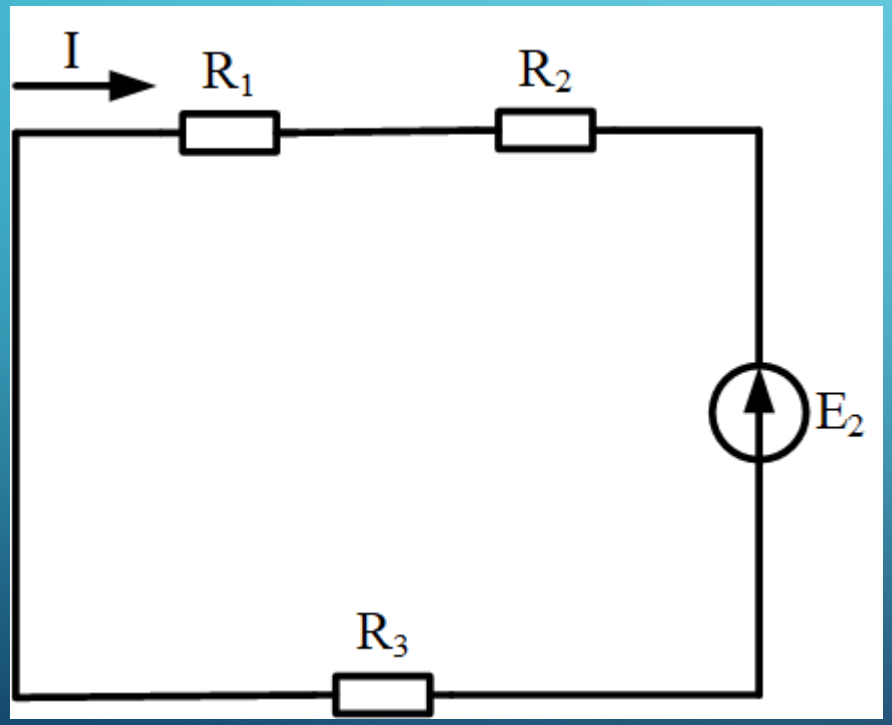
CALCULATION OF THE CURRENT GIVEN BY THE FIRST POWER SOURCE



$$I_1 = \frac{E_1}{R_1 + R_2 + R_3} =$$

$$= \frac{60}{5 + 10 + 15} = 2(A)$$

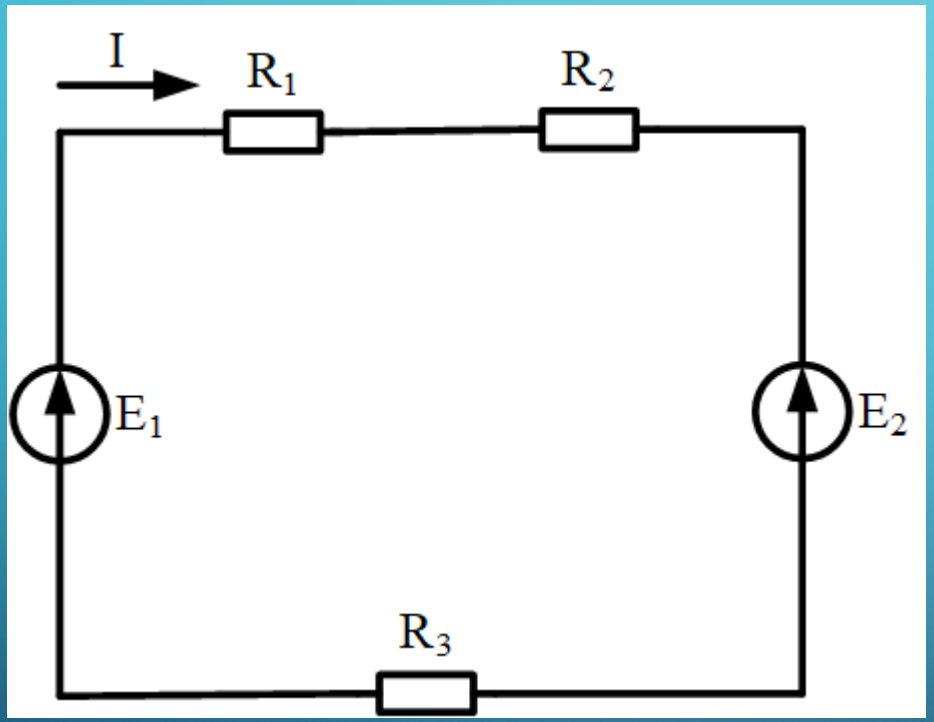
CALCULATION OF THE CURRENT PROVIDED BY THE SECOND POWER SOURCE



$$I_2 = \frac{-E_2}{R_1 + R_2 + R_3} =$$

$$= \frac{-30}{5 + 10 + 15} = -1\,(A)$$

CALCULATION OF THE TOTAL CURRENT

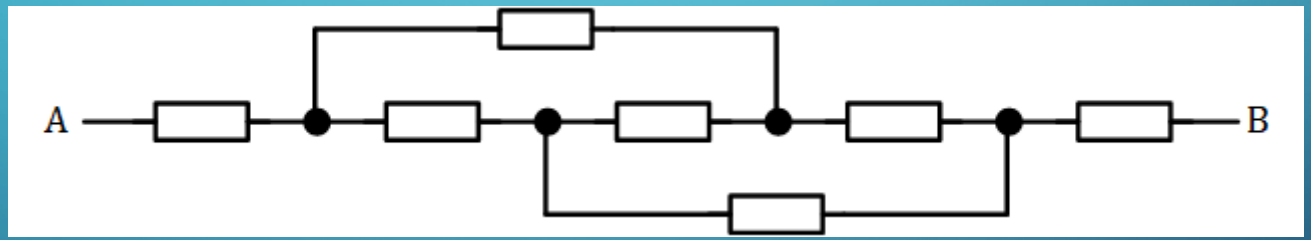


$$I = I_1 + I_2 =$$

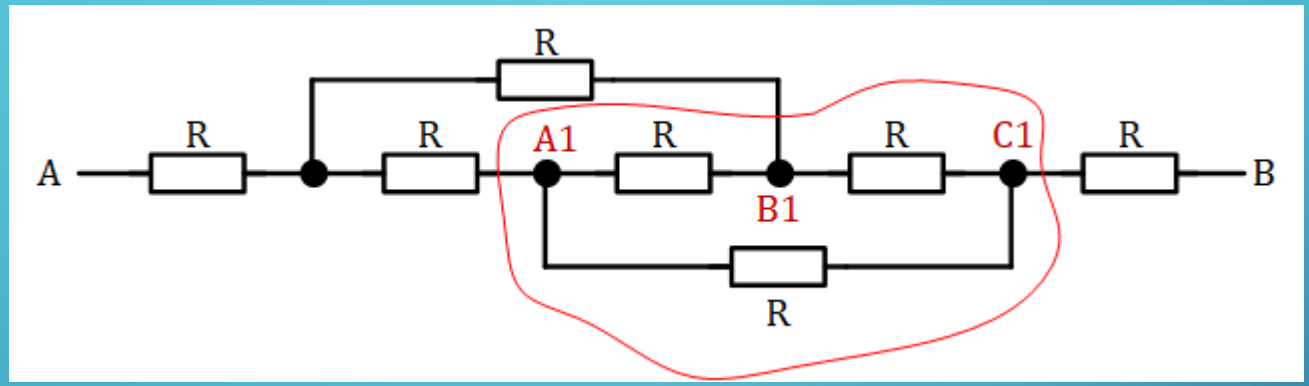
$$= 2 - 1 = 1\,(A)$$

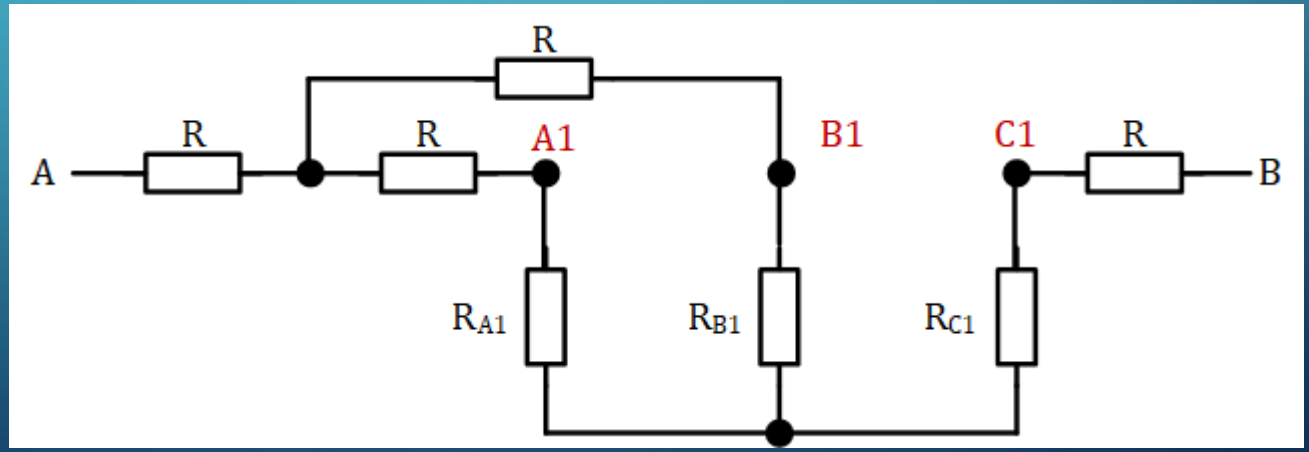
TASK

The circuit section AB consists of identical conductors with a resistance of 5 Ohms. Calculate the resistance of section AB accordance with the given electric circuit.

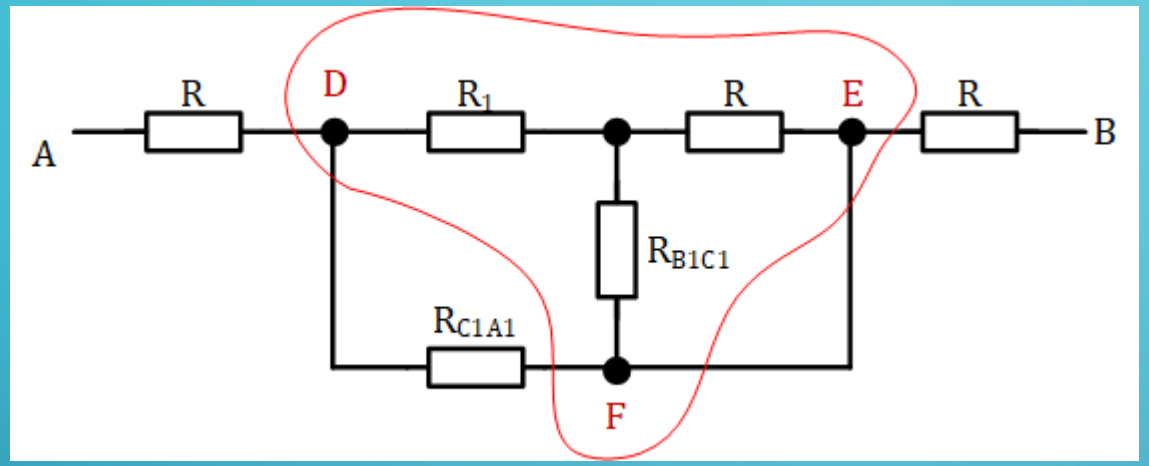


CONVERTING A "TRIANGLE" TO A "STAR"





CONVERTING A “STAR” TO A “TRIANGLE”



$$R_1 = \frac{R \cdot R_{A1B1}}{R + R_{A1B1}}$$