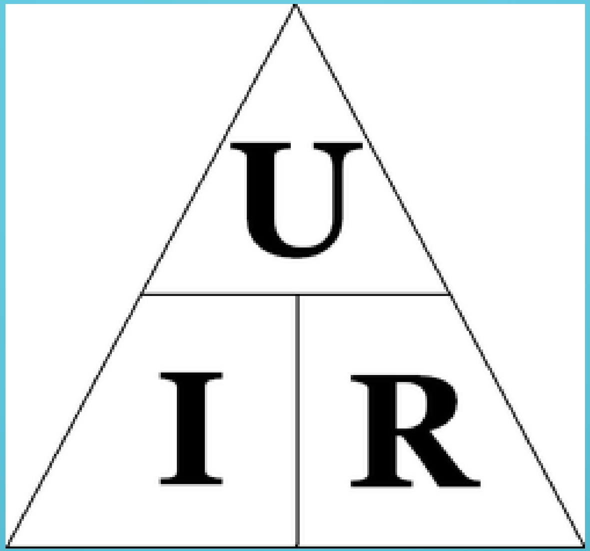
VINNITSA NATIONAL AGRARIAN UNIVERSITY

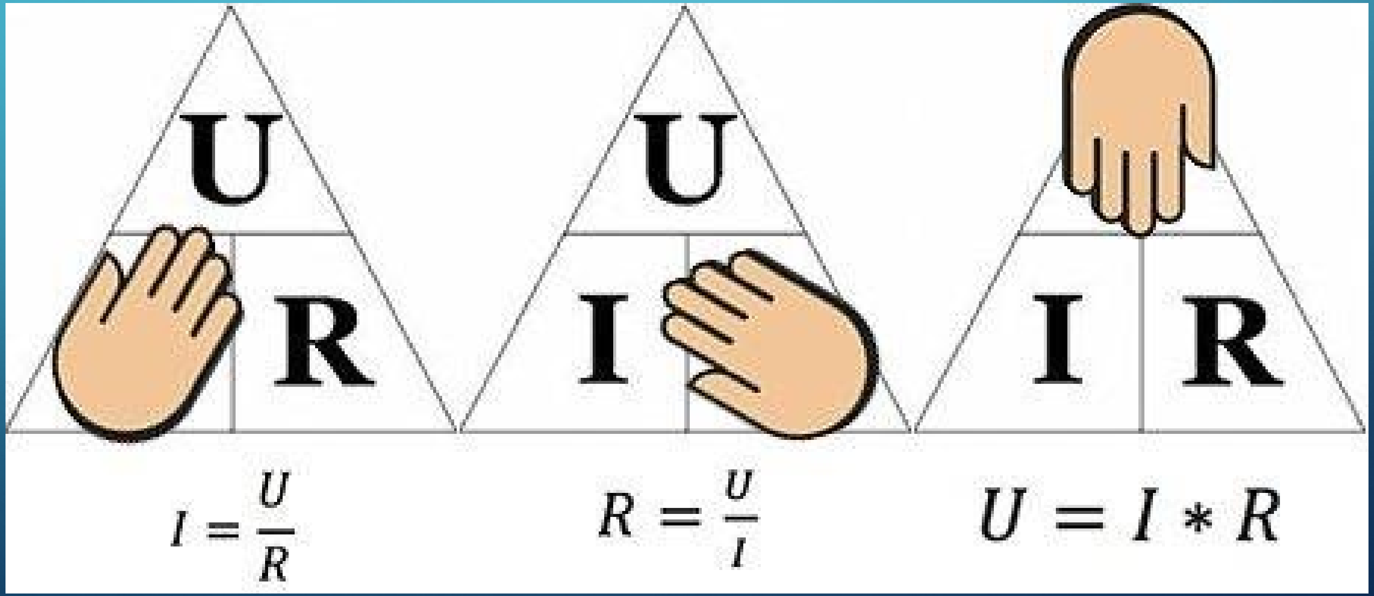
Department of Electric Power Engineering, Electrical Engineering and Electromechanics

EQUIVALENT TRANSFORMATION OF AN ELECTRIC CIRCUIT

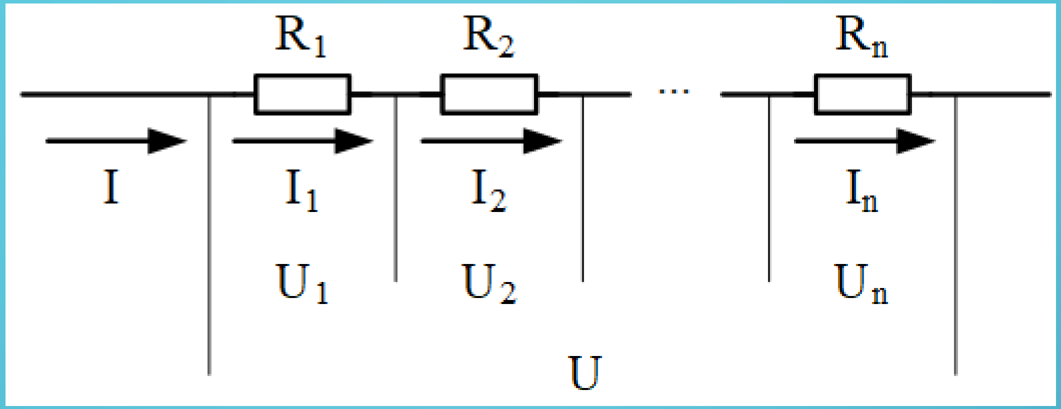
by Associate Professor V. Hraniak

OHM'S RULE





RULES OF SERIAL CONNECTION



- The voltage at the ends of this section of the circle consists of the voltages on each conductor:

$$U = U_1 + U_2 + \ldots + U_n$$

- The current in all conductors is the same, since the electric charge does not accumulate in them and the same charge passes through any cross-section of the conductor in a certain time

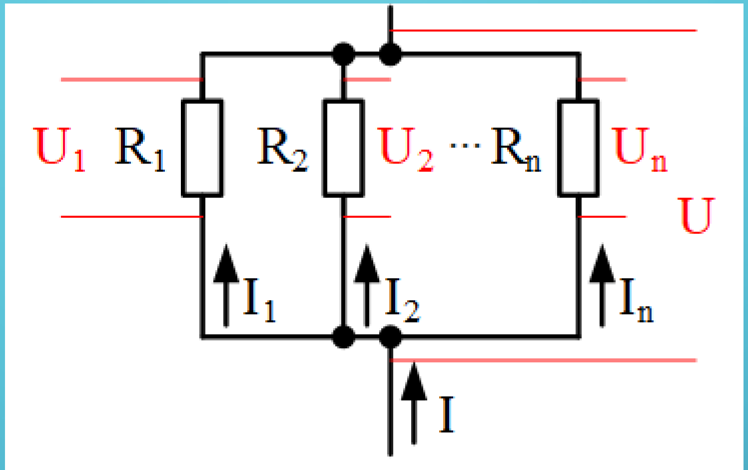
$$I_1 = I_2 = I_3 = \ldots = I$$

- Applying Ohm's rule for a section of a circle, you can prove that the total resistance of the circle is equal to the sum of the resistances of the elements

$$R = R_1 + R_2 + \ldots + R_n$$

RULES OF PARALLEL CONNECTION

$$\frac{I_1}{I_2} = \frac{R_2}{R_1}$$



For two resistors

$$R = \frac{R_1 \cdot R_2}{R_1 + R_2}$$

- The current in the unbranched part of the circuit is equal to the sum of the currents in the branches.

$$I = I_1 + I_2 + \ldots + I_n \quad (\text{if } R_1 < R_2, \text{ than } I_1 > I_2)$$

- Voltages on elements connected in parallel are the same

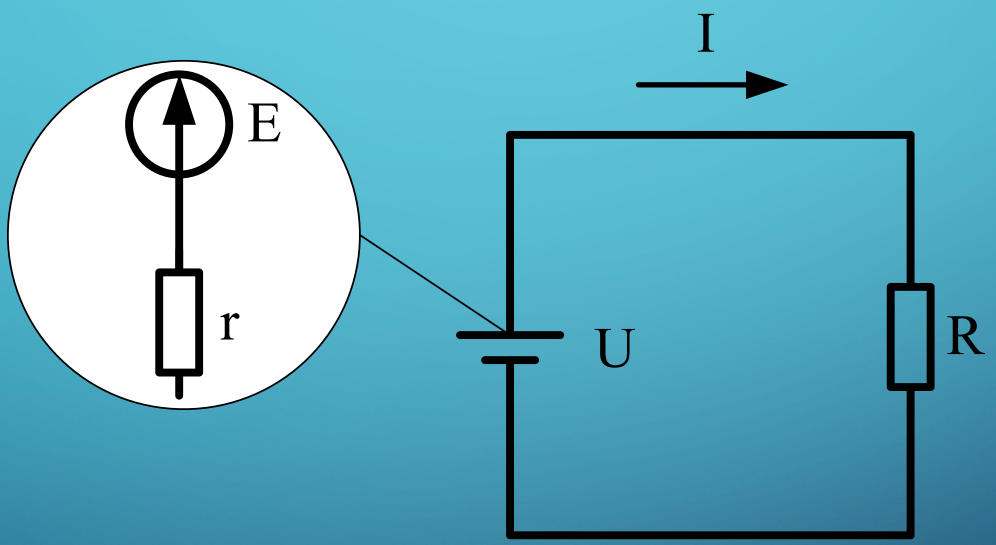
$$U = U_1 = U_2 = \ldots = U_n$$

- When connected in parallel, the conductances are added

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots + \frac{1}{R_n}$$

OHM'S RULE FOR A COMPLETE CIRCUIT

In a complete circle, there is a load in addition to the resistance another power source that has own internal resistance!!!



$$I = \frac{E}{r + R}$$

CALCULATION OF AN ELECTRIC CIRCUIT BY THE METHOD OF EQUIVALENT TRANSFORMATION

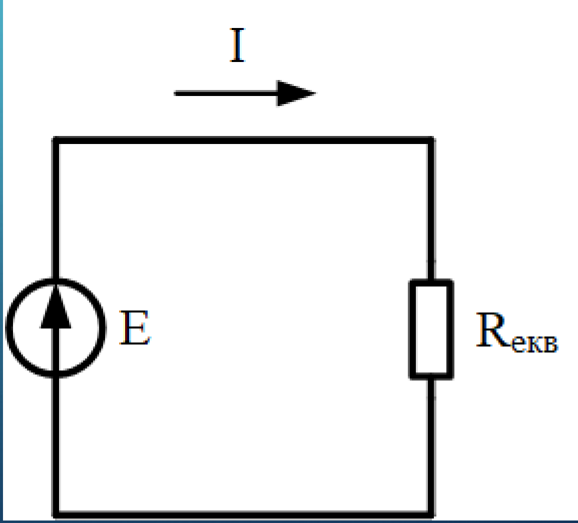
The transformation is called equivalent if the mode (current and voltage) in the part of the circuit in which the transformation is not carried out does not change.

The equivalent transformation method consists of two parts (stages)!!!

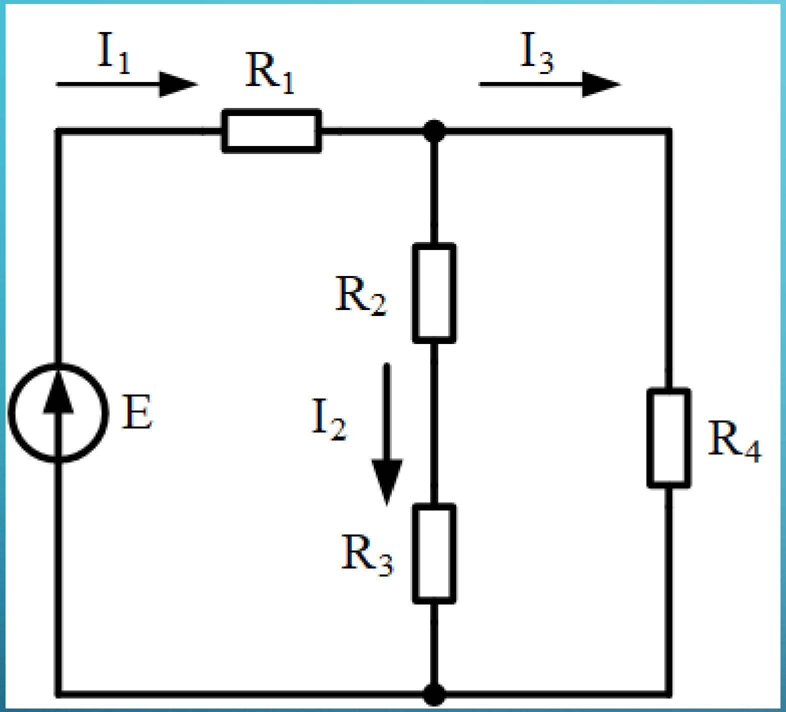
STAGE 1

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

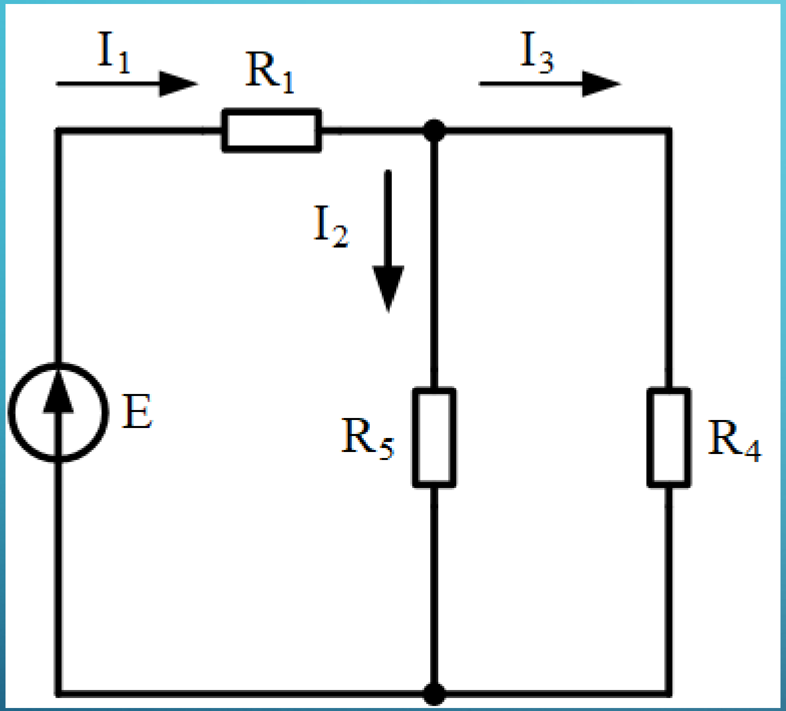


AN EXAMPLE OF SIMPLIFYING AN ELECTRIC CIRCUIT



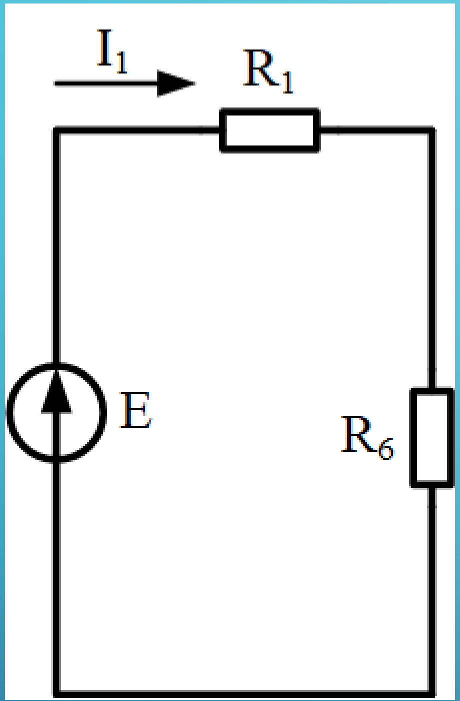
$$R_5 = R_2 + R_3$$

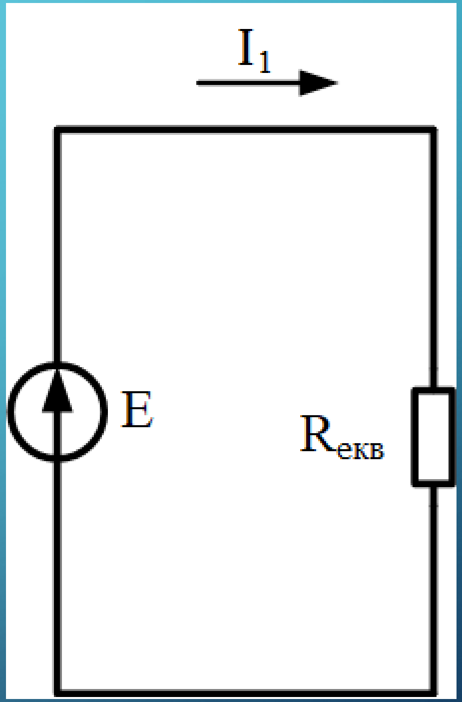
AN EXAMPLE OF SIMPLIFYING AN ELECTRIC CIRCUIT



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

AN EXAMPLE OF SIMPLIFYING AN ELECTRIC CIRCUIT





$$R_{екв} = R_1 + R_6$$

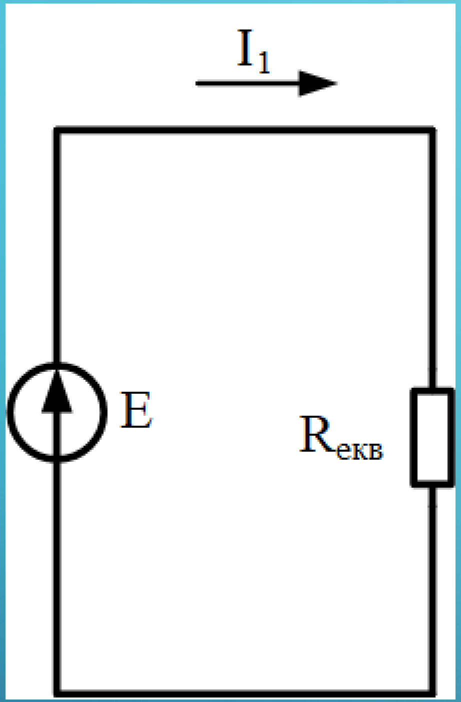
STAGE 2

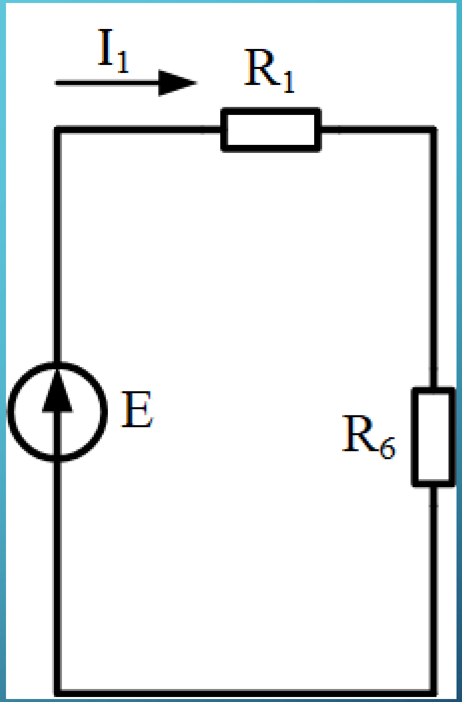
Step by step we return to circles with an intermediate simplification

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

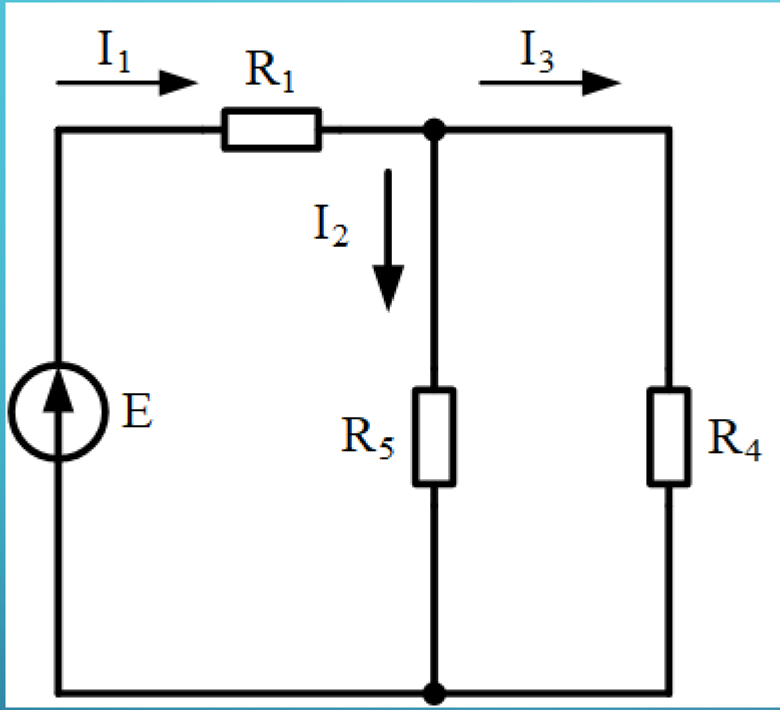




$$I_1 = \frac{E}{R_{екв}} \quad U_{екв} = E$$

$$I_1 \quad U_6 = I_1 R_6$$

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!