# VINNITSA NATIONAL AGRARIAN UNIVERSITY

**Department of Electric Power Engineering, Electrical Engineering and Electromechanics**

# BASIC CONCEPTS. OHM'S RULE

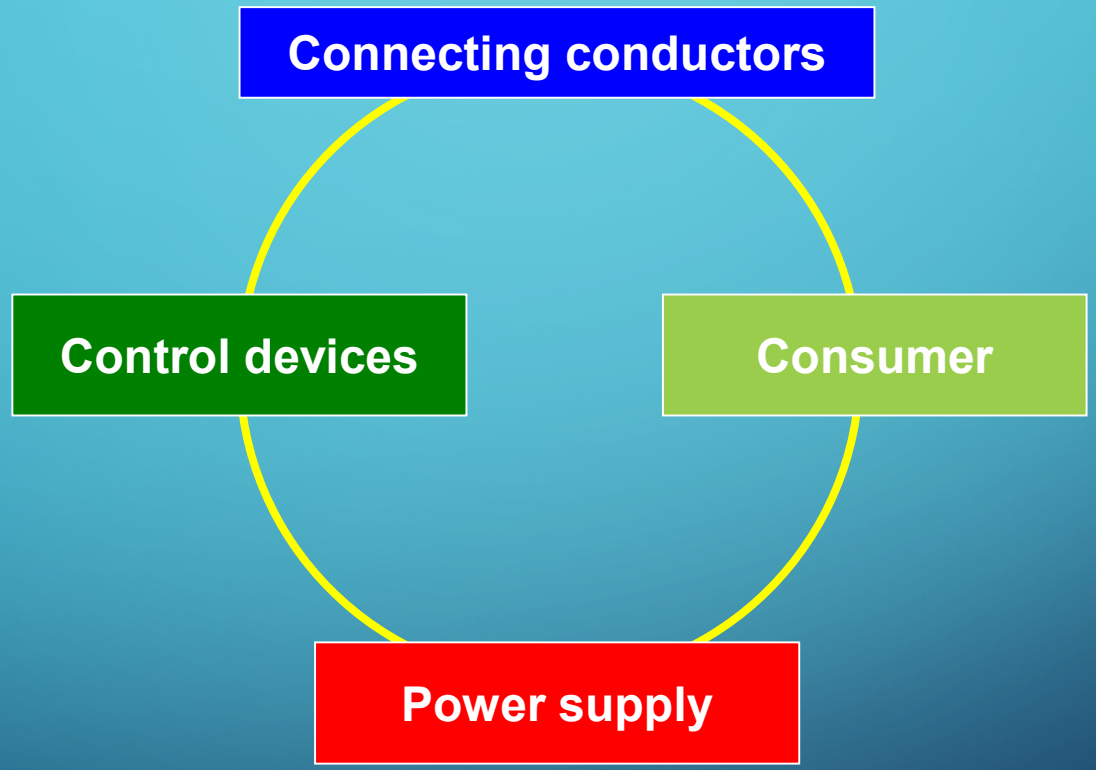
by Associate Professor V. Hraniak

# CONCEPT OF CURRENT AND VOLTAGE

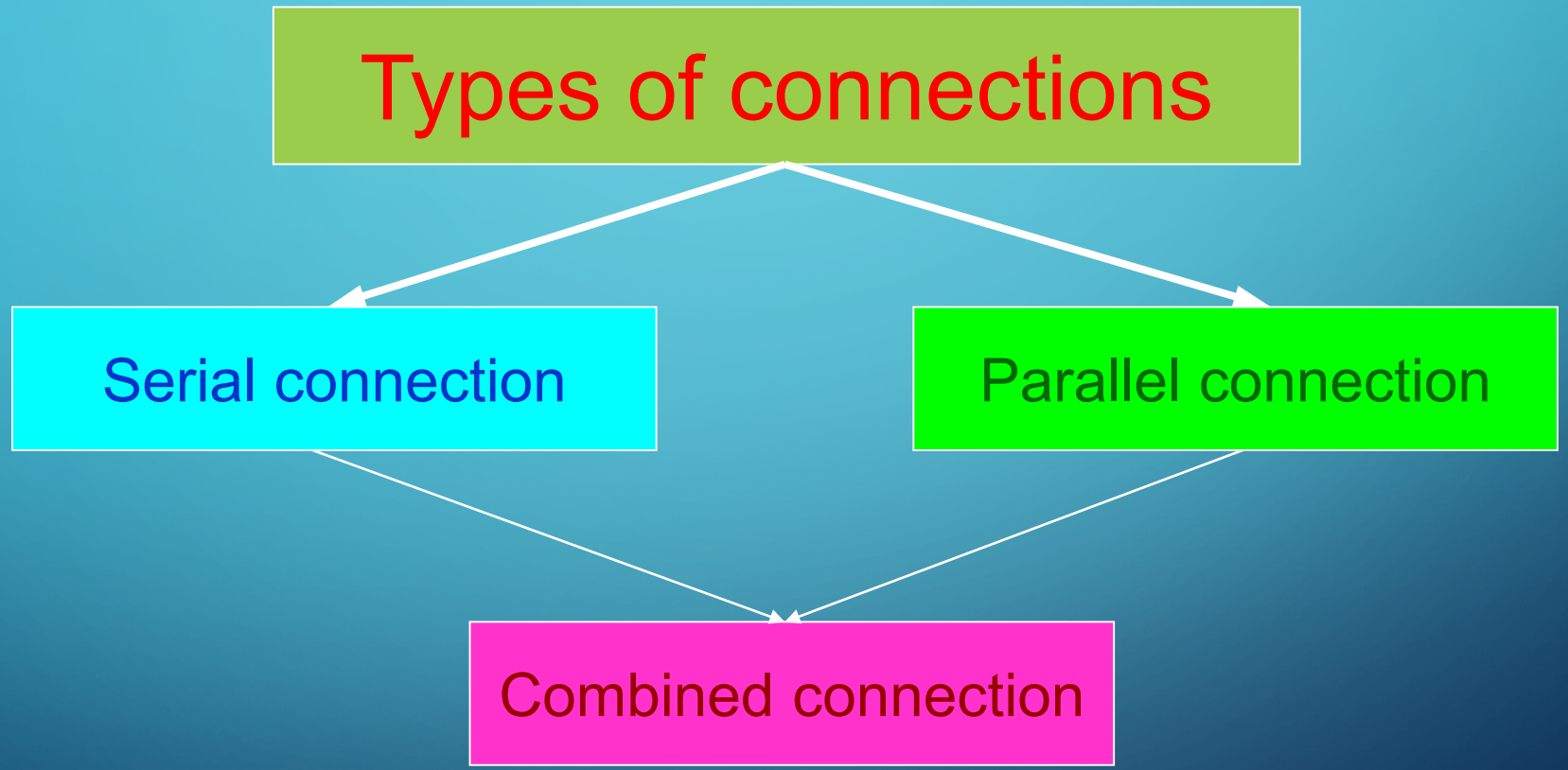
Electric current is the orderly movement of charged particles in space (a physical quantity that characterizes the speed of charge movement)

Electric voltage is a physical quantity that is numerically equal to the work of an electric field from the movement of a unit charge along a section of a circle

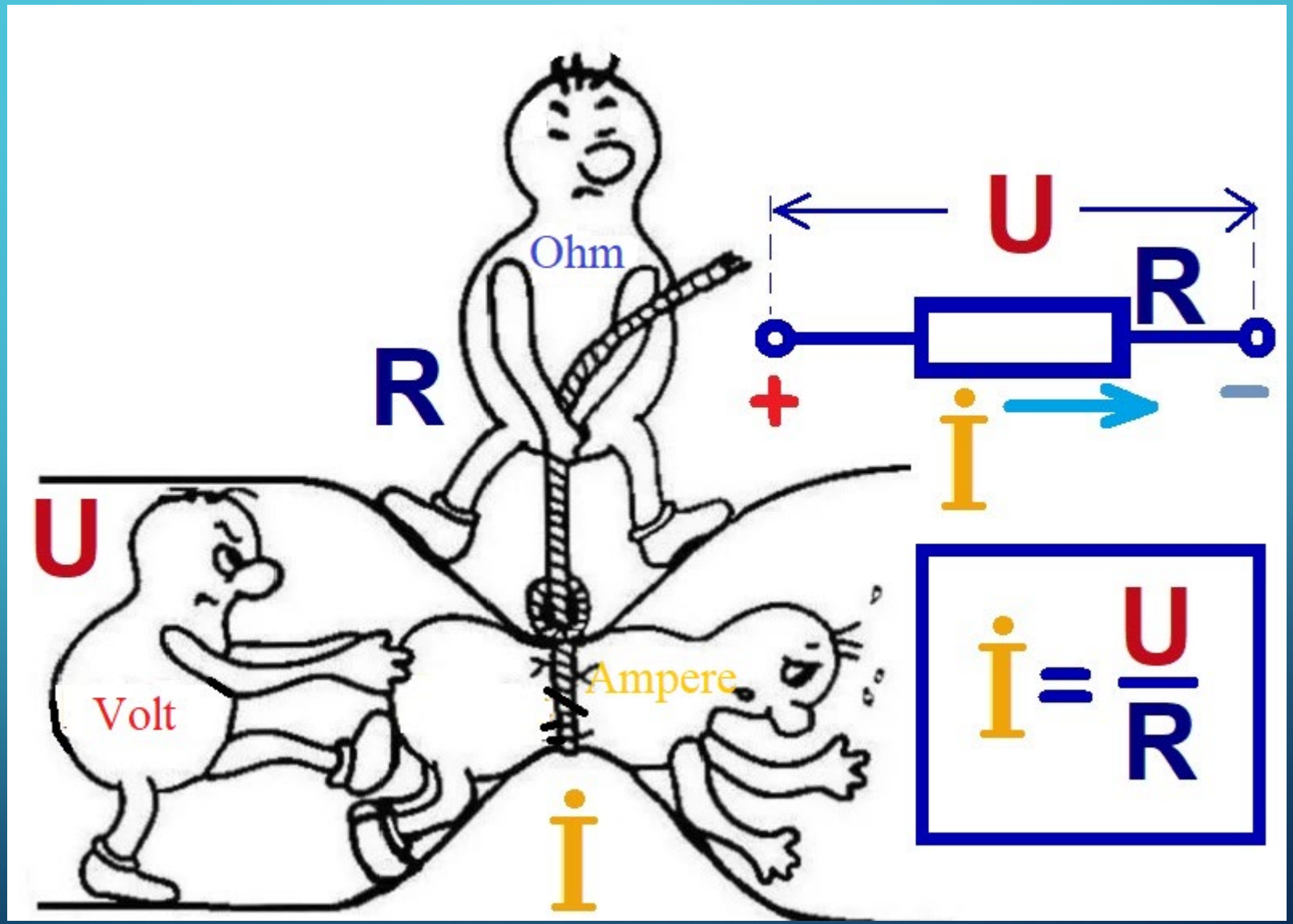
# ELECTRIC CIRCUIT



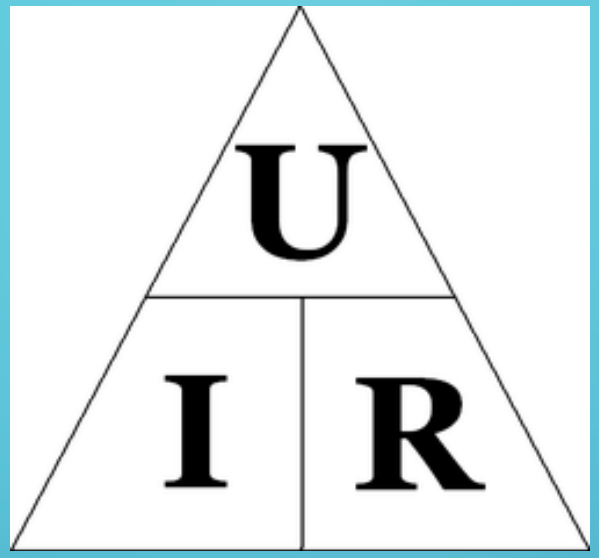
# TYPES OF CONNECTIONS

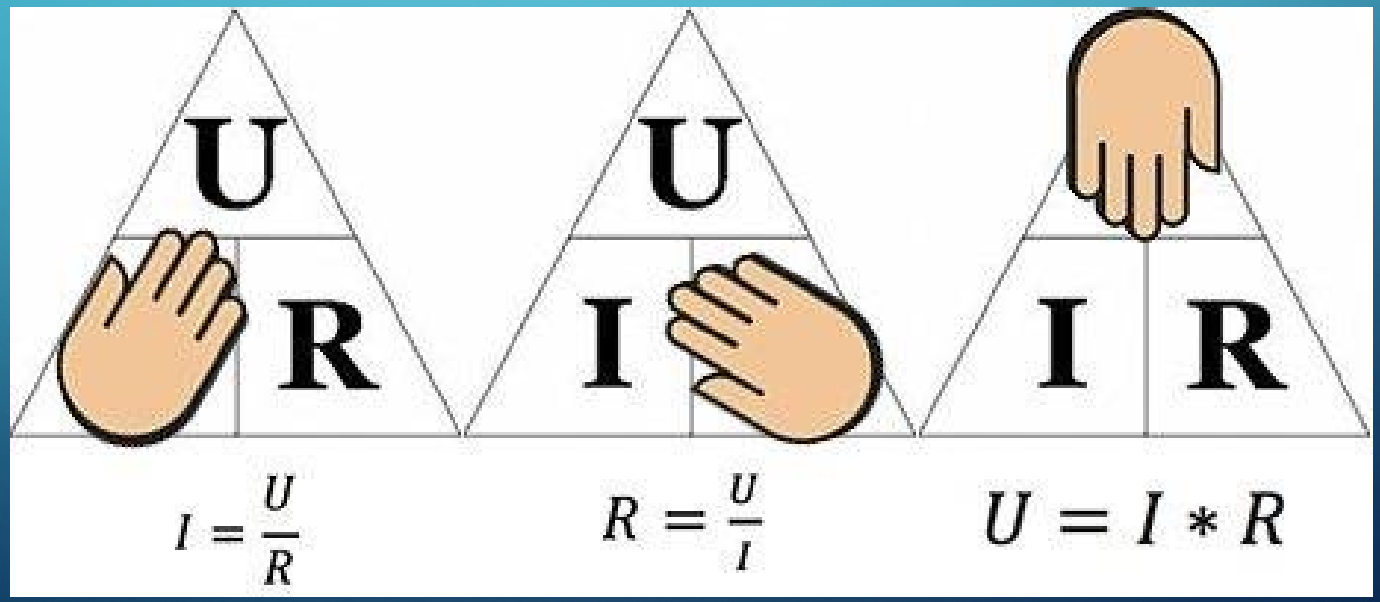


# OHM'S RULE



# OHM'S RULE



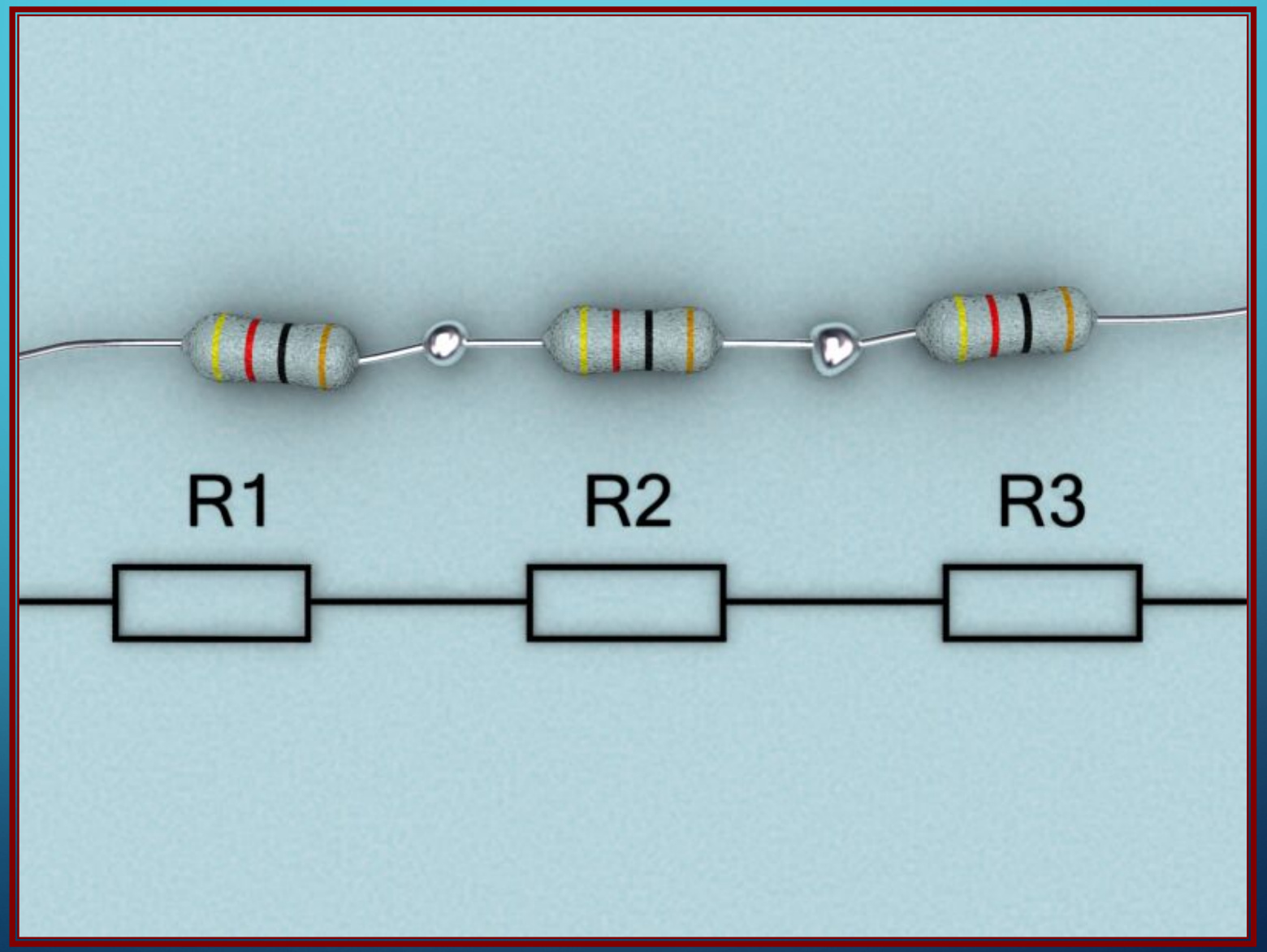
# RESISTANCE

- Electrical resistance (resistance) – the ability of a conductor to create an obstacle to the flow of electric current (a physical quantity characterizing the ability of a conductor to create an obstacle to the flow of an electric current)

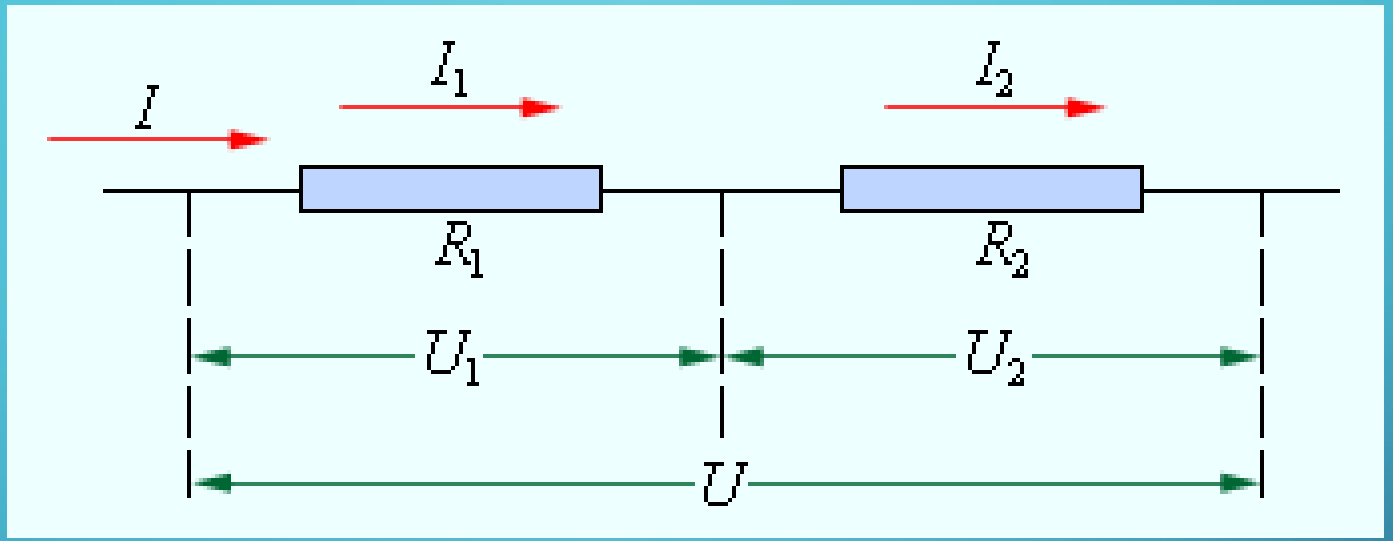
- Specific resistance is a specific physical quantity that quantitatively characterizes the ability of a substance to create resistance to the flow of electric current.

$$R = \rho \frac{l}{S}.$$

# SERIAL CONNECTION



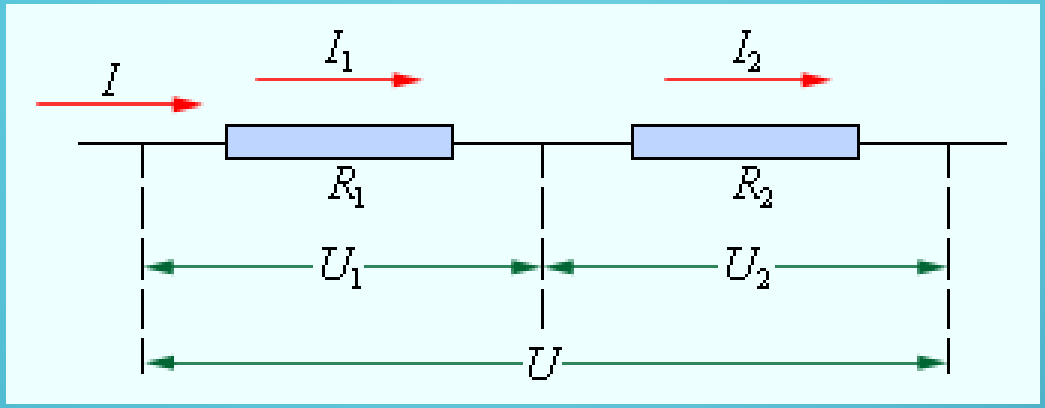
# SERIAL CONNECTION




- When connected in series, the electric circuit has no branches.

- All elements of the circle are switched on in the circle one after the other.

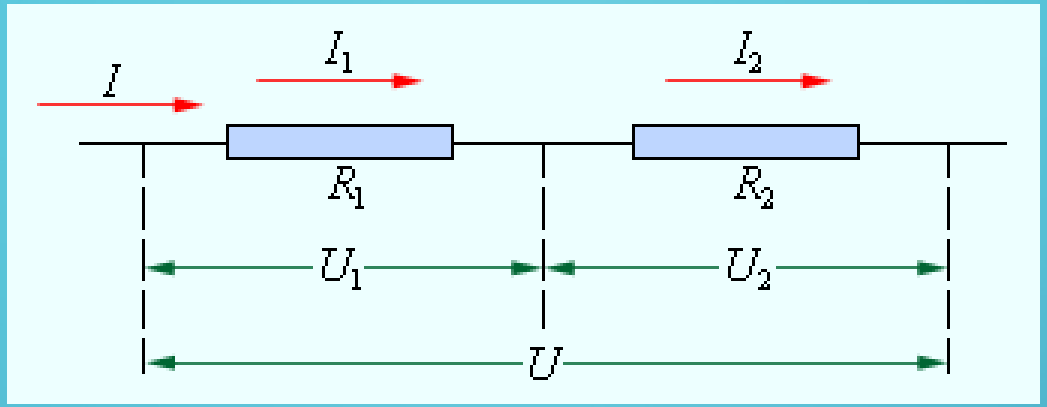
# SERIAL CONNECTION




The strength of 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

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

# SERIAL CONNECTION




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

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

- 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

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

# SERIAL CONNECTION

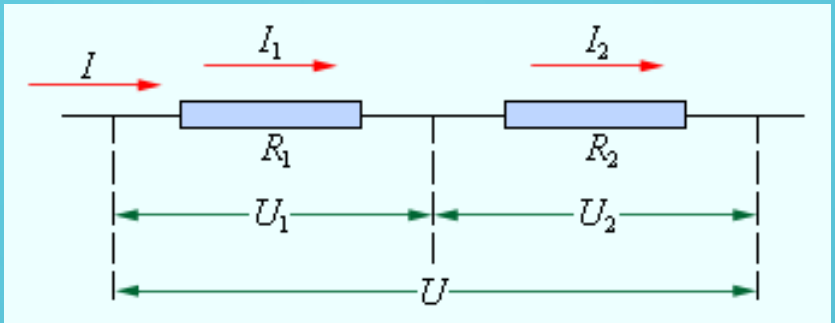
If the resistance of all elements is the same, then the resistance of n series-connected conductors

$$R = R_N * N$$

taking into account that the current strength in all elements is the same, and applying Ohm's law for the circle section, we have:

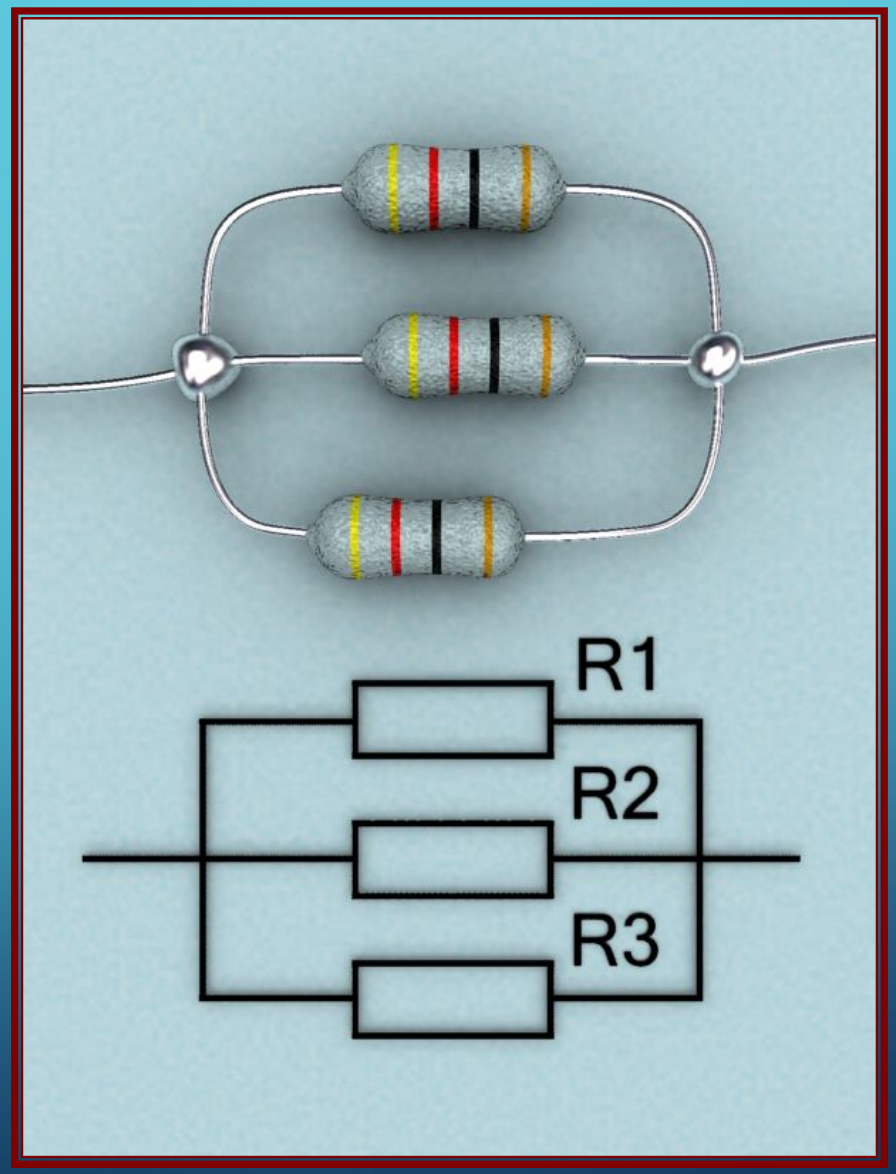
$$U = U_N * N$$

# SERIAL CONNECTION

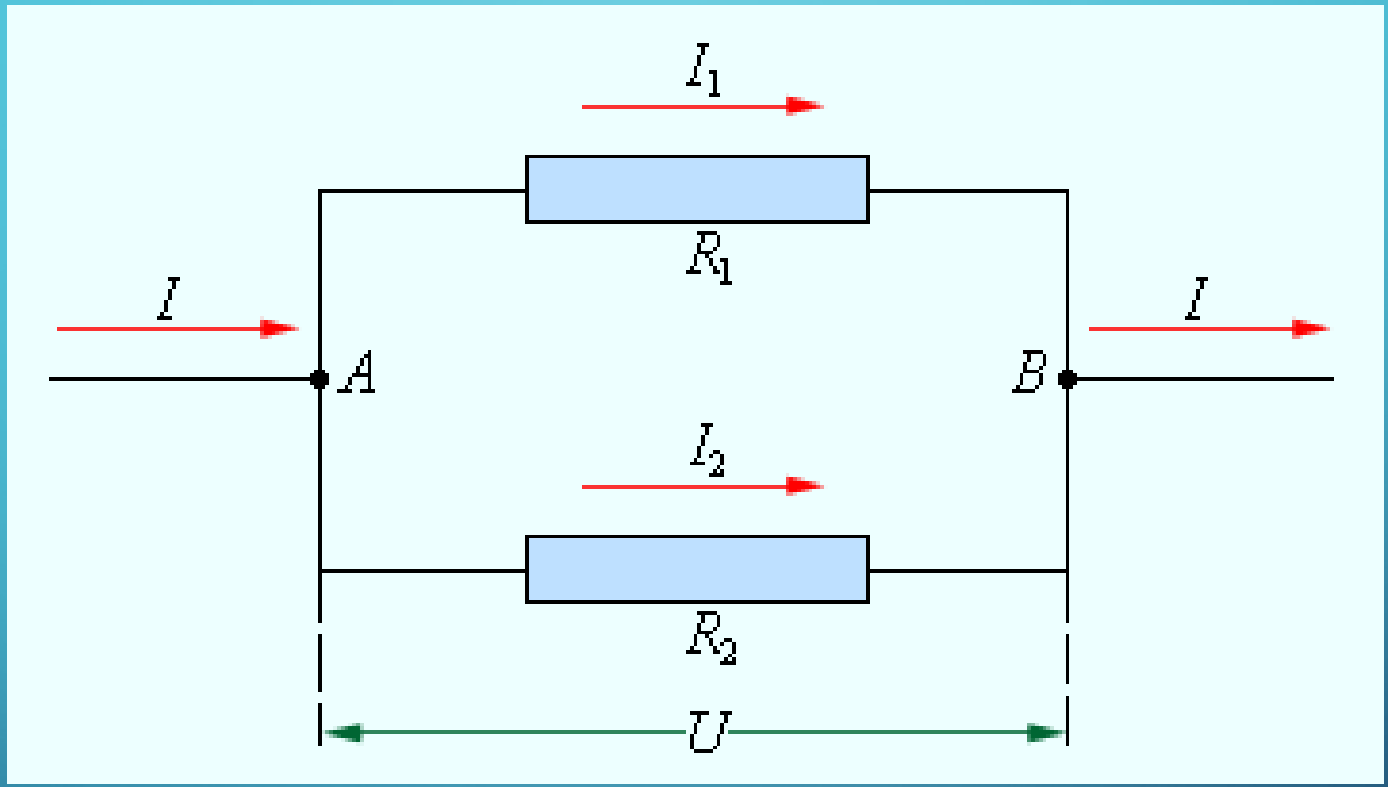



| Advantages | Disadvantages |
| --- | --- |
| • Elements that work at low voltage are used.<br>• Low costs of conductors for making connections. | • If one of the elements fails, the entire electric circuit will not work, because a gap appears in the circuit.<br>• Finding a malfunctioning element is quite a difficult task. |

# PARALLEL CONNECTION

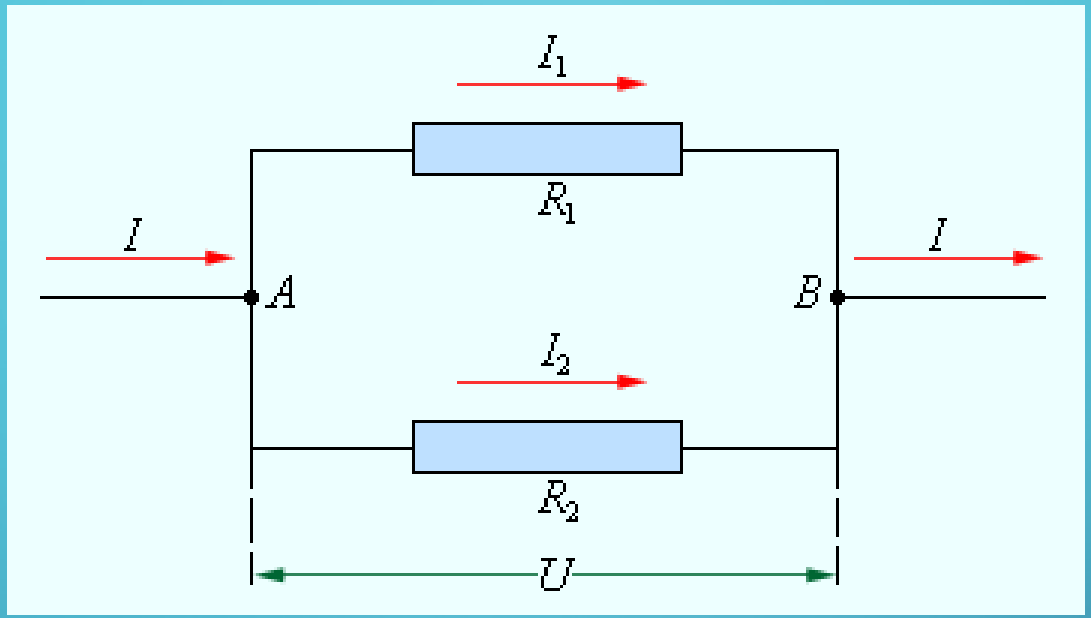


# PARALLEL CONNECTION




- With a parallel connection, the ends of the elements of the electric circuit are connected.

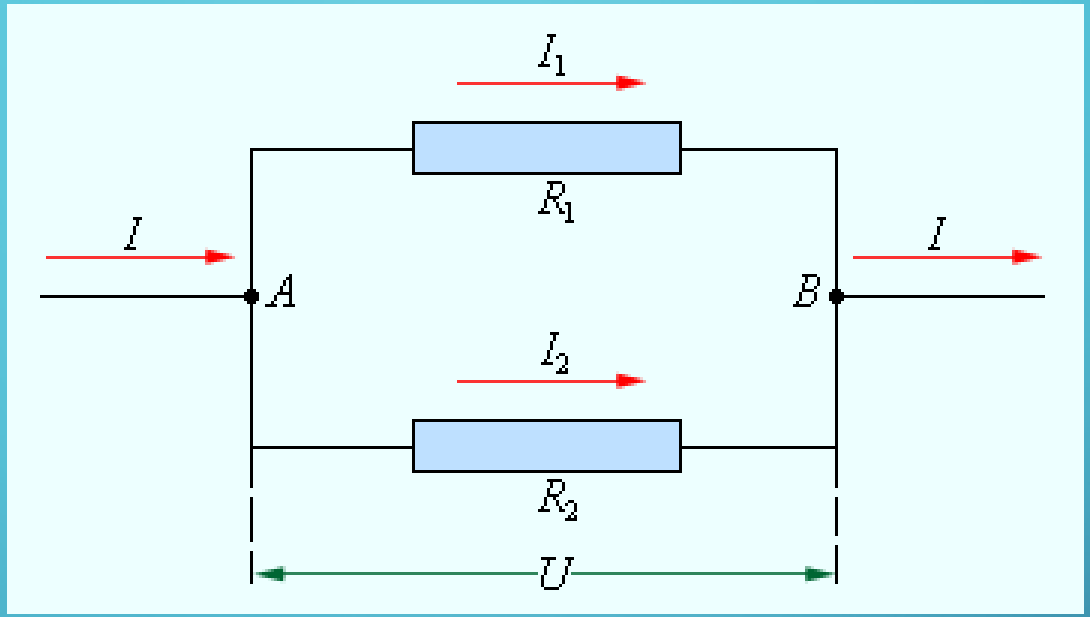
# PARALLEL CONNECTION




- Since electric charge does not accumulate at the branching point, the charge arriving at the node per unit of time is equal to the charge leaving the node during the same time. So:

$$I = I_1 + I_2 + \ldots + I_n$$

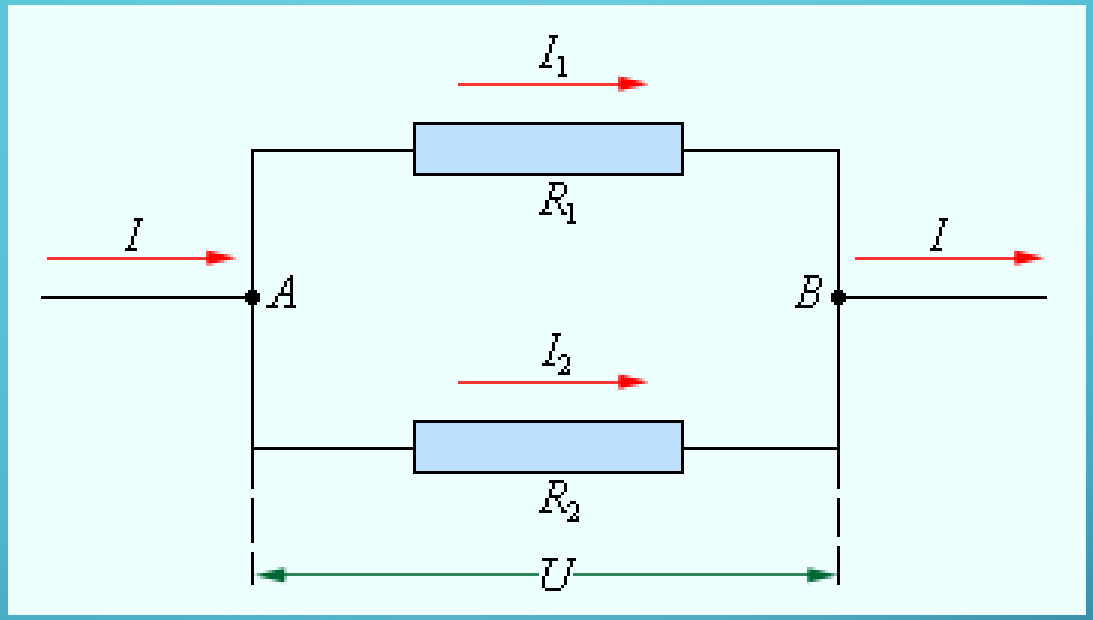
# PARALLEL CONNECTION




$$I = I_1 + I_2 + \ldots + I_n$$

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

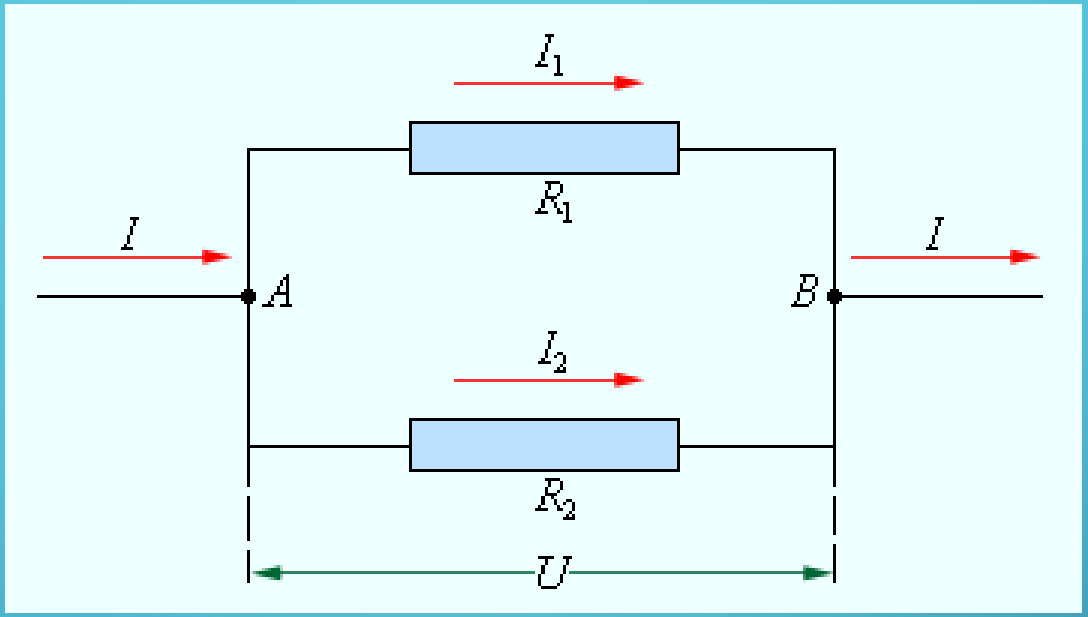
# PARALLEL CONNECTION




When connected in parallel, the current is greater in the conductor with lower resistance.

If $R_1 < R_2$, than $I_2 < I_1$

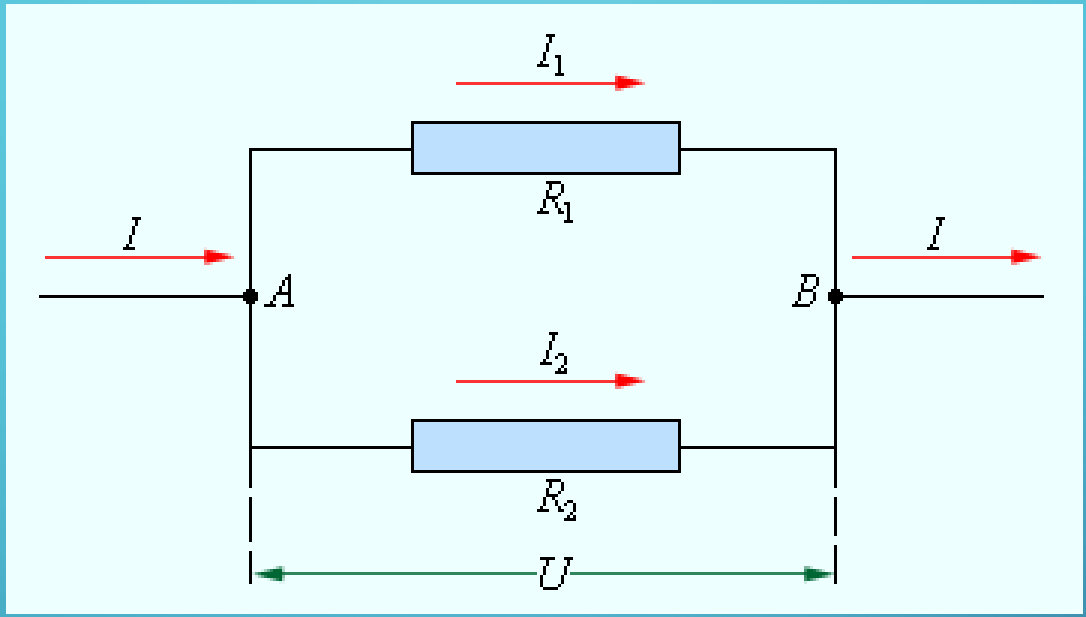
# PARALLEL CONNECTION




With a parallel connection, the current in the section of the circuit is inversely proportional to its resistance:

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

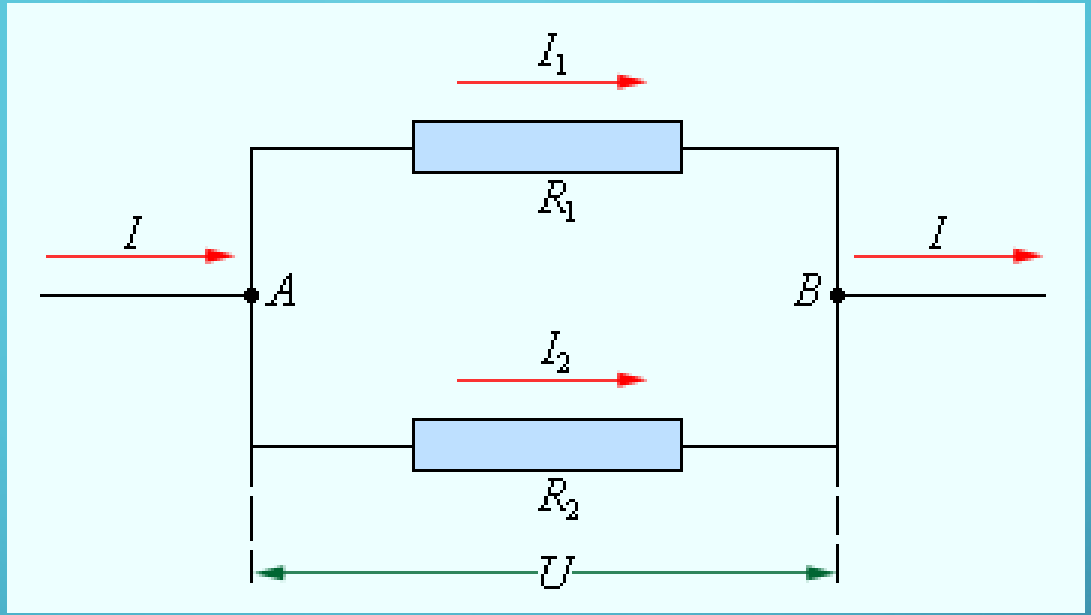
# PARALLEL CONNECTION




- The voltage at the ends of conductors connected in parallel is the same:

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

# PARALLEL CONNECTION




- Applying Ohm's rule for a section of a circle, it can be proved that

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

# PARALLEL CONNECTION

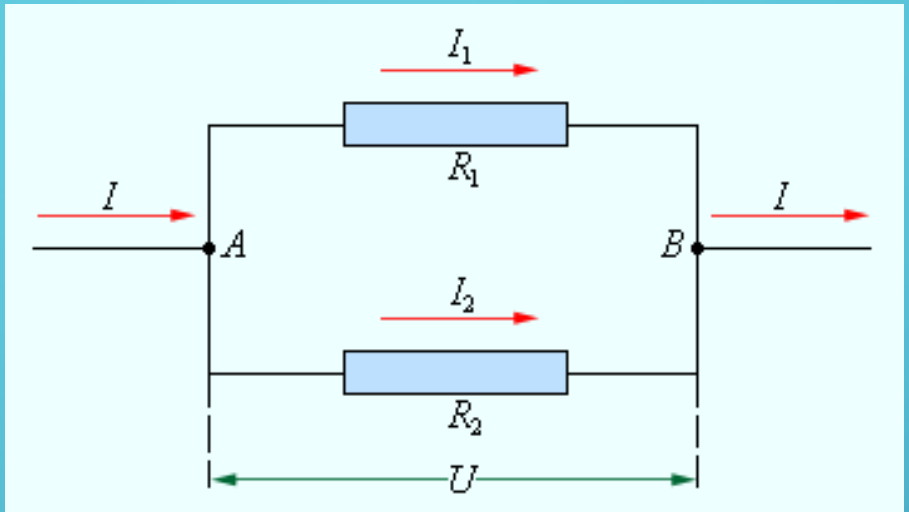
If the resistance of N parallel connected conductors is the same, then the total resistance

$$R = R_N / N$$

taking into account that the voltage on the conductors is the same, and applying Ohm's law for the section of the circle, we have:

$$I = I_N * N$$

# PARALLEL CONNECTION




| Advantages | Disadvantages |
| --- | --- |
| If one of the elements of the electrical circuit fails, the rest of the elements continue to work.<br>A malfunctioning circuit element can be easily detected. | All elements of the circuit are under the same voltage.<br>High costs of conductors for connecting elements. |