

ELECTROTECHNICS

DC CIRCUITS 2

Doc. Ing. Stanislav Kocman, Ph.D.

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DC CIRCUITS

Example 4

Assignment

Calculate voltage between the output terminals of the voltage divider to which a resistor of resistance $R_z = 150\ \Omega$ is connected. Calculate also power drawn by the resistor R_z from the divider.

Voltage divider parameters:

Resistor resistance $R_1 = 200\ \Omega$

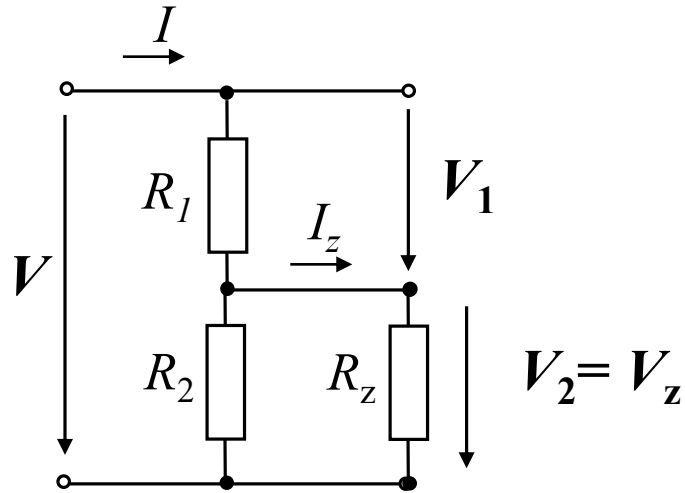
Resistor resistance $R_2 = 300\ \Omega$

Source voltage: $V = 150\ \text{V}$

DC CIRCUITS

Example 4

Wiring diagram



DC CIRCUITS

Example 4

Solution

We use the method step-by-step simplification.

Total resistance:

$$\frac{1}{R_{2Z}} = \frac{1}{R_2} + \frac{1}{R_Z} = \frac{1}{300} + \frac{1}{150} \rightarrow R_{2Z} = 100 \, \Omega$$

$$R_{tot} = R_1 + R_{2Z} = 200 + 100 = 300 \, \Omega$$

Total current:

$$I = \frac{V}{R_{tot}} = \frac{150}{300} = 0,5 \, \text{A}$$

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Example 4

Solution

Voltage between the output terminals: $V_z = R_z \cdot I_z$

2. Kirchhoff's law: $V_z = V - V_1$
 $V_1 = R_1 \cdot I = 0,5 \cdot 200 = 100 \text{ V}$
 $V_z = V - V_1 = 150 - 100 = 50 \text{ V}$

Power drawn by the resistor R_z : $P_z = V_z \cdot I_z$

$$I_z = \frac{V_z}{R_z} = \frac{50}{150} = 0,33 \text{ A}$$

$$P_z = V_z \cdot I_z = 50 \cdot 0,33 = 16,5 \text{ W}$$

DC CIRCUITS

Example 5

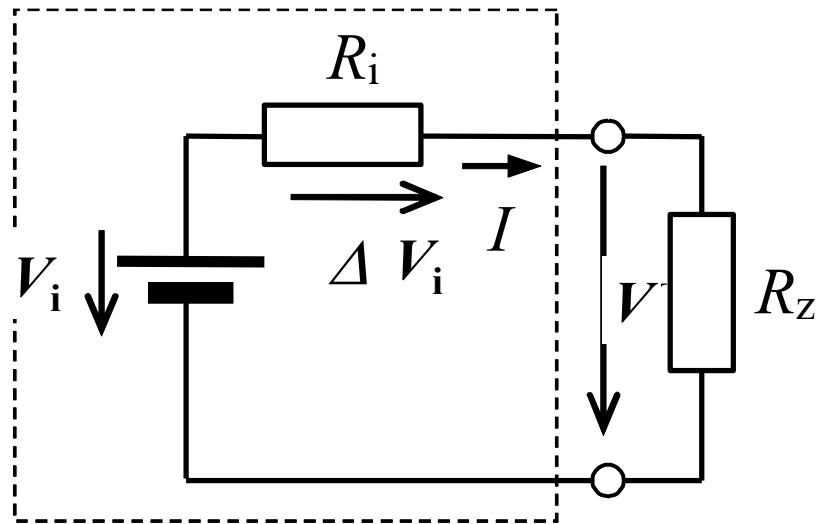
Assignment

A battery with internal resistance of $R_i = 0,05 \Omega$ is loaded by resistor with resistance of $R_z = 1,45 \Omega$. Terminal voltage of the battery is equal to 23,2 V. Calculate voltage under no-load condition and short-circuit current.

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Example 5

Wiring diagram



DC CIRCUITS

Example 5

Solution

Voltage under no-load V_0 =internal voltage V_i .

2. Kirchhoff's law: $V_i = \Delta V_i + V = R_i \cdot I + V$

Current : $I = \frac{V}{R_z} = \frac{23,2}{1,45} = 16 \text{ A}$

$$V_i = V_0 = R_i \cdot I + V = 0,05 \cdot 16 + 23,2 = 24 \text{ V}$$

Short-circ. current: $I_k = \frac{V_i}{R_i} = \frac{24}{0,05} = 480 \text{ A}$

DC CIRCUITS

Example 6

Assignment

Calculate current supplied by a source into a circuit and voltage on the resistor R_2 if the switch:

- a) is open
- b) is closed

Entered values:

Voltage source $V = 50 \text{ V}$

Resistor resistance $R_1 = 20 \text{ } \Omega$

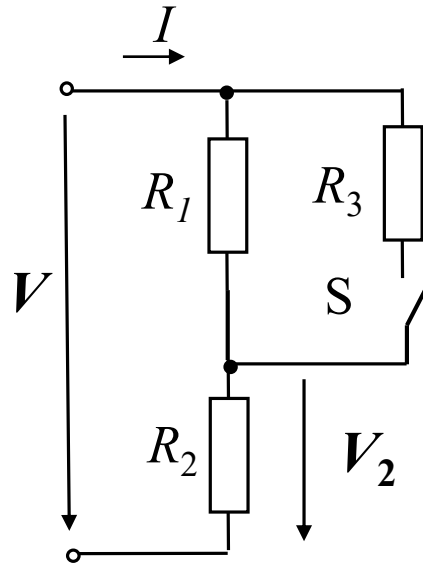
Resistor resistance $R_2 = 30 \text{ } \Omega$

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

DC CIRCUITS

Example 6

Wiring diagram



DC CIRCUITS

Example 6

Solution with the opened switch

Total resistance: $R_{tot} = R_1 + R_2 = 20 + 30 = 50 \, \Omega$

Supplied current: $I = \frac{V}{R_{tot}} = \frac{50}{50} = 1 \, \text{A}$

Voltage on resistor R_2 : $V_2 = R_2 \cdot I = 30 \cdot 1 = 30 \, \text{V}$

DC CIRCUITS

Example 6

Solution with the closed switch

Total resistance:

$$\frac{1}{R_{13}} = \frac{1}{R_1} + \frac{1}{R_3} = \frac{1}{20} + \frac{1}{10} \rightarrow R_{13} = 6,67 \, \Omega$$

$$R_{tot} = R_{13} + R_2 = 6,67 + 30 = 36,67 \, \Omega$$

Supplied current: $I = \frac{V}{R_{tot}} = \frac{50}{36,67} = 1,36 \, \text{A}$

Voltage on resistor R_2 : $V_2 = R_2 \cdot I = 30 \cdot 1,36 = 40,8 \, \text{V}$