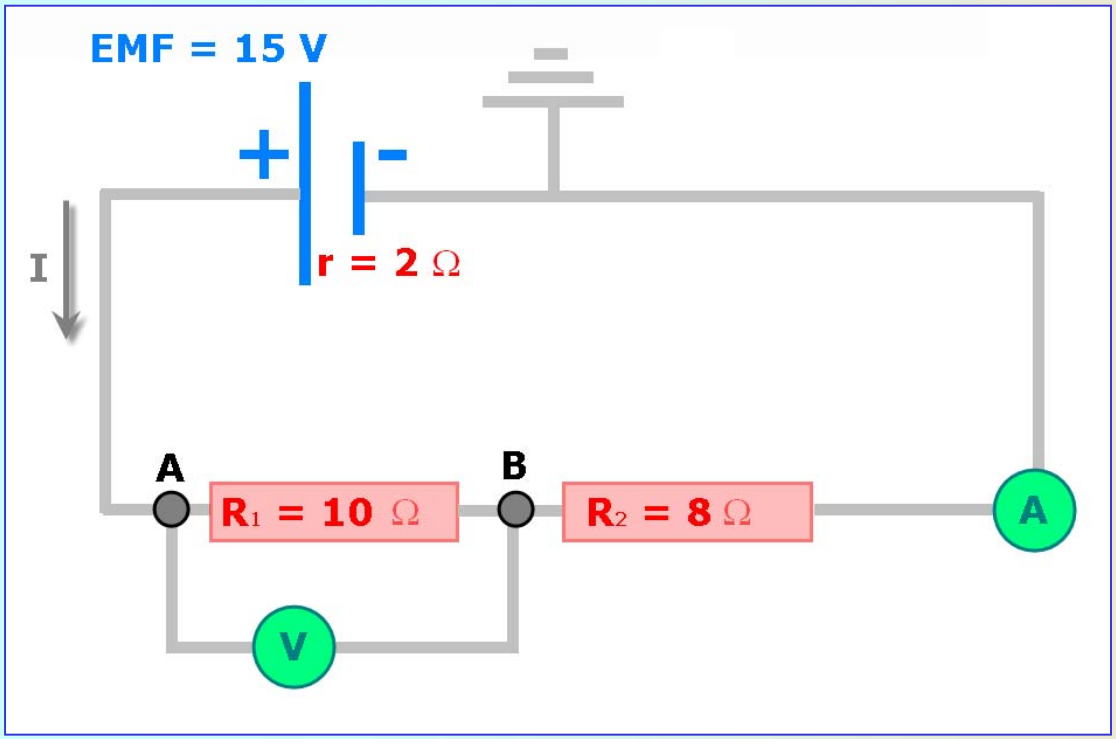
Ohm's Law

Rafa Muñoa
Lizardi Institutua
Zarautz



Exercise

In this electric circuit find:

a) the equivalent resistance
b) the current I
c) the voltage at point B
d) the reading from the voltmeter ("V")
e) the reading from the ammeter ("A")
f) the power and heat dissipated by the resistor R2 in 10 hrs

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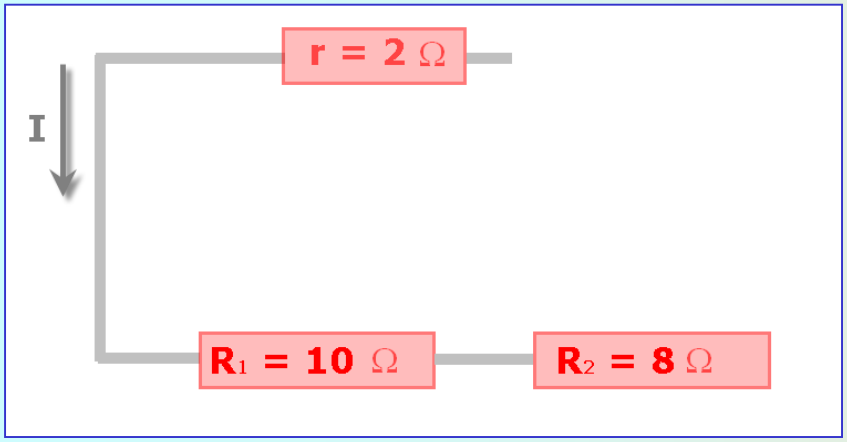

b) the current I

According to Ohm's Law:

$$I = \frac{EMF}{R_{equiv}} = \frac{15\ V}{20\ \Omega} = 0.75\ A$$

e) the reading from the ammeter ("A")

reading of "A" = 0.75 A

Solutions

a) the equivalent resistance

The three resistors (internal and the resistors in the circuit) are connected in series. When the resistors are connected in series, the equivalent resistance is:

$$R_{equiv} = r + R_1 + R_2 =$$
$$= 2\ \Omega + 10\ \Omega + 8\ \Omega = 20\ \Omega$$

c) the voltage at point B

In order to reach point "B" charges must overcome two resistances: r and R_1.

The change along a resistance can be calculated using this expression:

$$\Delta V = - I * R$$

In our case:

$$\Delta V = - 0.75\ A * (2\ \Omega + 10\ \Omega) = - 9\ V$$
$$V_B = V_{initial} + \Delta V = 15\ V - 9\ V = 6\ V$$

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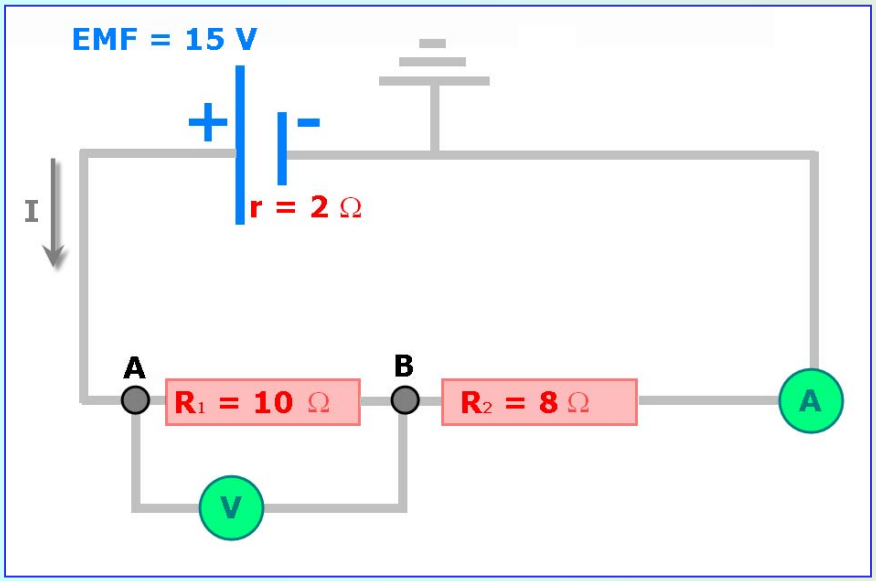

d) the reading from the voltmeter ("V")

The reading from the voltmeter corresponds to the change in voltage from point "A" to point "B":

$$V_A - V_B = -\Delta V = 0.75\ A * 10\ \Omega = 7.5\ V$$

f) the power and heat dissipated by the resistor R2 in 10 hrs

$$Power = P = I^2 * R$$

$$P_{R2} = (0.75\ A)^2 * 8\ \Omega = 4.5\ W$$

Energy dissipated = Power * time

$$E_{R2} = 4.5\ W * 36000\ s = 162000\ J$$

$$E_{R2} = 162000\ J \frac{1\ kW\text{-}h}{3600000\ J} = 0.045\ kW\text{-}h$$