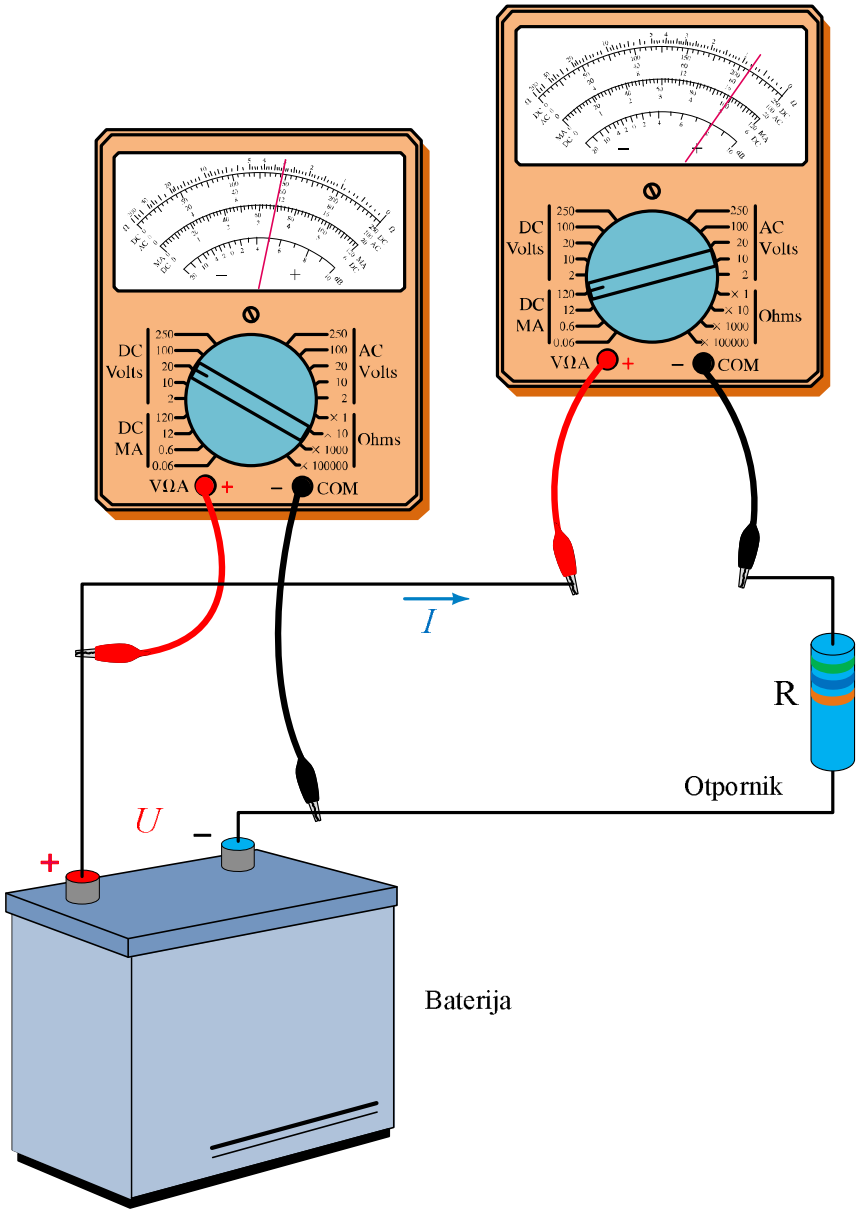
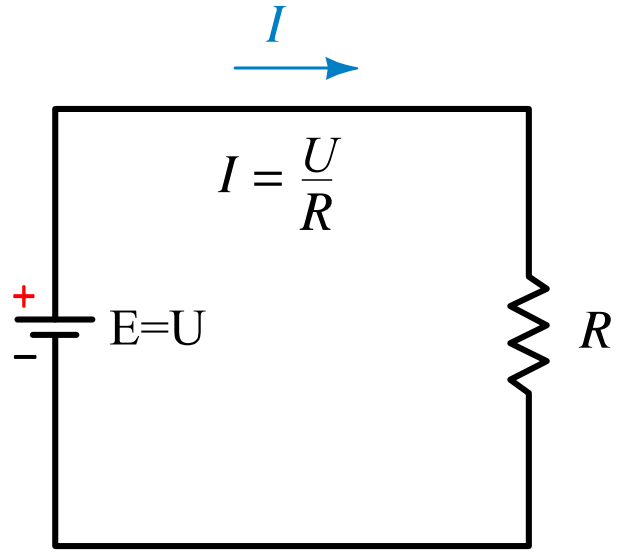
Omov zakon u električnom kolu

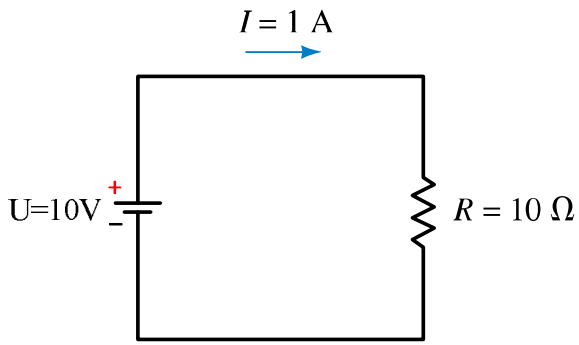


Om je eksperimentalno dokazao da je struja u kolu direktno proporcionalna priključenom naponu a obrnuto proporcionalna otpornosti kola

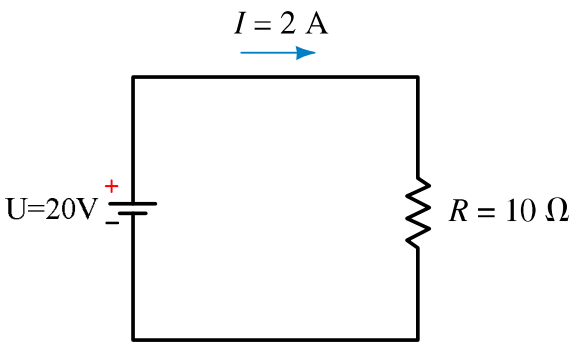
$$I = \frac{U}{R} \qquad R = \frac{U}{I} \qquad U = I \cdot R$$



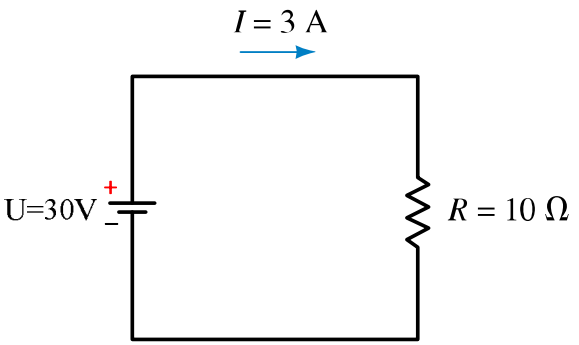
Primjena Omovog zakona



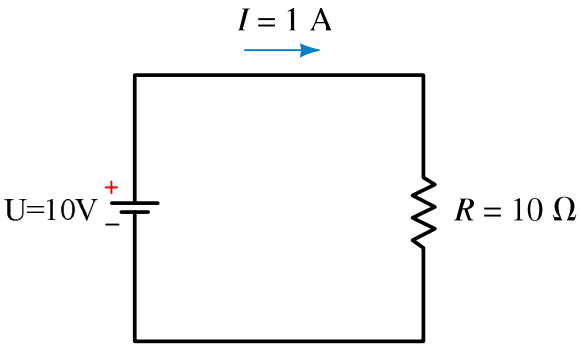
$$I = \frac{10\ \text{V}}{10\ \Omega} = 1\ \text{A}$$



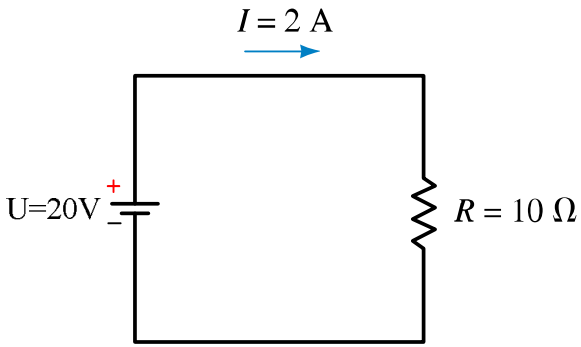
$$I = \frac{20\ \text{V}}{10\ \Omega} = 2\ \text{A}$$



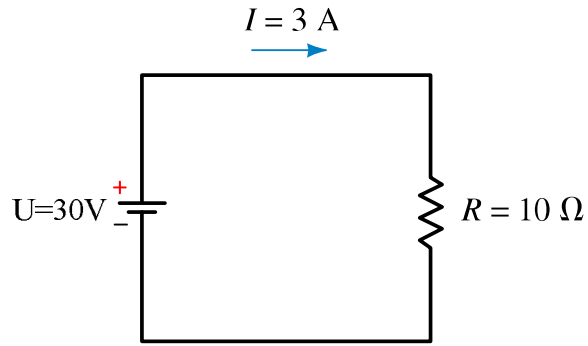
$$I = \frac{30\ \text{V}}{10\ \Omega} = 3\ \text{A}$$



$$I = \frac{10\ \text{V}}{10\ \Omega} = 1\ \text{A}$$



$$I = \frac{20\ \text{V}}{10\ \Omega} = 2\ \text{A}$$



$$I = \frac{30\ \text{V}}{10\ \Omega} = 3\ \text{A}$$

Omov zakon u električnom kolu

Primjer:

EXAMPLE 4–1 A 27-Ω resistor is connected to a 12-V battery. What is the current?

Solution Substituting the resistance and voltage values into Ohm's law yields

$$I = \frac{E}{R} = \frac{12\ \text{V}}{27\ \Omega} = 0.444\ \text{A}$$

Omov zakon u električnom kolu

Primjer:

EXAMPLE 4–2 The lamp of Figure 4–4 draws 25 mA when connected to a 6-V battery. What is its resistance?

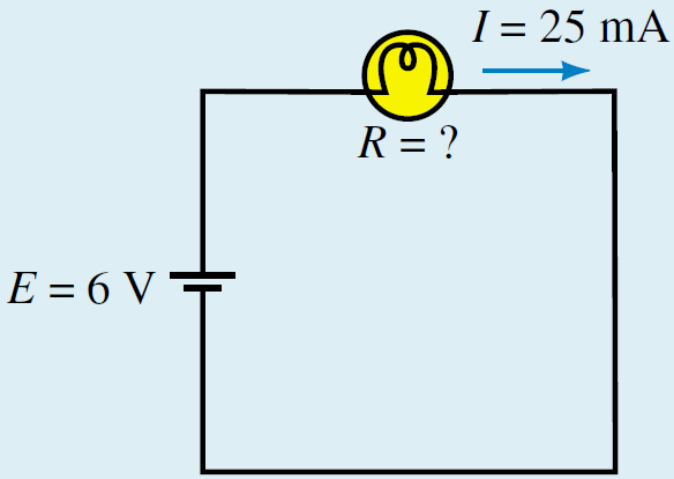


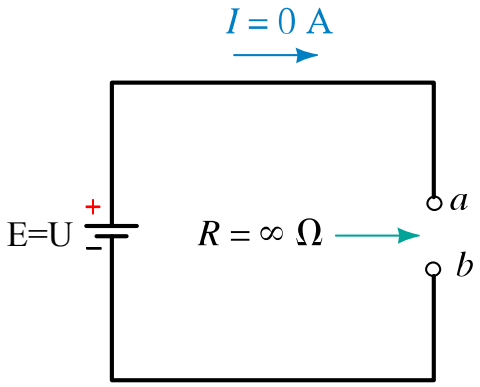
FIGURE 4–4

Solution Using Equation 4–3,

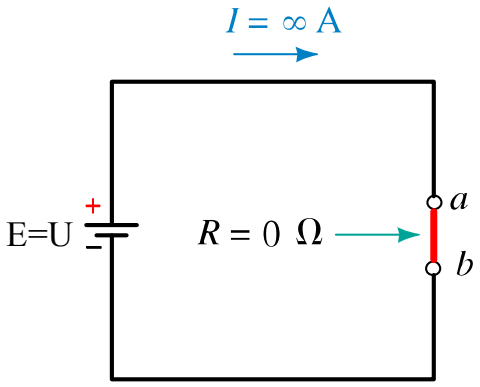
$$R = \frac{E}{I} = \frac{6\ \text{V}}{25 \times 10^{-3}\ \text{A}} = 240\ \Omega$$

Omov zakon u strujnom kolu (prekid kola i kratki spoj)

- U slučaju prekida kola struja kroz kolo ne teče pa je otpor kola beskonačan
- U slučaju kratkog spoja u kolu vrijednost struja u kolu je teoretski beskonačna (u praksi ima veliku vrijednost) a otpor u kolu je nula (u praksi ima veoma malu vrijednost)



$$I = \frac{U}{R} = \frac{U}{\infty} = 0\ A$$

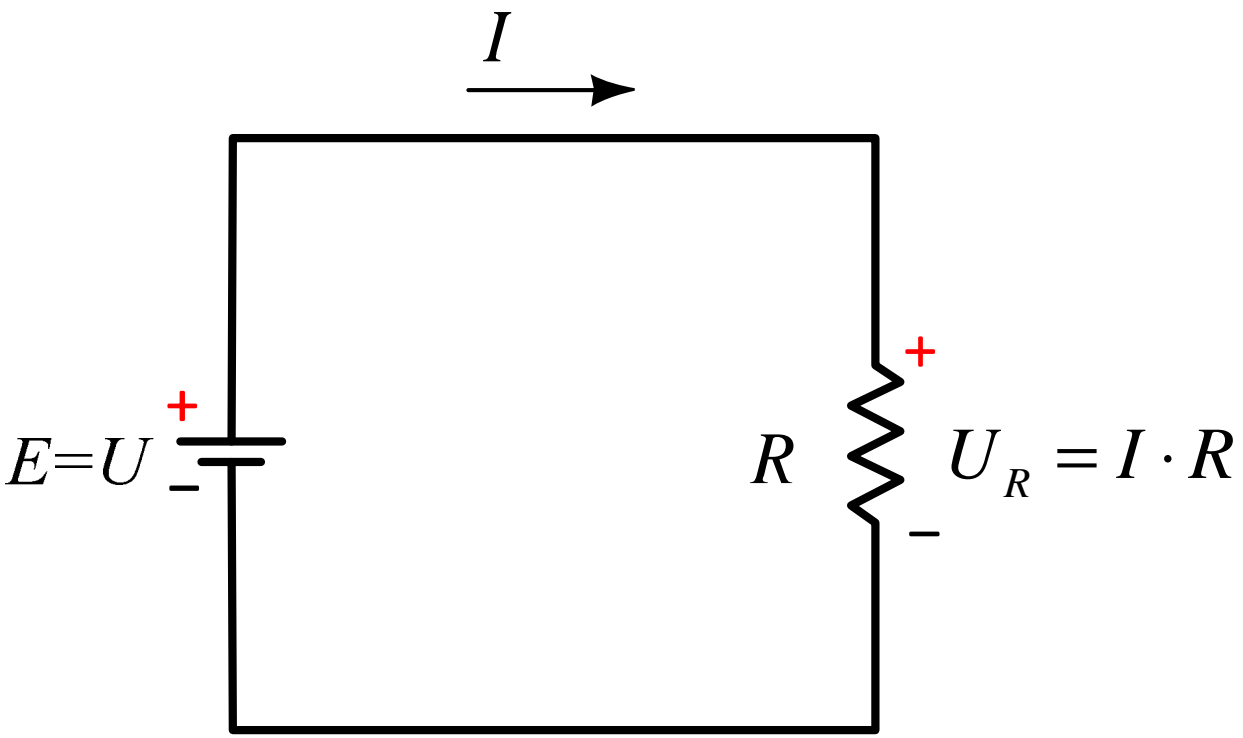


$$I = \frac{U}{R} = \frac{U}{0} = \infty\ A$$

Omov zakon (pad napona na otporniku)

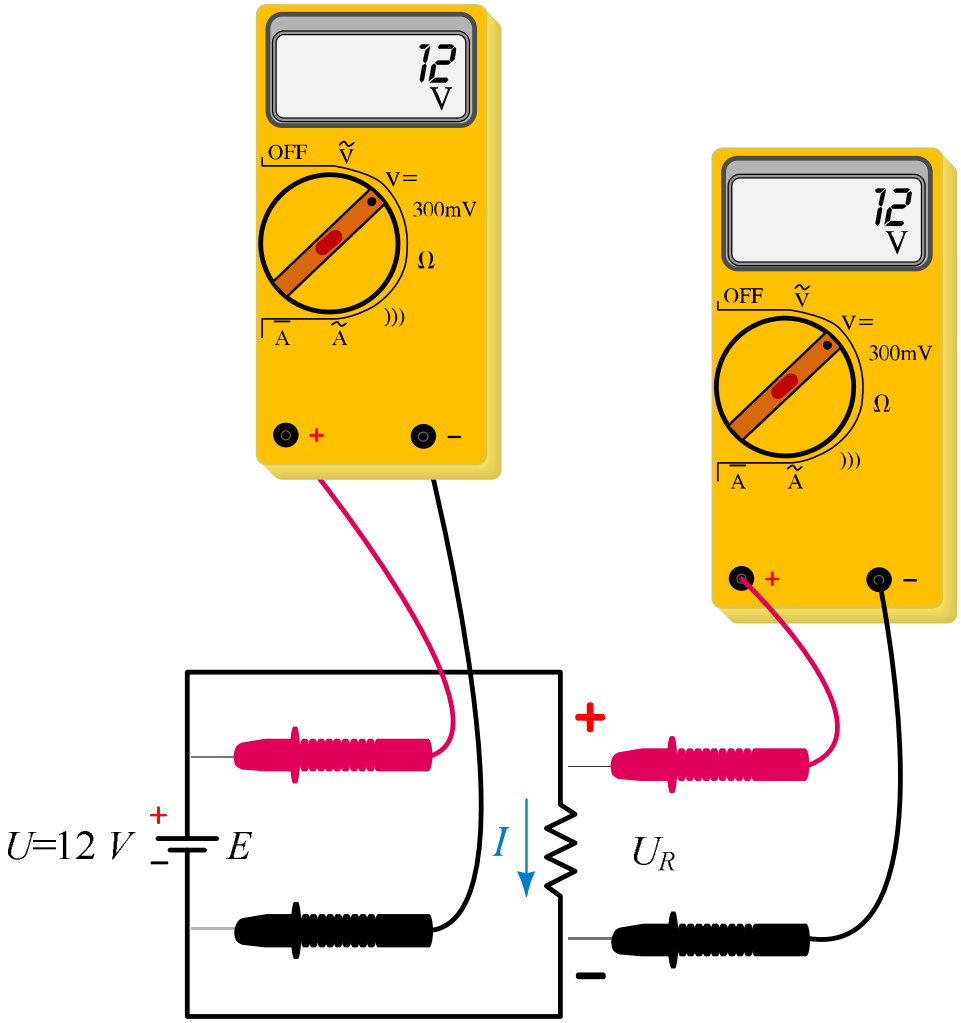
- U prostom strujnom kolu struja koja protiče na otporniku pravi pad napona U_R koji je jednak:

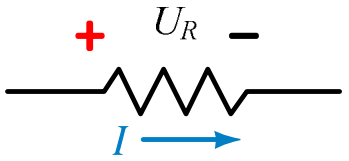
$$U_R = I \cdot R$$

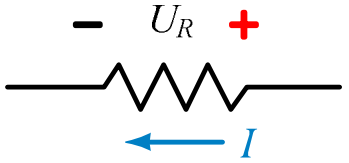


Omov zakon (pad napona na otporniku)

- Polaritet napona U_R takav da plus pol (+) odgovara ulasku struje u otpornik a minus pol izlazku struje iz otpornika (-)







Omov zakon (pad napona na otporniku)

Primjer:

EXAMPLE 4–5 The current through each resistor of Figure 4–10 is $I = 0.5$ A. Compute V_1 and V_2.

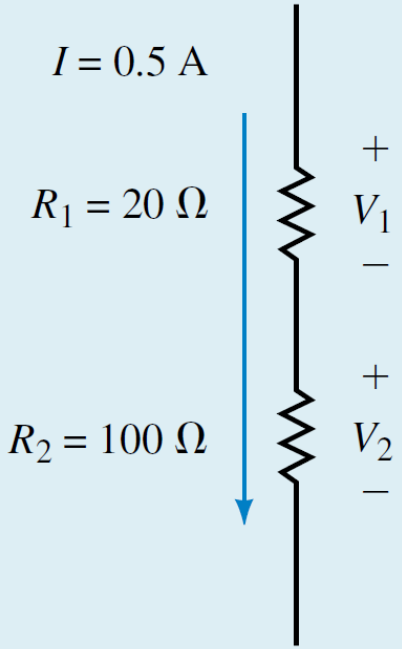


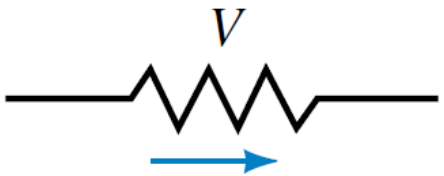
FIGURE 4–10 Ohm's law applies to each resistor.

Solution $V_1 = IR_1 = (0.5\text{ A})(20\ \Omega) = 10$ V. Note, I is also the current through R_2. Thus, $V_2 = IR_2 = (0.5\text{ A})(100\ \Omega) = 50$ V.

Omov zakon (pad napona na otporniku)

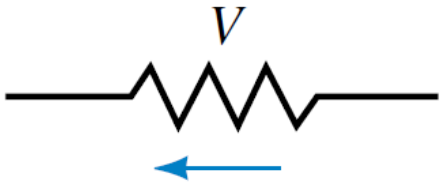
Primjer:

For each resistor of Figure 4–12, compute V and show its polarity.



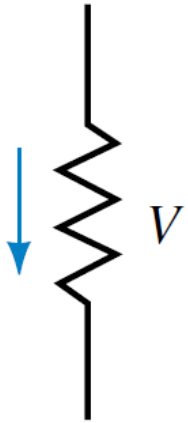
$I = 0.1$ A

(a) $R = 10$ kΩ



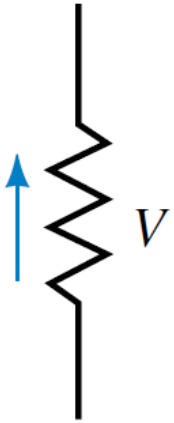
$I = 0.15$ mA

(b) $R = 3$ MΩ



$I = 0.3$ A

(c) $R = 400$ Ω



I = 2.5 A

(d) $R = 0.4$ Ω

Pojam električne snage

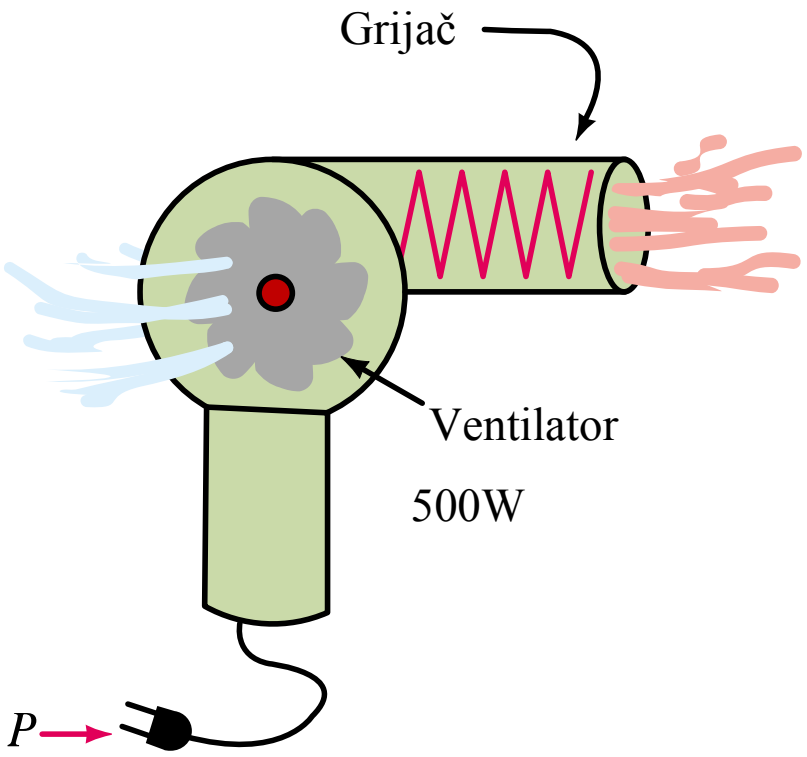
- Električni uređaji: grijači, sijalice, motori, ... imaju na sebi oznake 60W, 100W, 500W, 1000W.. Ove oznake predstavljaju **električnu snagu** uređaja
- Intuitivno nam je jano da što je veća snaga uređaja to se više električne energije pretvori u neki drugi oblik : toplotu, svjetlost, mehanički rad itd.
- Tako sijalica od 100W "daje" više svjetlosti od sijalice od 40W
- Motor od 4000W daje više mehaničke snage na osovini od motora od 100W....

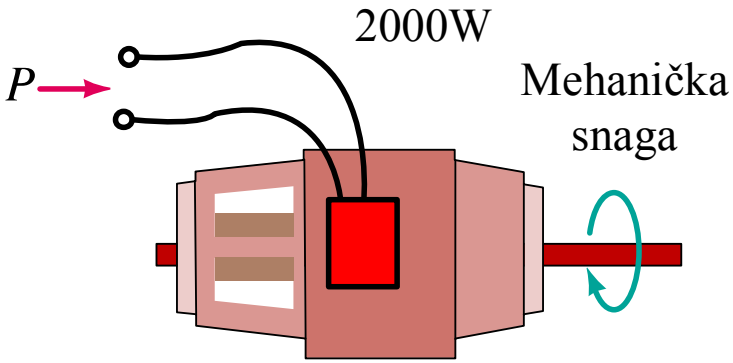
Pojam električne snage

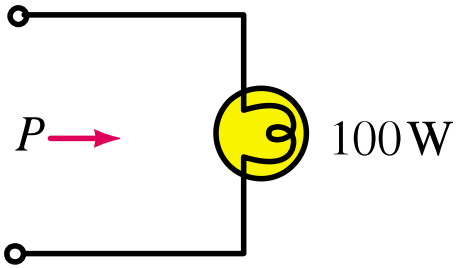
- Električna snaga predstavlja brzinu obavljanja rada, odnosno pretvaranja električne energije u neki drugi oblik u nekom posmatranom vremenskom intervalu:

$$P = \frac{A}{t}\left[W\ (Vat)\right]$$

- A- Električni rad (energija) – [J (Džul)]
- t – vremenski interval - [s]







Snaga u električkim kolima

- **Podsjetimo se:** Ako se utrošeni rad podijeli sa količinom naelektrisanja dobije se fizikalna veličina koja se naziva električni napon i mjeri se u voltima:

$$U = \frac{A}{Q}$$

- **Podsjetimo se:** Kažemo da je električna struja u kolu direktno proporcionalna količini naelektrisanja koja protekne u posmatranom vremenskom intervalu

$$I = \frac{Q}{t}$$

- Množenjem gornjih jednačina dobijamo izraz za električnu snagu:

$$U \cdot I = \frac{A}{Q} \cdot \frac{Q}{t} = \frac{A}{t} \Rightarrow P = \frac{A}{t} = U \cdot I \left[1W \left(Vat \right) \right]$$

Snaga u električkim kolima

- U istosmjernim kolima postoji samo aktivna snaga P koju izvori troše na otpornicima.
- Primjenom Omovog zakona mogu se dobiti ekvivalentni izrazi za električnu snagu:

$$P = U \cdot I,\ U = I \cdot R \quad \Rightarrow \quad P = I^2 \cdot R$$

$$P = U \cdot I,\ I = \frac{U}{R} \quad \Rightarrow \quad P = \frac{U^2}{R}$$

Snaga u električkim kolima

Primjer:

EXAMPLE 4–6 Compute the power supplied to the electric heater of Figure 4–16 using all three electrical power formulas.

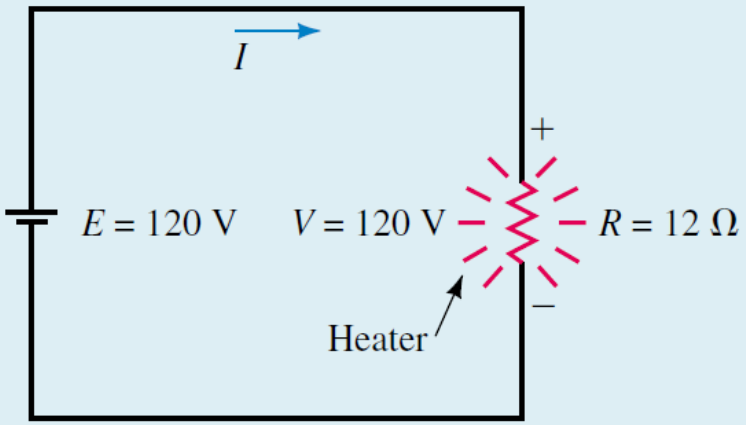


FIGURE 4–16 Power to the load (i.e., the heater) can be computed from any of the power formulas.

Solution $I = V/R = 120\ \text{V}/12\ \Omega = 10\ \text{A}$. Thus, the power may be calculated as follows:

a. $P = VI = (120\ \text{V})(10\ \text{A}) = 1200\ \text{W}$

b. $P = I^2R = (10\ \text{A})^2(12\ \Omega) = 1200\ \text{W}$

c. $P = V^2/R = (120\ \text{V})^2/12\ \Omega = 1200\ \text{W}$

Note that all give the same answer, as they must.

Snaga u električkim kolima

Primjer:

EXAMPLE 4–7 Compute the power to each resistor in Figure 4–17 using Equation 4–13.

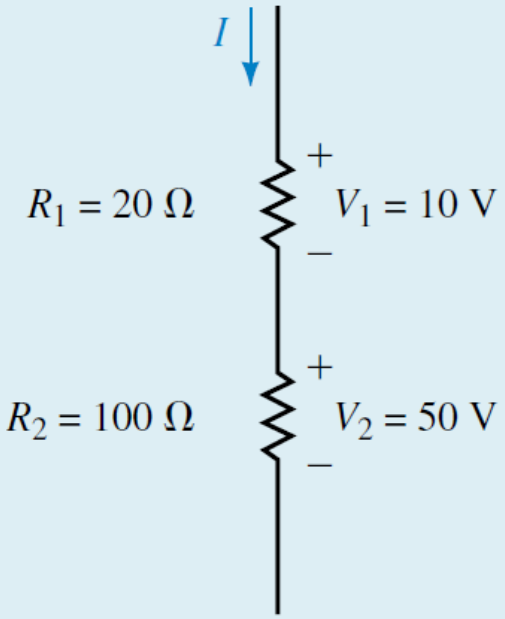


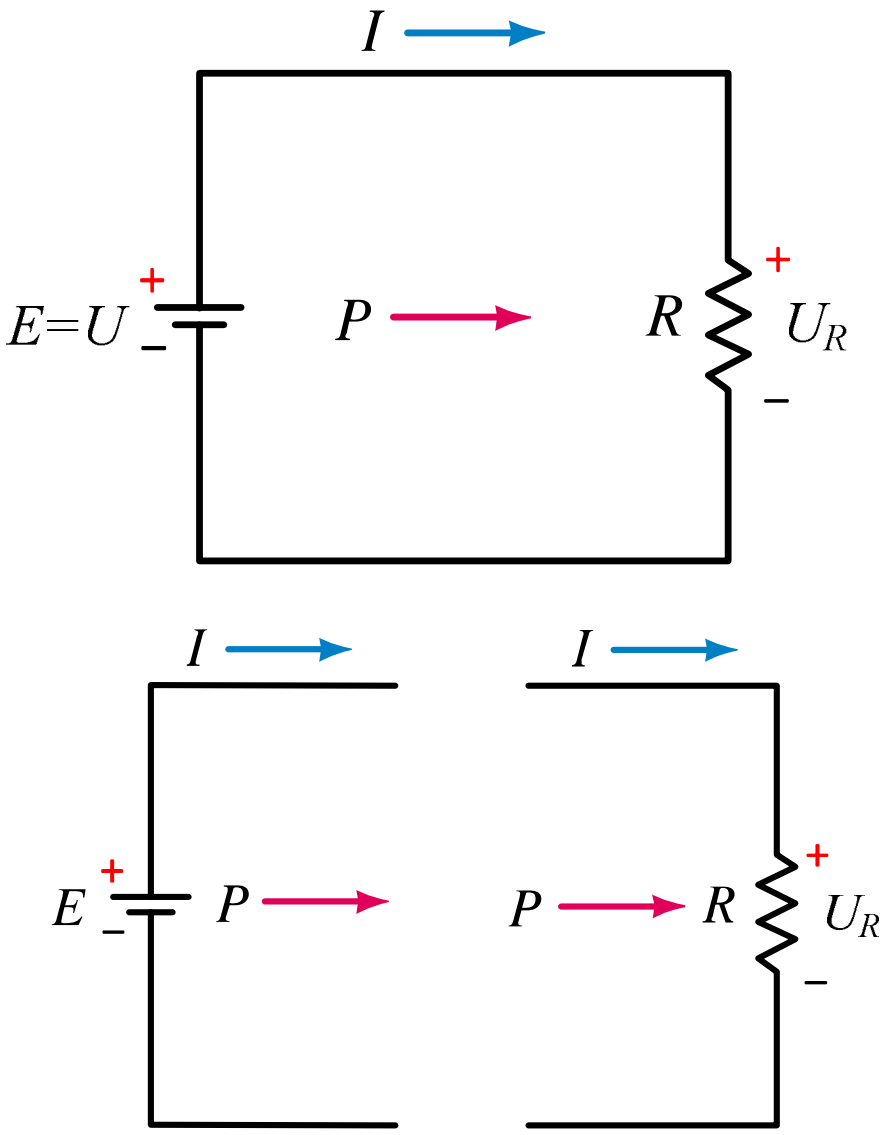
FIGURE 4–17

Solution You must use the appropriate voltage in the power equation. For resistor R_1, use V_1; for resistor R_2, use V_2.

a. $P_1 = V_1^2/R_1 = (10\text{ V})^2/20\ \Omega = 5\text{ W}$

b. $P_2 = V_2^2/R_2 = (50\text{ V})^2/100\ \Omega = 25\text{ W}$

Označavanje smijera toka snage u kolu



- Za smijer toka snage kažemo da je pozitivan ako se snaga izvora predaje potrošaču
- Za snagu izvora kažemo da je pozitivna ako su vrijednosti i napona E i strije I izvora pozitivne za usvojene smjerove kao na slici
- Za snagu potrošača kažemo da je pozitivna ako su vrijednosti i napona U_R i strije I potrošača pozitivne za usvojene smjerove kao na slici

Pojam električne energije

- Anžagovana snaga u nekom vremenskom intervalu naziva se energija

$$W = P \cdot t \quad \left[1W \cdot 1s = 1J\left(D\check{z}ul\right)\right]$$

- Ako se vremenski intervali mjere u satima

$$W = P \cdot t \quad \left[1W \cdot 1h = 1Wh\right]$$

- Najčešće korišćena jedinica je

$$W = P \cdot t \quad \left[1kW \cdot 1h = 1kWh\right]$$

Električna energija

Primjer:

EXAMPLE 4–10 Determine the total energy used by a 100-W lamp for 12 hours and a 1.5-kW heater for 45 minutes.

Solution Convert all quantities to the same set of units, e.g., convert 1.5 kW to 1500 W and 45 minutes to 0.75 h. Then,

$$W = (100\ \text{W})(12\ \text{h}) + (1500\ \text{W})(0.75\ \text{h}) = 2325\ \text{Wh} = 2.325\ \text{kWh}$$

Alternatively, convert all power to kilowatts first. Thus,

$$W = (0.1\ \text{kW})(12\ \text{h}) + (1.5\ \text{kW})(0.75\ \text{h}) = 2.325\ \text{kWh}$$

Električna energija

Primjer:

EXAMPLE 4–11 Suppose you use the following electrical appliances: a 1.5-kW heater for 7½ hours; a 3.6-kW broiler for 17 minutes; three 100-W lamps for 4 hours; a 900-W toaster for 6 minutes. At \$0.09 per kilowatthour, how much will this cost you?

Solution Convert time in minutes to hours. Thus,

$$W = (1500)(7\tfrac{1}{2}) + (3600)\left(\frac{17}{60}\right) + (3)(100)(4) + (900)\left(\frac{6}{60}\right)$$

$$= 13\,560 \text{ Wh} = 13.56 \text{ kWh}$$

$$\text{cost} = (13.56 \text{ kWh})(\$0.09/\text{kWh}) = \$1.22$$

Uređaji za mjerenje potrošnje električne energije

- Električno brojilo je uređaj kojim se mjeri i registruje električna energija isporučena potrošaču.
- Za domaćinstva se mjeri i obračunava samo aktivna energija P, a mjerna jedinica je kilovatsat (kWh)
- U zavisnosti o vrsti električnog priključka domaćinstva brojila mogu biti jednofazna ili trofazna. Dvotarifna i višetarifna brojila mogu odvojeno registrovati potrošnju u razdobljima utvrđenih tarifnim sistemom