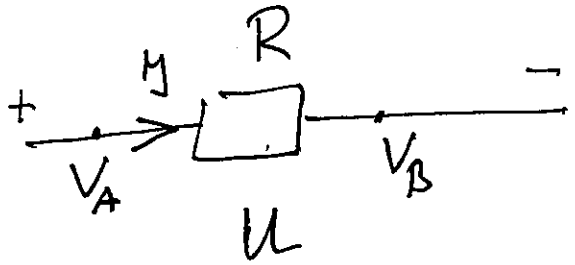
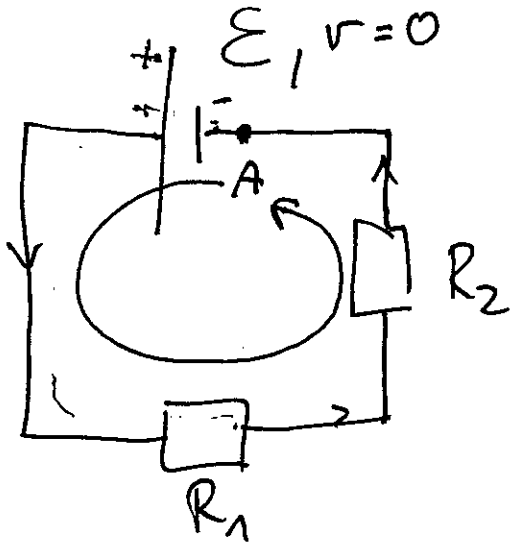
II prawo Kirchoffa.

$U = JR$

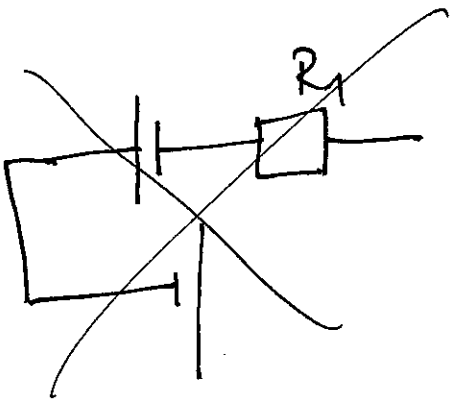


$V_A > V_B$

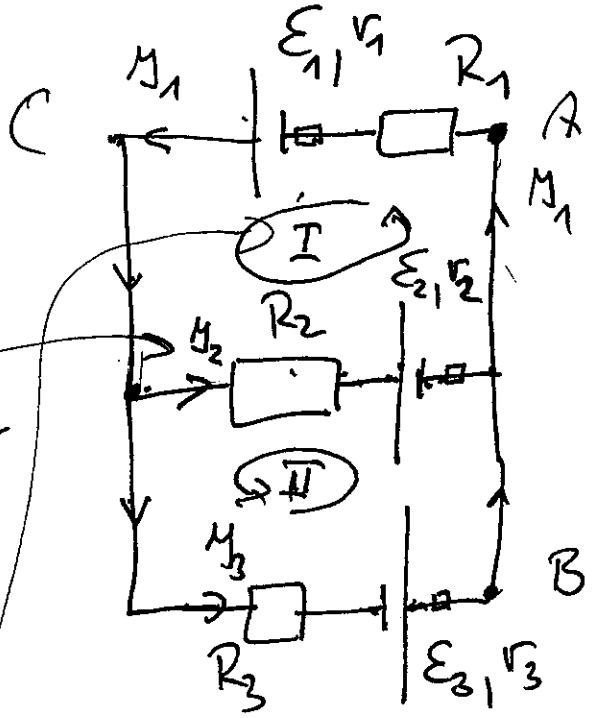


$\mathcal{E} - JR_1 - JR_2 = 0$

$J = \frac{\mathcal{E}}{R_1 + R_2}$



Szukane I_1, I_2, I_3.



zakreślony zwrot „w prawo"

dla I. 2 A do A

dla II 2 B do B

1) $I_1 = I_2 + I_3$ — I prawo Kirchoffa.

2) $-R_1 I_1 - r_1 I_1 + \mathcal{E}_1 - I_2 R_2 - \mathcal{E}_2 - I_2 r_2 = 0$

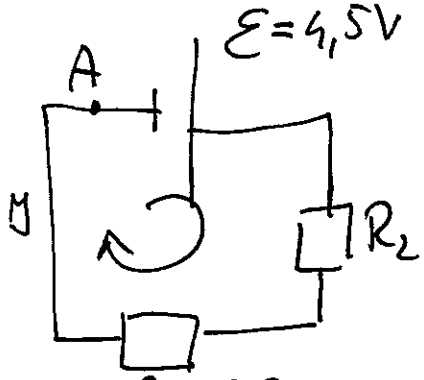
3) $I_2 r_2 + \mathcal{E}_2 + I_2 R_2 - I_3 R_3 + \mathcal{E}_3 - I_3 r_3 = 0$

„+" bo idziemy pod prąd.

$U_{AC} = -I_1 R_1 - I_1 r_1 + \mathcal{E}_1$ gdy $U_{AC} < 0$ to $V_C < V_A$

i odwrotnie.

9.12.



$U_2=1,5V$

$U_1 = R_1 \cdot I \Rightarrow$ ~~$I = 5\,3 = 1,5A$~~

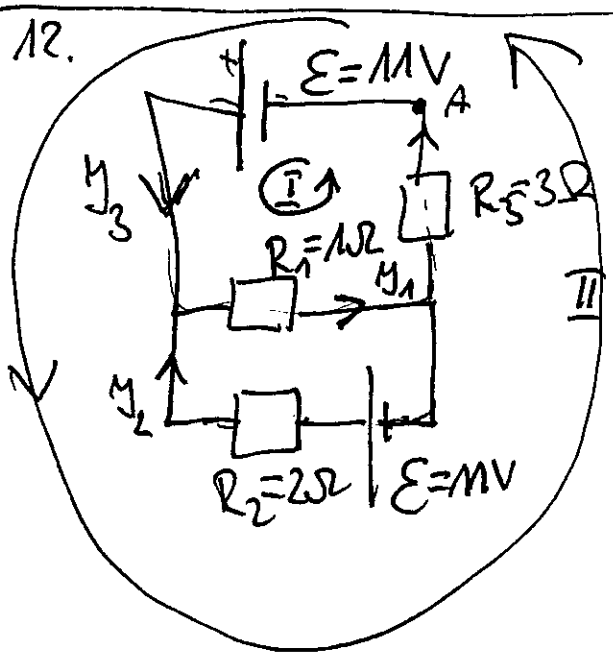
$I = \frac{U_1}{R_1} = \frac{3}{5} = 0,6A = I_1 = I_2$

$U_2 = R_2 \cdot I \Rightarrow R_2 = \frac{U_2}{I} = \frac{1,5}{0,6} = 2,5\Omega$

$P_1 = U_1 \cdot I_1 = 3 \cdot 0,6 = 1,8\,W$

$P_2 = U_2 \cdot I_2 = 1,5 \cdot 0,6 = 0,9\,W$

9.12.



1) $I_3 + I_2 = I_1$ I prawo Kirchoffa

2) 2 A do A przez I

$\mathcal{E} - I_1 R_1 - I_3 R_3 = 0$

3) 2 A do A przez II

$\mathcal{E} + I_2 R_2 - \mathcal{E} - I_3 R_3 = 0$

1) $I_3 + I_2 = I_1$

2) $11 - I_1 - 3I_3 = 0 \Rightarrow I_3 = \frac{11}{3} - \frac{1}{3} I_1$

3) $11 + 2I_2 - 3I_3 = 0$

1') $\frac{11}{3} - \frac{1}{3} I_1 + I_2 = I_1 \Rightarrow I_2 = \frac{4}{3} I_1 - \frac{11}{3}$.

3') $11 + 2I_2 - 3\left(\frac{11}{3} - \frac{4}{3} I_1\right) = 0$

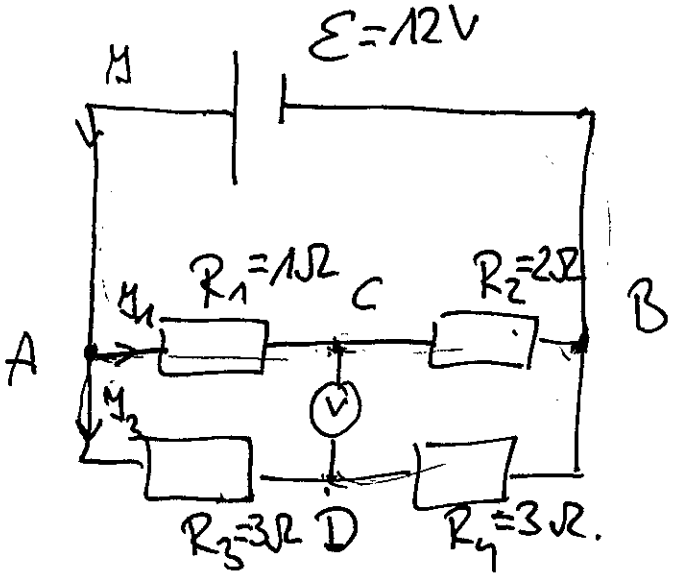
$2\left(\frac{4}{3} I_1 - \frac{11}{3}\right) - 11 + I_1 = 0$

$\frac{8}{3} I_1 - \frac{22}{3} - 11 + I_1 = 0$

$\frac{11}{3} I_1 - \frac{55}{3} = 0$

$I_1 = \frac{55}{11} \cdot \frac{3}{11} = 5A$

9.18.



$-I_1 R_1 - I_1 R_2 + \mathcal{E} = 0 \Rightarrow -1 \cdot I_1 - 2 I_1 + 12 = 0$

$I_1 = \frac{12}{3} = 4A$

$-I_3 R_3 - I_3 R_4 + \mathcal{E} = 0 \Rightarrow -3 I_3 - 3 I_3 + 12 = 0$

$I_3 = 2A$

$U_{AC} = -I_1 R_1 = -1 \cdot 4 = -4V$ – czyli w C potencjał jest niższy o 4V od A.

$U_{AD} = -I_3 R_3 = -2 \cdot 3 = -6V$ – w D potencjał jest niższy o 6V od A.

$U_{CD} = 2V$ ⇐ i w D potencjał niższy

CD. 9.18.

$U_{CD} = 0$ gdy.

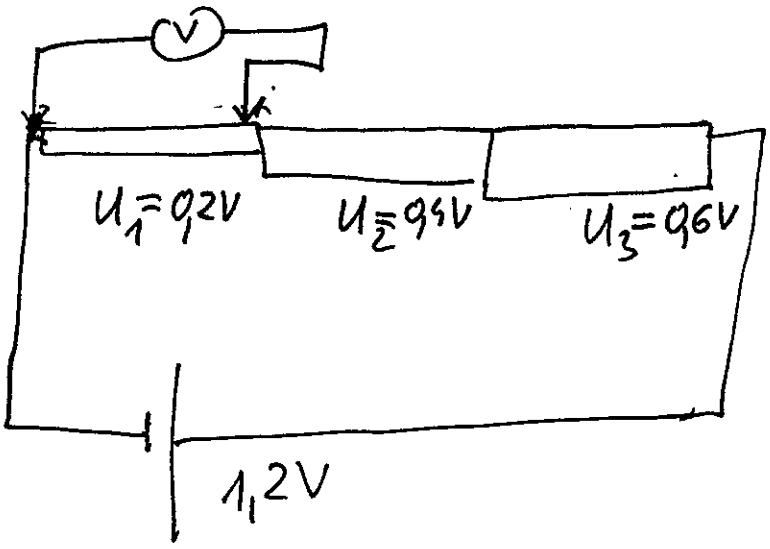
$U_1 = I_1 R_1 = U_3 = I_3 R_3 \Rightarrow I_1 R_1 = I_3 R_3$ → dzielimy stronami

i jednocześnie.

$U_2 = U_4 \Rightarrow I_1 R_2 = I_3 R_4$

$$\frac{I_1 R_1}{I_1 R_2} = \frac{I_3 R_3}{I_3 R_4} \Rightarrow R_4 = \frac{R_3 \cdot R_2}{R_1}$$

9.6.



$$I = \frac{U_1}{R_1} = \frac{U_2}{R_2} = \frac{U_3}{R_3} \quad \Rightarrow \quad R_1 = \frac{U_1}{I} \quad R_2 = \frac{U_2}{I} \quad R_3 = \frac{U_3}{I}$$

$$R_1 : R_2 : R_3 = U_1 : U_2 : U_3$$

$$R = \rho \frac{l}{S} \quad \Rightarrow \quad S = \frac{\rho l}{R}$$

$$S_1 = \frac{\rho l}{R_1} \qquad S_2 = \frac{\rho l}{R_2} \qquad S_3 = \frac{\rho l}{R_3}$$

$$\frac{S_1}{S_2} = \frac{R_2}{R_1} = \frac{U_2}{U_1} \qquad \frac{S_2}{S_3} = \frac{R_3}{R_2} = \frac{U_3}{U_2}$$

9.15.

$$Q = m \cdot c \cdot \Delta T$$

$$Q = P \cdot t$$

$$P = \frac{mc\Delta T}{t} = \frac{4\,kg \cdot 4200 \cdot 90}{10 \cdot 60} = 630\,W$$

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

$$Q = P \cdot t \Rightarrow t = \frac{Q}{P} = \frac{Q}{\frac{U^2}{R}} = \frac{Q \cdot R}{U^2}$$

w USA $U = 110\,V$ czyli $\frac{230}{110}$ razy mniejsze.

czyli czas będzie $\left(\frac{23}{11}\right)^2$ razy dłuższy.

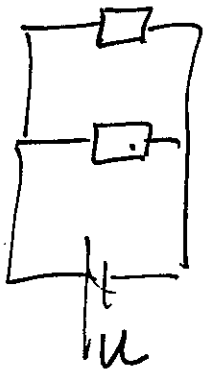
$$t_{USA} = 10\,min \cdot \left(\frac{23}{11}\right)^2 = \ldots$$

9.16.

$$t = \frac{Q}{P} \Rightarrow \boxed{P_5 = 2 \cdot P_{10}}$$

$$\frac{Q}{P_5} = t_5$$

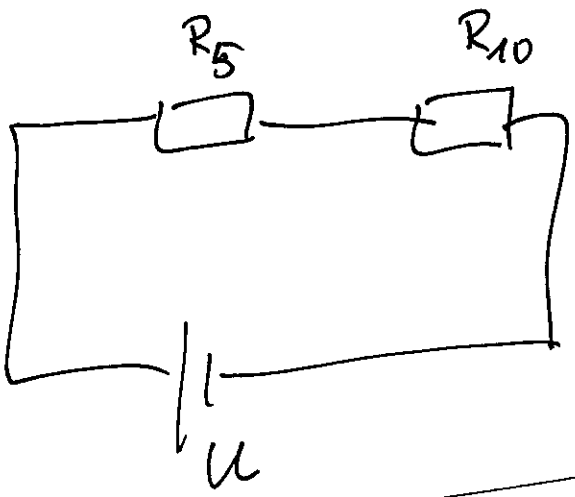
$$\frac{Q}{P_{10}} = t_{10}$$



$$P_{równoległego} = P_5 + P_{10}$$

$$t_{równoległego} = \frac{Q}{P_5 + P_{10}} \overset{\cdot\frac{1}{Q}}{=} \frac{1}{\frac{P_5}{Q} + \frac{P_{10}}{Q}} = \frac{1}{\frac{1}{t_5} + \frac{1}{t_{10}}} = \frac{t_5 \cdot t_{10}}{t_5 + t_{10}}$$

$$\frac{1}{t_{równoległego}} = \frac{1}{t_5} + \frac{1}{t_{10}}$$



$$P_{szeregowego} = U \cdot I = U \cdot \frac{U}{R_5 + R_{10}} =$$

$$P_5 = \frac{U^2}{R_5} \qquad P_{10} = \frac{U^2}{R_{10}}$$

$$R_5 = \frac{U^2}{P_5} \qquad R_{10} = \frac{U^2}{P_{10}}$$

$$= \frac{U^2}{\frac{U^2}{P_5} + \frac{U^2}{P_{10}}} = \frac{U^2}{U^2\left(\frac{1}{P_5} + \frac{1}{P_{10}}\right)} = \frac{1}{\frac{1}{P_5} + \frac{1}{P_{10}}}$$

$$t_{szeregowego} = \frac{Q}{\frac{1}{P_5} + \frac{1}{P_{10}}} = \frac{Q}{\frac{1}{\frac{1}{P_5} + \frac{1}{P_{10}}}} = Q \cdot \left(\frac{1}{P_5} + \frac{1}{P_{10}}\right) =$$

$$= \frac{Q}{P_5} + \frac{Q}{P_{10}} = t_5 + t_{10} = 15\,\text{min}.$$

9.17.

$$P_{mikrofal} \cdot t_{1h} = Q = m \cdot C \cdot \Delta T$$

$$\Delta T = \frac{P_{mikrofal} \cdot t_{1h}}{m \cdot C}$$

$$P_{mikrofal} = U \cdot I_{w\ rzeczywisty} = \frac{U \cdot Q}{t_{rzeczywisty}}$$

pojemność $Q = I_{w\ rzeczywisty} \cdot t_{rzeczywisty}$

$$P_{mikrofal} = \frac{3{,}7\,V \cdot 0{,}720\,mA \cdot 1\,h}{300\,mAh \cdot 5\,h} = \frac{3{,}7 \cdot 0{,}72}{5} = 0{,}532$$

$$\Delta T = \frac{0{,}532 \cdot 3600}{1{,}4 \cdot 4200} = 0{,}32\ K$$

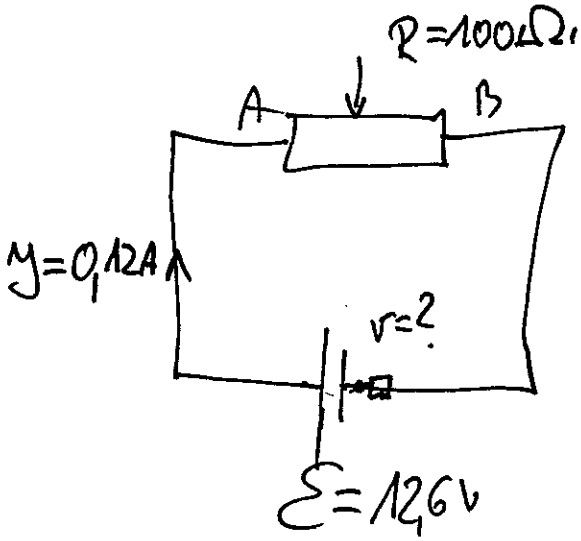
3.1. $U = 12V \qquad I = 0{,}12A$

$$R = \frac{U}{I} = \frac{12}{0{,}12} = 100\Omega$$

$$R = \rho \frac{l}{S} \Rightarrow l = \frac{R \cdot S}{\rho} = \frac{100 \cdot 0{,}5 \cdot 10^{-6}}{10^{-6}} = 50m$$

$S = 0{,}5\,mm^2 = 0{,}5\,(10^{-3}m)^2 = 0{,}5 \cdot 10^{-6}m^2$

3.2.



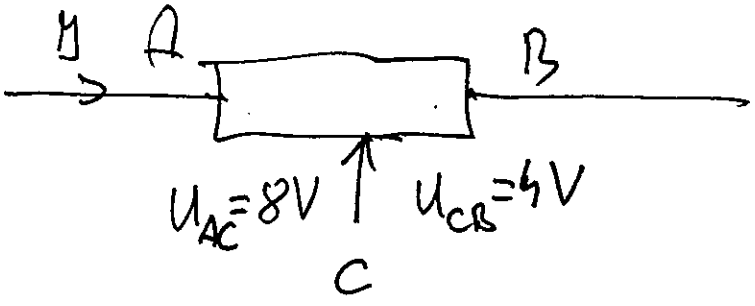
$\varepsilon - IR - Ir = 0 \qquad \left(I = \frac{\varepsilon}{R+r}\right.$

$$\frac{\varepsilon - IR}{I} = r$$

$$r = \frac{\varepsilon}{I} - R = \frac{12{,}6}{0{,}12} - 100$$

$r = 105 - 100 = 5\Omega$

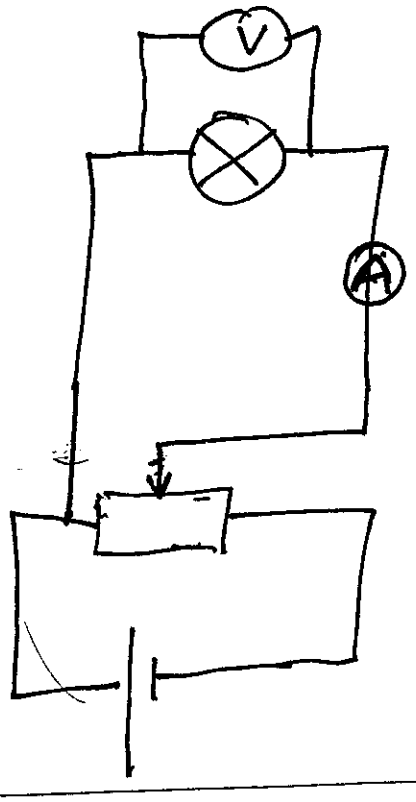
3.3. $U_{AB} = 12V$



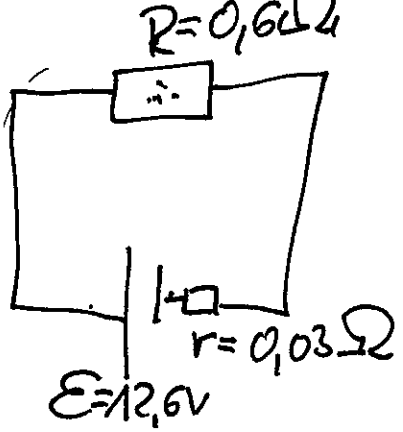
$$I = \frac{U_{AC}}{R_{AC}} = \frac{U_{CB}}{R_{CB}} \Rightarrow \frac{U_{AC}}{\frac{\rho \cdot l_{AC}}{S}} = \frac{U_{CB}}{\frac{\rho \cdot l_{CB}}{S}}$$

$$\frac{l_{AC}}{l_{CB}} = \frac{U_{AC}}{U_{CB}} = \frac{8}{4} = \frac{2}{1}$$

3.4.



23.1 $P = U \cdot I = U \cdot \frac{U}{R}$



$I = \frac{\varepsilon}{R+r} = \frac{12,6}{0,6+0,03} = 20A$

$U = I \cdot R = 20 \cdot 0,6 = \underline{12V}$

$P = U \cdot I = 20 \cdot 12 = \underline{240W}$

23.2. ▭

$R = \rho \frac{l}{S} \Rightarrow \rho = \frac{R S}{l} = \frac{0,6 \cdot 4 \cdot 0,1 \cdot 10^{-6}}{0,628} = 3,8 \cdot 10^{-7} \Omega$

23.3.

$$P = \frac{Q}{t} \Rightarrow t = \frac{Q}{P}$$

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

$$t = \frac{Q \cdot R}{U^2}$$

$$t' = \frac{QR}{(0{,}8 \cdot U)^2} = \frac{QR}{0{,}64 \cdot U^2} = \frac{1}{0{,}64} \cdot t$$

$$\frac{1}{0{,}64} = 1{,}56$$

Odp: t wzrośnie 1,56 razy.