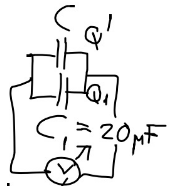
Fizika i 7. gyakorlat

F1

$C = ?$ ha

$U = 150\,V$



$U' = 50\,V$

$C = \frac{Q}{U} \rightarrow Q = CU$

$Q = Q' + Q_1$

$Q' = C \cdot U'\,,\; Q_1 = C_1 U'$

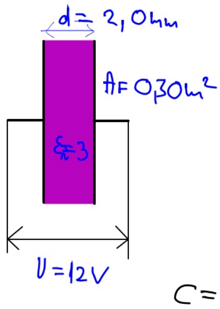
$Q = U'(C + C_1)$

$[C] = \frac{[Q]}{[U]} = \frac{C}{V} = F$

$CU = (C + C_1)U'$

$C = \frac{C_1 U'}{U - U'} = \frac{2\cancel{0}\,\mu F \cdot 5\cancel{0}\,V}{1\cancel{0}0\,V} = 10\,\mu F$

F2



a) $Q = ?$

b) $\sigma_{pol} = ?$

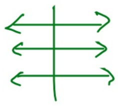
c) $U = ?$, ha kihúzzuk a szigetelőt

d) $W_{kihúzás} = ?$

$C = \varepsilon_0 \varepsilon_r \frac{A}{d} = 8{,}85 \cdot 10^{-12} \frac{F}{m} \cdot 3 \cdot \frac{0{,}30\,m^2}{2{,}0 \cdot 10^{-3}\,m} = 3{,}98 \cdot 10^{-9}\,F \approx 4\,nF$

a) $Q = CU = 4\,nF \cdot 12\,V = 48\,nC$

b) egy lemezre Gauss t.



$2E \cdot A = \frac{\sigma A}{\varepsilon_0}$ $\qquad E_0 = \frac{\sigma}{2\varepsilon_0}$

kondenzátorra vonatkozó $E_0 = \frac{\sigma}{\varepsilon_0}$

dielektrikumban $E_{ind} = -\frac{\sigma_{ind}}{\varepsilon_r \varepsilon_0}$

$E = E_0 + E_{ind} = \frac{1}{\varepsilon_0}\left(\sigma - \frac{\sigma_{ind}}{\varepsilon_r}\right)$

de $E = \frac{E_0}{\varepsilon_r} \Rightarrow \frac{E_0}{\varepsilon_r} = \frac{1}{\varepsilon_0}\left(\sigma - \frac{\sigma_{ind}}{\varepsilon_r}\right) \Rightarrow \frac{\sigma}{\cancel{\varepsilon_0}\varepsilon_r} = \frac{1}{\cancel{\varepsilon_0}}\left(\sigma - \frac{\sigma_{ind}}{\varepsilon_r}\right)$

$\sigma_{ind} = \varepsilon_r \cdot \sigma\left(1 - \frac{1}{\varepsilon_r}\right) = \sigma(\varepsilon_r - 1)$

$\sigma_{ind} = \sigma(\varepsilon_r - 1) = \varepsilon_0 \frac{U}{d}(\varepsilon_r - 1) = 8{,}85 \cdot 10^{-12} \frac{F}{m} \cdot \frac{12V}{2 \cdot 10^{-3}\,m} \cdot 2 = 1{,}06 \cdot 10^{-7} \frac{C}{m^2}$

$\sigma = \varepsilon_0 E = \varepsilon_0 \frac{U}{d}$

$\frac{F}{m} \cdot \frac{V}{m} = \frac{C\cancel{V}}{\cancel{V}m^2} = \frac{C}{m^2}$

c) ha nincs szigetelő $\Rightarrow C' = \varepsilon_0 \frac{A}{d} = \frac{C}{\varepsilon_r}$

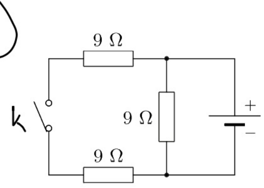
$U' = \frac{Q}{C'} = \varepsilon_r \frac{Q}{C} = 3 \cdot 12V = 36\,V$

d) $W = E_{végén} - E_{kezdeti} = \frac{1}{2}C'U'^2 - \frac{1}{2}CU^2$

$= \frac{1}{2}C\left(\frac{U'^2}{\varepsilon_r} - U^2\right) = \frac{1}{2}\cdot 3{,}98\cdot 10^{-9}\,F\cdot\left(\frac{36^2}{3} - 12^2\right)V^2 = 5{,}74\cdot 10^{-7}\,J$

$F\cdot V^2 = \frac{C}{V}\cdot V^2 = CV = J$

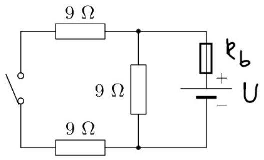
F3



Ha k nyitott 400 mA a telep ágában.
zárt 500 mA

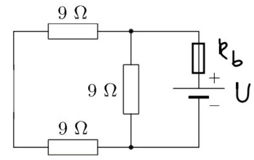
$R_b = ?$

nyitott =>



$I_1 = \frac{U}{R_b + 9\Omega} \Rightarrow U = I_1(R_b + 9\Omega)$

zárt =>



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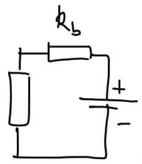
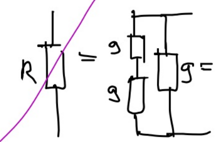




$= \frac{1}{\frac{1}{9+9} + \frac{1}{9}} = \frac{18}{3} = 6\Omega$

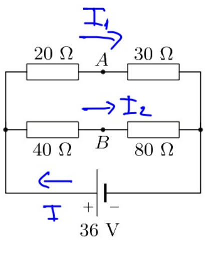
(ohm)

$I_2 = \frac{U}{R+R_b} = \frac{R_b + 9\Omega}{R + R_b}\cdot I_1$

$RI_2 + R_bI_2 = R_bI_1 + 9\Omega\cdot I_1$

$R_b = \frac{9\Omega\cdot I_1 - R\cdot I_2}{I_2 - I_1} = \frac{9\cdot 4\cancel{00} - 6\cdot 5\cancel{00}}{1\cancel{00}}\,\frac{\cancel{m}A\Omega}{m\cancel{A}} = 6\Omega$

F4.



a) $U_{AB} = ?$

b) $R = ?$ a 30Ω helyett, hogy $U_{AB} = 0$ legyen

a) $U_{AB} = I_1\cdot 20\Omega - I_2\cdot 40\Omega$ és

$I_1\cdot(20+30) = I_2(40+80) \Rightarrow 5\cancel{0}I_1 = 12\cancel{0}I_2$

$I = \frac{U}{R_e} = \frac{36}{\frac{1}{\frac{1}{20+30} + \frac{1}{40+80}}} = 36\cdot\frac{5\cancel{0}+12\cancel{0}}{5\cancel{0}\cdot 120} = 36\cdot\frac{17}{600} = 1{,}02\,A$

$I_1 + I_2 = I$

$5I_1 = 12I_2$

$\Rightarrow I_1 + \frac{5}{12}I_1 = I$

$I_1 = \frac{12}{17}I = \frac{36\cdot 12}{600} = 0{,}72\,A$

$I_2 = I - I_1 = 0{,}3\,A$

$$U_{AB} = 20\Omega \cdot 0{,}72A - 40\Omega \cdot 0{,}3A = 2{,}4V$$

b) ha 30Ω helyett R-et írunk

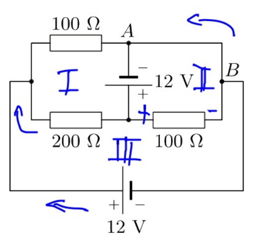
$U_{AB} = 0 \Rightarrow I_1 \cdot R = I_2 \cdot 80\Omega$

és $(20\Omega + R)I_1 = 120\Omega I_2$

$$\left.\begin{array}{l} I_1 \cdot R = I_2 \cdot 80\Omega \\ (20\Omega + R)I_1 = 120\Omega I_2 \end{array}\right\} \frac{20+R}{R} = \frac{12\cancel{0}}{8\cancel{0}}$$

$$20 + R = 1{,}5R$$
$$20 = 0{,}5R$$
$$R = 40\Omega$$

F5



a) $I_{200\Omega} = ?$

b) $I_{AB} = ?$

c) $P = ?$

a) I. hurok: $U_{100\Omega} = 12V$

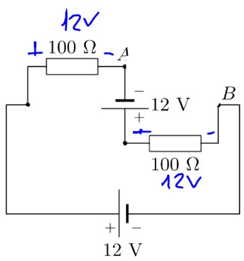
III.: $U_{200} + U_{100} = 12V$

$\} \; U_{200} = 0\,\Omega$

$\Downarrow$

$\boxed{I_{200\Omega} = 0A}$

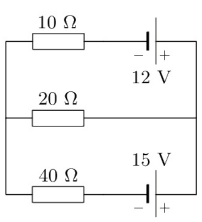
b) $U_{AB} = 0V \checkmark \Rightarrow \boxed{I_{AB} = 0}$



c) $I_{100\Omega} = \frac{12V}{100\Omega} = 0{,}12A \Rightarrow P_{100\Omega} = I^2 \cdot R = 1{,}44W$

$P = 2 \times P_{100\Omega} = 2{,}88W$

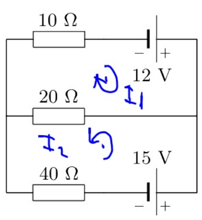
F6



a, Kirchhoff tv-el

b, szuperpozíció elve

a)



a)

$-12 + I_1 \cdot 10 + 20(I_1 + I_2) = 0 \Rightarrow 30I_1 + 20I_2 = 12$

$20 \cdot (I_1 + I_2) + 40 \cdot I_2 - 15V = 0 \Rightarrow 20I_1 + 60I_2 = 15$

$I_1 = \frac{12}{30} - \frac{2}{3}I_2$

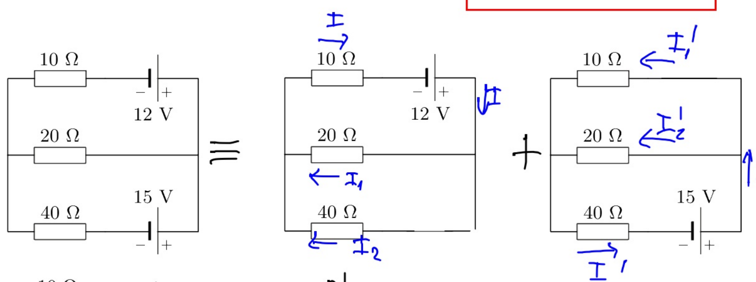
$$20\cdot\frac{12}{30} - \frac{40}{3}I_2 + 60I_2 = 15$$

$$\frac{140}{3}I_2 = 7 \qquad I_2 = \frac{21}{140} = 0{,}15\ \text{A}$$

$$I_1 = \frac{2}{5} - \frac{2}{3}I_2 = 0{,}4 - 0{,}1 = 0{,}3\ \text{A}$$

10 Ω-on	0,3 A
20 Ω	0,45 A
40 Ω	0,15 A

b)



$I = I_1 + I_2$

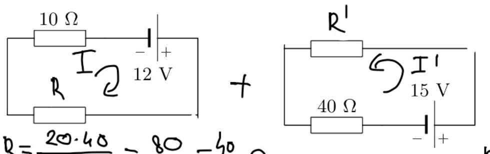
$I' = I_1' + I_2'$

$I_{10\Omega} = I_1' - I$

$I_{40\Omega} = I' - I_2$

$I_{20\Omega} = I_1 + I_2'$

≡



$$R = \frac{20\cdot 40}{20+40} = \frac{80}{6} = \frac{40}{3}\,\Omega \qquad R' = \frac{20\cdot 10}{20+10} = \frac{20}{3} = 6\tfrac{1}{3}\,\Omega$$

$$\Uparrow \qquad\qquad \Downarrow$$

$$I = \frac{12\,\text{V}}{(10 + 40/3)\,\Omega} \qquad I' = \frac{15\,\text{V}}{(40 + 6\frac{1}{3})\,\Omega}$$

$$I = \frac{12}{70/3} = \frac{36}{70} = \frac{18}{35}\ \text{A} \qquad I' = \frac{15}{140/3} = \frac{45}{140} = \frac{9}{28}\ \text{A}$$

$$\left.\begin{aligned} I &= I_1 + I_2 \\ \cancel{20}^{1} I_1 &= \cancel{40}^{2} I_2 \end{aligned}\right\} \quad I_2 = \frac{I}{3} = \frac{6}{35}\ \text{A}, \quad I_1 = \frac{12}{35}\ \text{A}$$

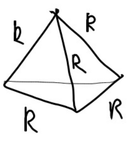
$$\left.\begin{aligned} I' &= I_1' + I_2' \\ I_1'\cdot 1\cancel{0} &= I_2'\cdot 2\cancel{0} \end{aligned}\right\} \quad I_2' = \frac{I'}{3} = \frac{3}{28}\ \text{A}, \quad I_1' = \frac{6}{28}\ \text{A} = \frac{3}{14}\ \text{A}$$

$$\boxed{I_{10\Omega} = \frac{3}{14} - \frac{18}{35} = -0{,}3\ \text{A}} \quad \boxed{I_{20\Omega} = \frac{12}{35} + \frac{3}{28} = 0{,}45\ \text{A}} \quad \boxed{I_{40\Omega} = \frac{9}{28} - \frac{6}{35} = 0{,}15\ \text{A}}$$

F7 1 kΩ-os huzalokból a) tetraéder $R_e = ?$ ∀ 2 csúcspont között

b) kocka $R_e = ?$ testátló két végén

a) felülről nézve: kapcsoljunk U fesz. A és B közé ⇒ $U_{CD} = 0$



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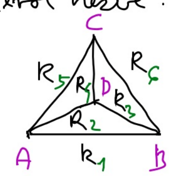
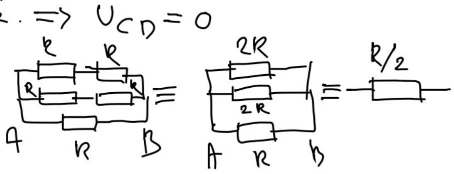
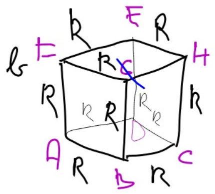


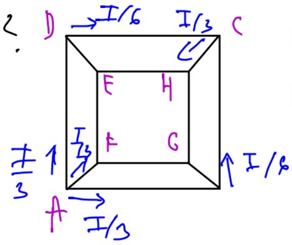
⇒



$$\boxed{R_e = 0{,}5\ \text{k}\Omega}$$



$R_{AH} = ?$



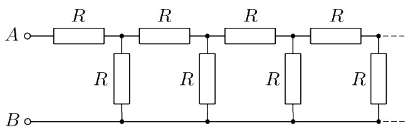
$U_{AH} = R_{AH}\cdot I$

$U_{AH} = R\cdot\frac{I}{3} + R\cdot\frac{I}{6} + R\frac{I}{3} =$

$= \frac{5}{6}RI$

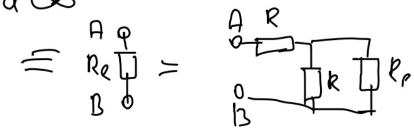
$R_{AH} = \frac{5}{6}I$

F8



Tegyük fel, hogy az eredő ell. R_e!

Mivel ∞



$R_{AB} = R_E$ és $R_{AB} = R + \dfrac{1}{\frac{1}{R} + \frac{1}{R_E}} = R + \dfrac{R_E R}{R_E + R}$

$$R_E = R + \frac{R_E R}{R_E + R}$$

$$R_E^2 + \cancel{R_E R} = \cancel{R R_E} + R^2 + R R_E$$

$$R_E^2 - R\cdot R_E - R^2 = 0$$

$R_{E_{1,2}} = \dfrac{R \pm \sqrt{R^2 + 4R^2}}{2} = R\,\dfrac{1\pm\sqrt{5}}{2}\,R$ és $R_E > 0$

$$R_E = \frac{1+\sqrt{5}}{2}R$$