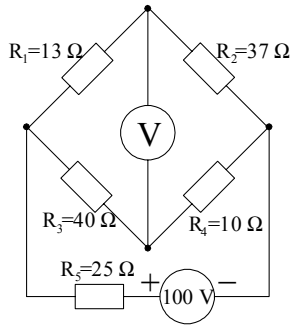
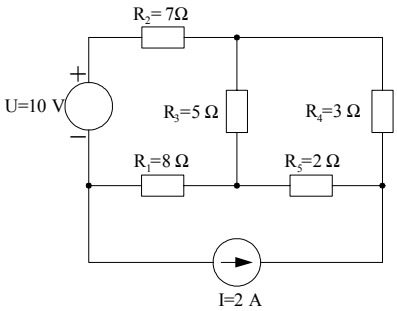
Prvi kolokvij iz OE I (VSP)
11. 12. 2001

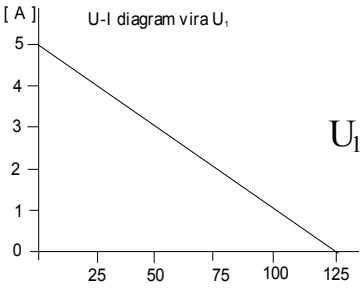
1. Koliko kaže idealni V-meter? V shemo (na vašem listu) vrišite tudi pravilno polariteto priključnih sponk za pozitiven prikaz napetosti na V-metru!

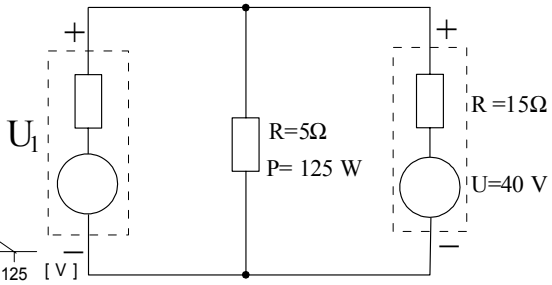


2. Koliko moči oddaja tokovni vir v vezje?

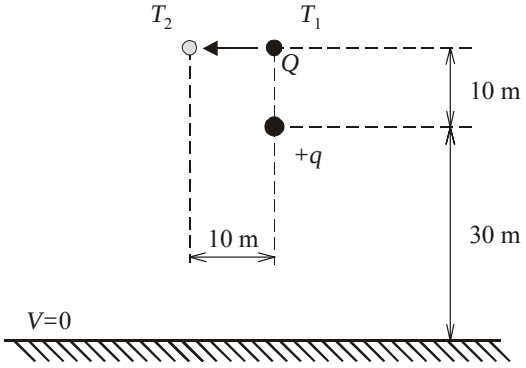


3. Določite delovno točko na U-I diagramu vira U_1 (na vašem listu), če se na uporu R=5Ω troši moč 125 W!

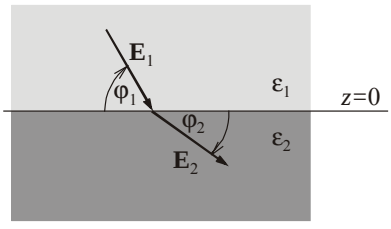




4. 30 m nad zemljo je prema elektrina $q = 10^{-4}$ C/m. Določite delo A, ki ga opravimo pri premiku točkastega naboja $Q = -10^{-6}$ C iz točke T_1 v točko T_2!



5. Ravnina $z = 0$ je meja med dvema dielektrikoma, z relativnima dielektričnostima $\varepsilon_{r1} = 5$ za prostor $z > 0$ in $\varepsilon_{r2} = 12$ za prostor $z < 0$. V prvem prostoru je električna poljska jakost $E_1 = 10^5$ V/m in je usmerjena pod kotom $\varphi_1 = 60°$ glede na ravnino $z = 0$. Določite velikost električne poljske jakosti v drugem prostoru in kot φ_2, ki ga oklepa z ravnino $z = 0$.



Rešitve so objavljene na: http://torina.fe.uni-lj.si/oe

REŠITVE prvega kolokvija iz OE I (VSP)
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1.

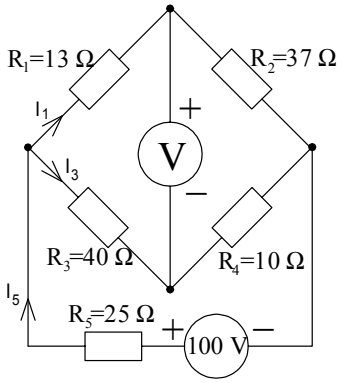
$$R_N = \frac{(R_1+R_2)(R_3+R_4)}{(R_1+R_2)+(R_3+R_4)} + R_5 = 50\Omega$$

$$I_5 = \frac{U}{R_N} = 2\,A,\ U_5 = I_5 R_5 = 50\,\mathrm{V},\ I_1 = \frac{100-U_5}{50} = 1\mathrm{A}$$

$$U_1 = I_1 R_1 = 13\mathrm{V},\quad U_3 = I_3 R_3 = 40\,\mathrm{V}$$

$$U_2 = I_1 R_2 = 37\,\mathrm{V},\ U_4 = I_3 R_4 = 10\,\mathrm{V}$$

$$U_V = 37-10 = 27\mathrm{V}$$



2.

$$J_3 = I = 2\,A$$

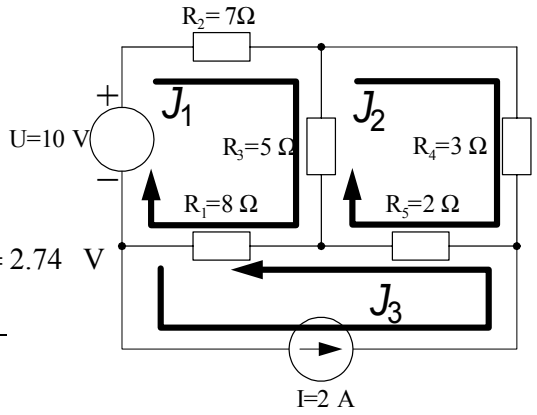
$$J_1(R_1+R_2+R_3) - J_2 R_3 + J_3 R_1 - U = 0$$

$$-J_1 R_3 + J_2(R_3+R_4+R_5) + J_3 R_5 = 0$$

$$J_1 = -0.457\,\mathrm{A},\ J_2 = -0.628\,\mathrm{A}$$

$$U_1 = (J_1+J_3)R_1 = 12.34\ \ \mathrm{V},\quad U_5 = (J_2+J_3)R_5 = 2.74\ \ \mathrm{V}$$

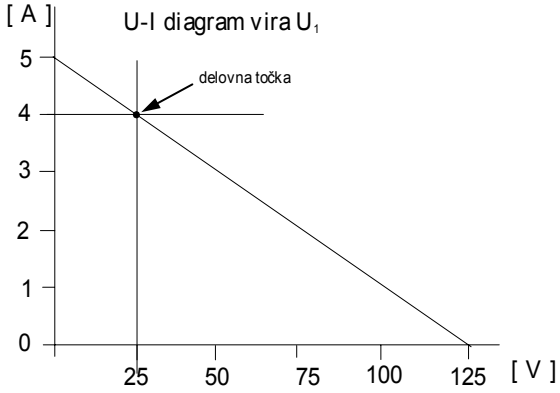
$$U_A = U_1+U_2 = 15.08\ \ \mathrm{V},\quad P_A = U_A I = 30.16\ \ \mathrm{W}$$



3.

$$U_R = \sqrt{P \cdot R} = \sqrt{125 \cdot 5} = 25\ \mathrm{V}$$

Delovna točka je pri 25 V in jo vrišemo na abscisno os U-I diagrama vira U_1. Presečišče na diagramu nam podaja delovno točko vira U_1, Preostali padec napetosti 125-25=100V pa je na notranji upornosti vira U_1. Iz diagrama lahko odčitamo tudi tok iz vira U_1 in sicer 4 A.



4.

Opravljeno delo je enako $A = Q \cdot U_{21} = Q \cdot (V_2 - V_1)$

$q = 10^{-4}\,\mathrm{C/m}$

$Q = -10^{-6}\,\mathrm{C}$

$a = 10\,\mathrm{m}$

$h = 30\,\mathrm{m}$

$$V_1 = \frac{q}{2\pi\varepsilon_0} \ln \frac{a+2h}{a}$$

$$V_2 = \frac{q}{2\pi\varepsilon_0} \ln \frac{\sqrt{a^2 + (a+2h)^2}}{a\sqrt{2}}$$

$$A = Q \cdot U = Q \cdot (V_2 - V_1) = \frac{Q \cdot q}{2\pi\varepsilon_0} \ln \frac{a\sqrt{a^2 + (a+2h)^2}}{(a+2h)a\sqrt{2}}$$

$$\underline{A = 0,605\mathrm{J}}$$

5.

$E_1 = 10^5\,\mathrm{V/m}$ $\qquad$ $E_{1t} = E_1 \cos\varphi_1 = 50\mathrm{kV/m}$

$\varphi_1 = 60^\circ$ $\qquad$ $E_{1n} = E_1 \sin\varphi_1 = 86,6\mathrm{kV/m}$

$\varepsilon_{r1} = 5$ $\qquad$ $E_{2t} = E_2 \cos\varphi_2$

$\varepsilon_{r2} = 12$ $\qquad$ $E_{2n} = E_2 \sin\varphi_2$

$E_{2t} = E_{1t} = 50\mathrm{kV/m}$

$$D_{2n} = D_{1n} \rightarrow E_{2n} = E_{1n} \frac{\varepsilon_{r1}}{\varepsilon_{r2}} = 36,1\mathrm{kV/m}$$

$$\underline{E_2 = \sqrt{E_{2t}^2 + E_{2n}^2} = 61,7\mathrm{kV/m}}$$

$$\underline{\tan\varphi_2 = \frac{E_{2n}}{E_{2t}} \rightarrow \varphi_2 = 35,8^\circ}$$