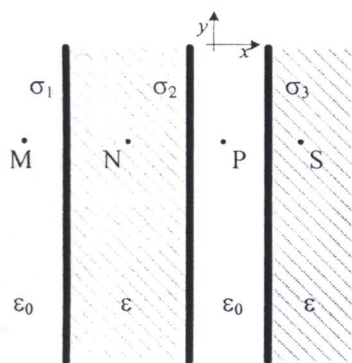


PRVI KOLOKVIJUM IZ ELEKTROTEHNIKE

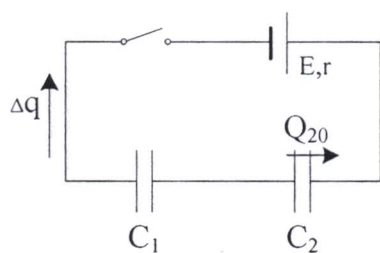
24. novembar 2016.

GRUPA 4

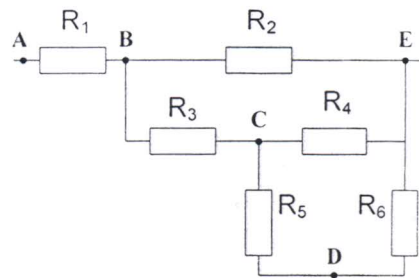
1. Na Slici 1 prikazane su tri paralelne, veoma velike, ravnomerno naelektrisane površi, površinskih gustina naelektrisanja  $\sigma_1 = \sigma = 10 \mu\text{C}/\text{m}^2$ ,  $\sigma_2 = -2\sigma$  i  $\sigma_3 = 3\sigma$ . Desno od treće ravni i između prve i druge ravni nalazi se dielektrik dielektrične konstante  $\epsilon = 10^{-8} \text{ F/m}$ , dok je u ostalom delu prostora vazduh ( $\epsilon_0 = 8.85 \cdot 10^{-12} \text{ F/m}$ ). Odrediti vektor električnog polja u tački S. (4 poena)



Slika 1

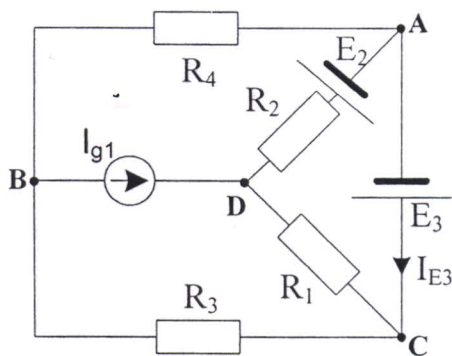


Slika 2

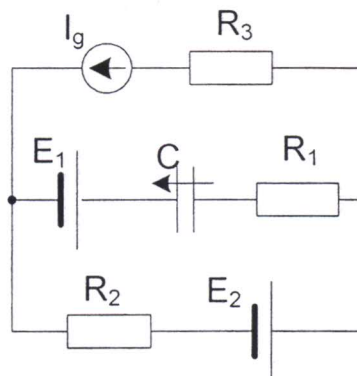


Slika 3

3. Na Slici 3 prikazana je grupa od šest otpornika poznatih otpornosti,  $R_1 = R_2 = R_3 = R_6 = R = 8 \Omega$ ,  $R_4 = R_5 = 2R = 16 \Omega$ . Odrediti ekvivalentnu otpornost između tačaka C-D. (6 poena)



Slika 4



Slika 5

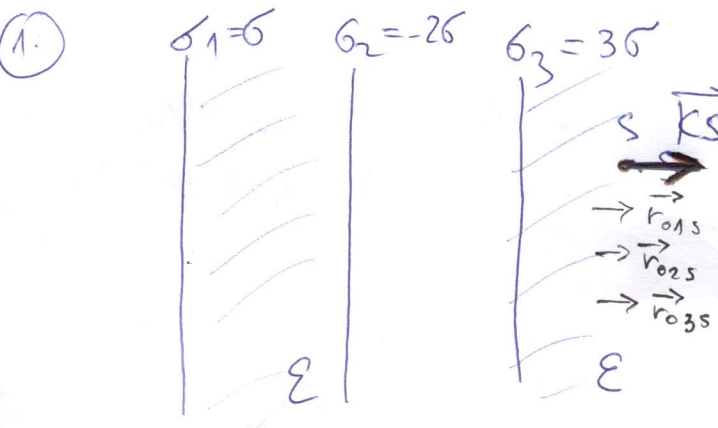
4. U kolu na Slici 4 poznato je:  $R_1 = R_2 = R_3 = R_4 = 5 \Omega$ ,  $E_2 = 60 \text{ V}$ ,  $E_3 = 40 \text{ V}$ ,  $I_{g1} = 2 \text{ A}$ . Primenom:

a) Primenom metode napona između čvorova ili metode konturnih struja odrediti intenzitet struje i snagu otpornika  $R_2$ . (7 poena)

b) Primenom Tevenenove teoreme odrediti intenzitet struje  $I_{E3}$  kroz naponski generator  $E_3$ . (10 poena)

5. U kolu na Slici 5 poznato je:  $R_1 = 10 \Omega$ ,  $R_2 = 5 \Omega$ ,  $R_3 = 20 \Omega$ ,  $E_1 = 3 \text{ V}$ ,  $E_2 = 20 \text{ V}$ ,  $I_g = 2 \text{ A}$ ,  $C = 20 \mu\text{F}$ . Odrediti količinu naelektrisanja kondenzatora u naznačenom smeru i elektrostatičku energiju kondenzatora. (7 poena)

Izrada kolokvijuma traje 90 minuta. Nije dozvoljena upotreba digitrona. Na vežbanci napisati broj grupe zadatka. Papir sa tekstom zadatka predaje se u vežbanci tj. ne sme se izneti.



$\epsilon = 10^{-8} \text{ F/m}$     $\sigma = 10 \mu\text{C/m}^2$

$$\vec{K}_S = \vec{K}_{S1} + \vec{K}_{S2} + \vec{K}_{S3}$$

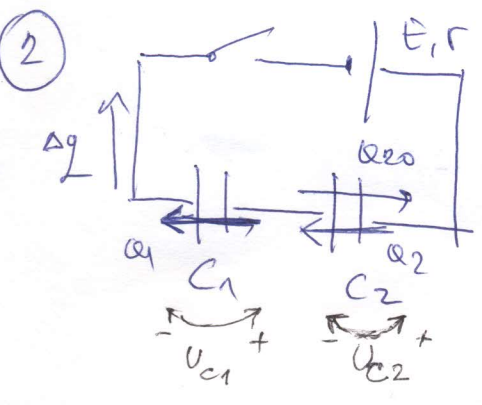
$$\vec{K}_{S1} = \frac{\sigma_1}{2\epsilon} \vec{v}_{01S} = \frac{\sigma}{2\epsilon} \vec{l}$$

$$\vec{K}_{S2} = \frac{\sigma_2}{2\epsilon} \vec{v}_{02S} = \frac{-2\sigma}{2\epsilon} \vec{l}$$

$$\vec{K}_{S3} = \frac{\sigma_3}{2\epsilon} \vec{v}_{03S} = \frac{3\sigma}{2\epsilon} \vec{l}$$

$$\vec{K}_S = \left( \frac{\sigma}{2\epsilon} - \frac{2\sigma}{2\epsilon} + \frac{3\sigma}{2\epsilon} \right) \vec{l} = \frac{2\sigma}{2\epsilon} \vec{l} = \frac{\sigma}{\epsilon} \vec{l} = \frac{10 \cdot 10^{-6}}{10^{-8} \cdot 10^{-2}} \vec{l} \frac{\text{V}}{\text{m}}$$

$\vec{K}_S = 1000 \frac{\text{V}}{\text{m}} \vec{l}$



$C_1 = C_2 = 40 \mu\text{F}$     $E = 16 \text{ V}$ ,    $r = 1 \Omega$ ,    $Q_{20} = 160 \mu\text{C}$

$$Q_1 = \Delta q$$

$$Q_2 = \Delta q - Q_{20}$$

$$U_{C1} + U_{C2} = E$$

$$\frac{Q_1}{C_1} + \frac{Q_2}{C_2} = E$$

$$\frac{\Delta q}{C_1} + \frac{\Delta q - Q_{20}}{C_2} = E \Rightarrow \Delta q \left( \frac{1}{C_1} + \frac{1}{C_2} \right) = E + \frac{Q_{20}}{C_2}$$

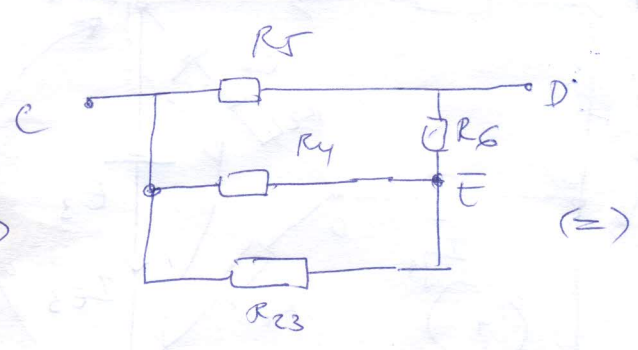
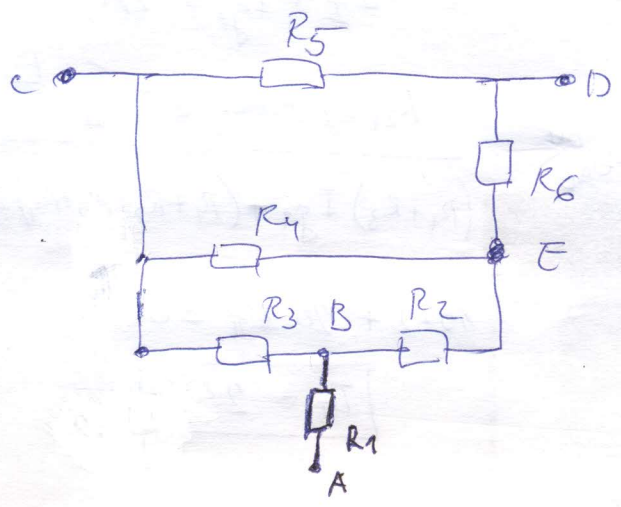
$$\Delta q = \frac{E + \frac{Q_{20}}{C_2}}{\frac{1}{C_1} + \frac{1}{C_2}} = \frac{16 + \frac{160 \mu\text{C}}{40 \mu\text{F}}}{\frac{1}{40 \mu\text{F}} + \frac{1}{40 \mu\text{F}}} = \frac{16 + 4}{\frac{2}{40 \mu\text{F}}} = 20 \cdot 20 \mu\text{C} = 400 \mu\text{C}$$

$$U_{C1} = \frac{Q_1}{C_1} = \frac{\Delta q}{C_1} = \frac{400 \mu\text{C}}{40 \mu\text{F}} = 10 \text{ V}$$

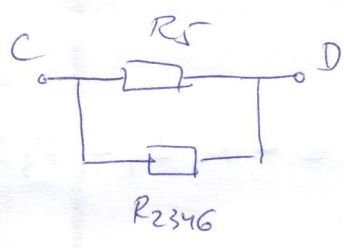
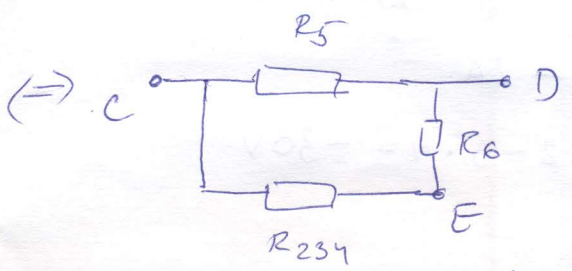
$$Q_2 = \Delta q - Q_{20} = 400 \mu\text{C} - 160 \mu\text{C} = 240 \mu\text{C}$$

**IV**

**3**



$$R_{23} = R_2 + R_3 = 2R = 16 \Omega$$



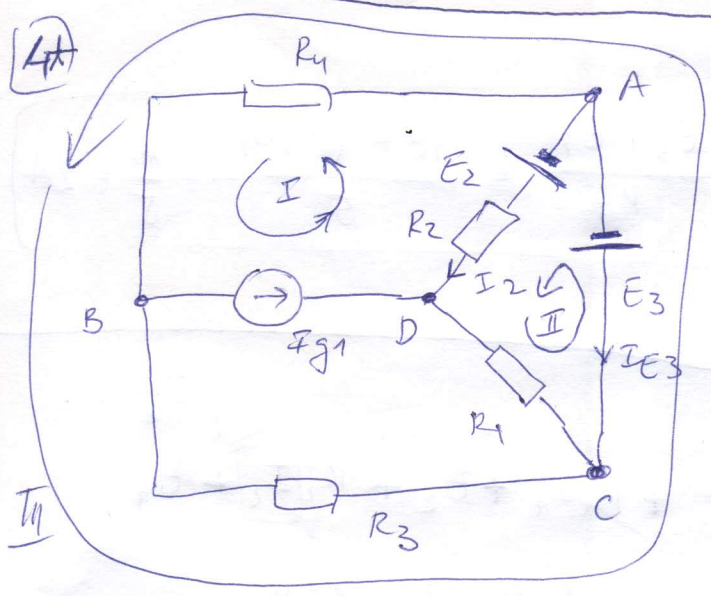
$$R_{234} = \frac{1}{\frac{1}{R_4} + \frac{1}{R_{23}}} = \frac{1}{\frac{1}{2R} + \frac{1}{2R}} = R = 8 \Omega$$

$$R_{2346} = R_{234} + R_6 = 2R = 16 \Omega$$



$$\Rightarrow R_{CD} = \frac{R_5 \cdot R_{2346}}{R_5 + R_{2346}} = \frac{2R \cdot 2R}{2R + 2R} = R = 8 \Omega$$

**4A**



$$I_I = I_{g1} = 2A$$

$$R_{21} I_I + R_{22} I_{II} + R_{23} I_{III} = \sum_{II} E$$

$$R_{31} I_I + R_{32} I_{II} + R_{33} I_{III} = \sum_{III} E$$

$$-R_2 \cdot I_{g1} + (R_1 + R_2) I_{II} + 0 \cdot I_{III} = -E_3 + E_2$$

$$R_4 I_{g1} + 0 \cdot I_{II} + (R_3 + R_4) I_{III} = -E_3$$

$$-5 \cdot 2 + 10 I_{II} = -40 + 60$$

$$5 \cdot 2 + 10 I_{III} = -40$$

$$10 I_{II} = 30 \Rightarrow I_{II} = 3A$$

$$10 I_{III} = -50 \Rightarrow I_{III} = -5A$$

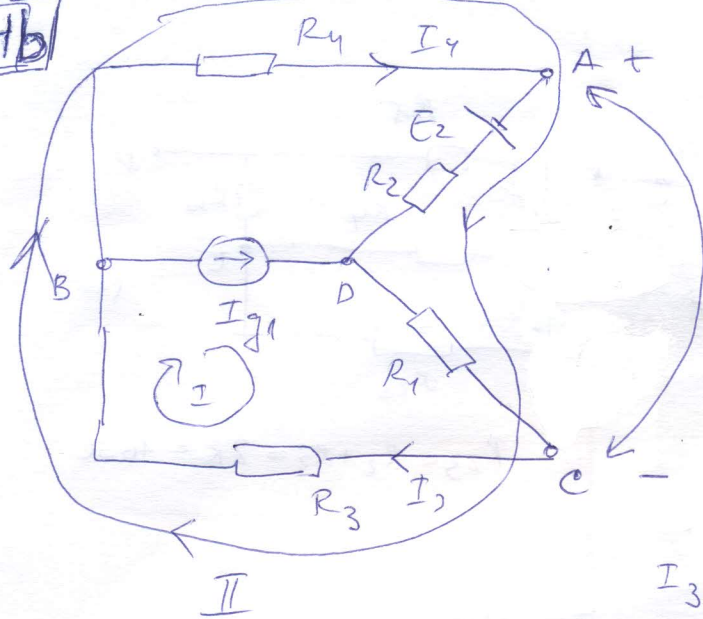
$$I_2 = I_{II} - I_I = 3 - 2 = 1A$$

$$P_{R2} = R_2 \cdot I_2^2 = 5 \cdot 1^2 = 5W$$

$$I_{E3} = -I_{II} - I_{III} = -3 - (-5) = 2A$$

za proveru zadatka 5.

4b



$$I_I = I_{g1} = 2A$$

$$R_{21} I_I + R_{22} I_{II} = \frac{\epsilon}{II} E$$

$$(R_1 + R_3) I_{g1} + (R_1 + R_2 + R_3 + R_4) I_{II} = E_2$$

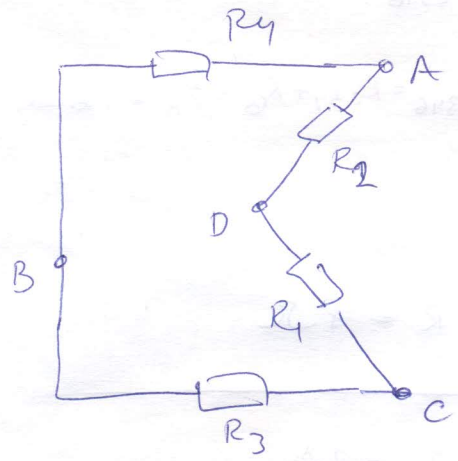
$$10 \cdot 2 + 20 I_{II} = 60$$

$$I_{II} = 2A$$

$$I_3 = I_I + I_{II} = 2 + 2 = 4A$$

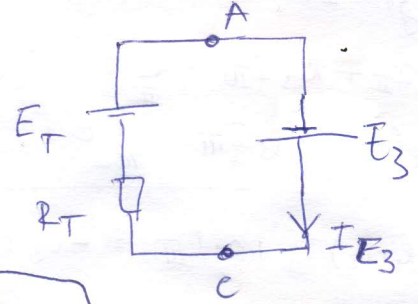
$$I_4 = I_{II} = 2A$$

$$E_T = U_{AC}^{OV} = -R_4 I_4 - R_3 I_3 = -5 \cdot 2 - 5 \cdot 4 = -30V$$



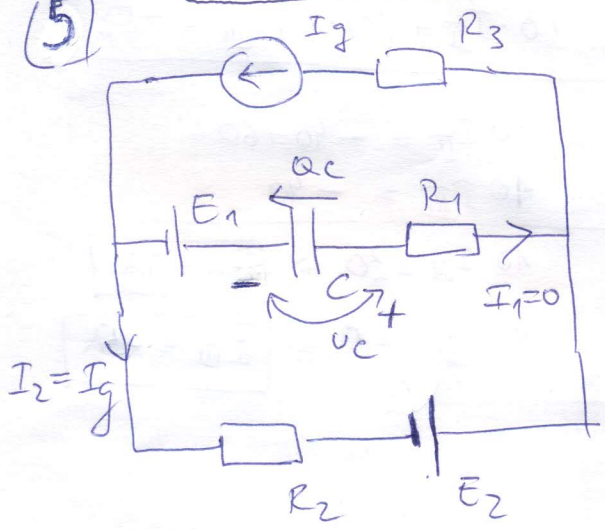
$$R_T = R_{AC} = (R_4 + R_3) \parallel (R_1 + R_2)$$

$$R_T = 2R \parallel 2R = R = 5\Omega$$



$$I_{E3} = \frac{E_3 + E_T}{R_T} = \frac{40 + (-30)}{5} = \frac{10}{5} = 2A$$

5



$$U_c = +R_1 I_1 + E_2 - R_2 I_2 - E_1$$

$$U_c = 20 - 5 \cdot 2 - 3 = 7V$$

$$Q_c = C U_c = 20\mu \cdot 7 = 140\mu C$$

$$W_c = \frac{1}{2} C U_c^2 = \frac{1}{2} \cdot 20\mu \cdot 7^2 = 490\mu J$$

$$W_c = 0,49 mJ$$