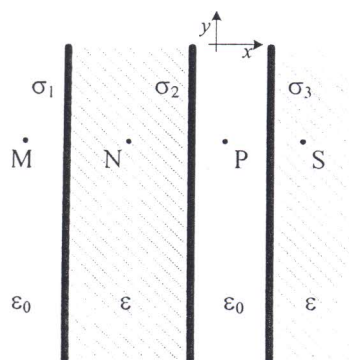


PRVI KOLOKVIJUM IZ ELEKTROTEHNIKE

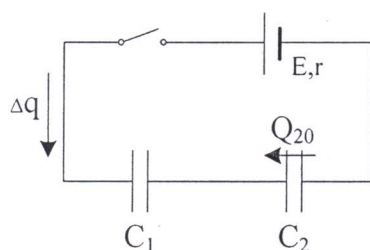
24. novembar 2016.

GRUPA 2

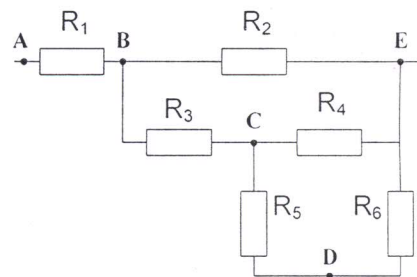
1. Na Slici 1 prikazane su tri paralelne, veoma velike, ravnomerno naelektrisane površi, površinskih gustina naelektrisanja $\sigma_1 = \sigma = 4 \text{ nC/m}^2$, $\sigma_2 = 3\sigma$ i $\sigma_3 = -\sigma$. Desno od treće ravni i između prve i druge ravni nalazi se dielektrik dielektrične konstante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



Slika 1

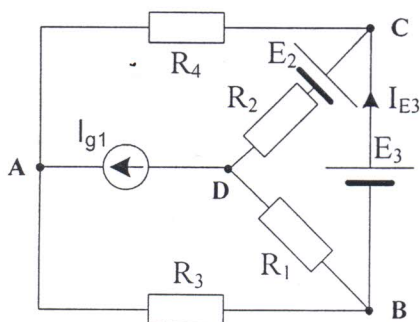


Slika 2

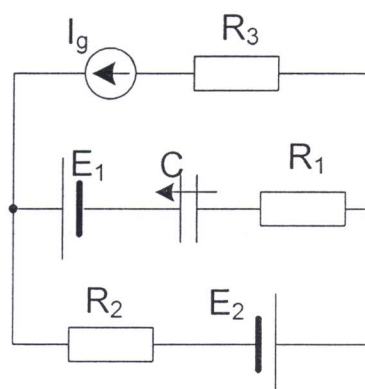


Slika 3

3. Na Slici 3 prikazana je grupa od šest otpornika poznatih otpornosti, $R_1 = R_2 = R_3 = R_5 = R_6 = R = 9 \Omega$, $R_4 = 2R = 18 \Omega$. Odrediti ekvivalentnu otpornost između tačaka B-C. (6 poena)



Slika 4



Slika 5

4. U kolu na Slici 4 poznato je: $R_1 = R_2 = R_3 = R_4 = 2 \Omega$, $E_2 = 8 \text{ V}$, $E_3 = 14 \text{ V}$, $I_{g1} = 5 \text{ A}$.

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

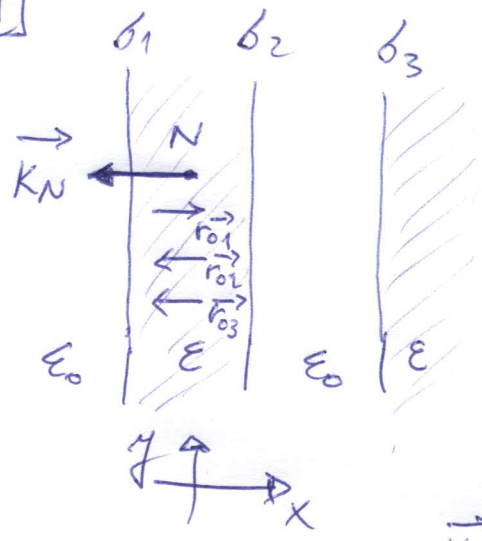
b) Primenom Tevenenove teoreme odrediti intenzitet struje I_{E3} kroz naponski generator E_3 . (10 poena)

5. U kolu na Slici 5 poznato je: $R_1 = 10 \Omega$, $R_2 = 5 \Omega$, $R_3 = 20 \Omega$, $E_1 = 7 \text{ V}$, $E_2 = 5 \text{ V}$, $I_g = 2 \text{ A}$, $C = 20 \mu\text{F}$. 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.

GRUPA 2

1



$$\vec{K}_N = \vec{K}_{N1} + \vec{K}_{N2} + \vec{K}_{N3}$$

$$\vec{K}_{N1} = \frac{\sigma_1}{2\epsilon} \vec{r}_{01} = \frac{\sigma}{2\epsilon} \vec{r}$$

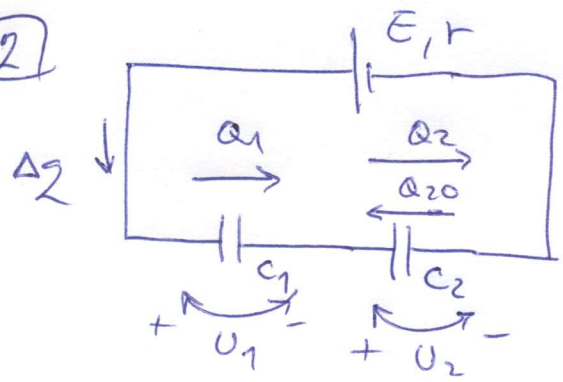
$$\vec{K}_{N2} = \frac{\sigma_2}{2\epsilon} \vec{r}_{02} = \frac{3\sigma}{2\epsilon} (-\vec{r}) = -\frac{3\sigma}{2\epsilon} \vec{r}$$

$$\vec{K}_{N3} = \frac{\sigma_3}{2\epsilon} \vec{r}_{03} = \frac{-\sigma}{2\epsilon} (-\vec{r}) = \frac{\sigma}{2\epsilon} \vec{r}$$

$$\vec{K}_N = \frac{\sigma}{2\epsilon} \vec{r} - \frac{3\sigma}{2\epsilon} \vec{r} + \frac{\sigma}{2\epsilon} \vec{r} = -\frac{\sigma}{2\epsilon} \vec{r}$$

$$\vec{K}_N = -\frac{4 \cdot 10^{-9}}{2 \cdot 10^{-10}} = -2 \cdot 10 = -20 \frac{V}{m}$$

2



$$E - U_1 - U_2 = 0$$

$$U_1 = \frac{Q_1}{C_1} \quad U_2 = \frac{Q_2}{C_2}$$

$$Q_1 = \Delta Q \quad Q_2 = \Delta Q - Q_{20}$$

$$E = \frac{\Delta Q}{C_1} + \frac{\Delta Q - Q_{20}}{C_2}$$

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

$$\Delta Q = \frac{E + \frac{Q_{20}}{C_2}}{\frac{1}{C_1} + \frac{1}{C_2}}$$

$$\Delta Q = \frac{8 + \frac{80\mu C}{40\mu F}}{\frac{1}{40\mu F} + \frac{1}{40\mu F}} = \frac{8 + 2}{\frac{2}{40\mu F}}$$

$$\Delta Q = 200\mu C$$

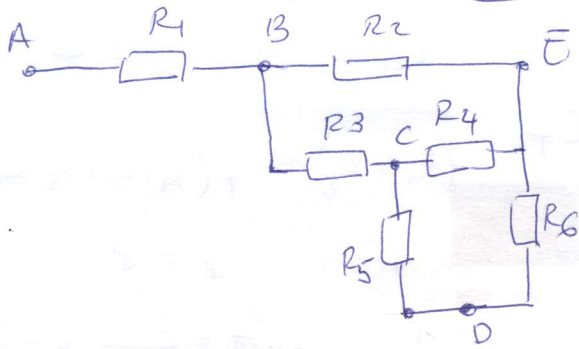
$$Q_1 = \Delta Q = 200\mu C$$

$$Q_2 = \Delta Q - Q_{20} = 120\mu C$$

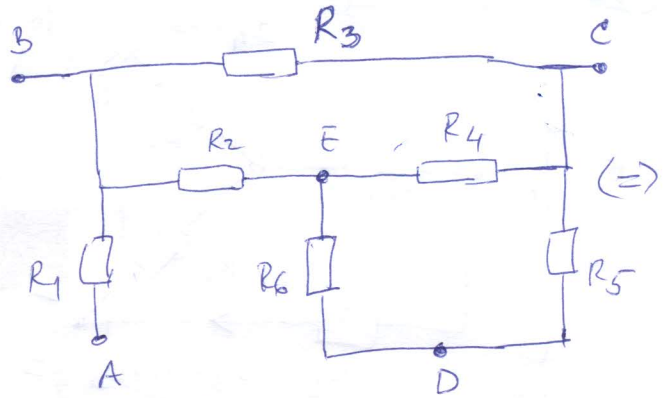
$$U_2 = \frac{Q_2}{C_2} = \frac{120\mu C}{40\mu F} = 3V$$

(II) GRUPA

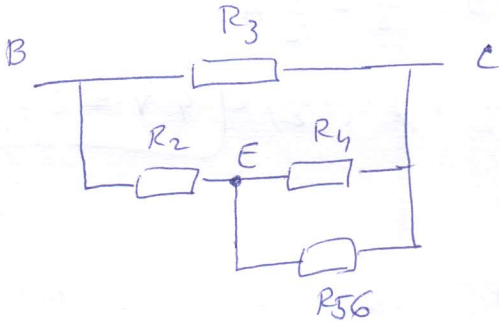
3



\Leftrightarrow

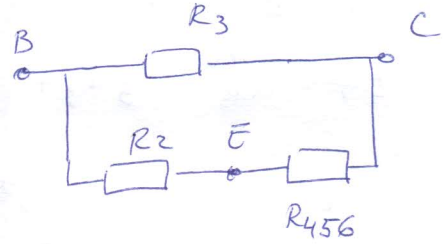


\Leftrightarrow



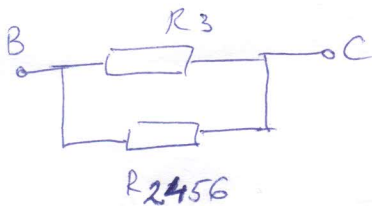
$$R_{56} = R_5 + R_6 = 2R = 18 \Omega$$

\Leftrightarrow



$$R_{456} = \frac{1}{\frac{1}{R_4} + \frac{1}{R_{56}}} = \frac{1}{\frac{1}{2R} + \frac{1}{2R}} = R = 9 \Omega$$

\Leftrightarrow



$$R_{2456} = R_2 + R_{456} = 2R = 18 \Omega$$

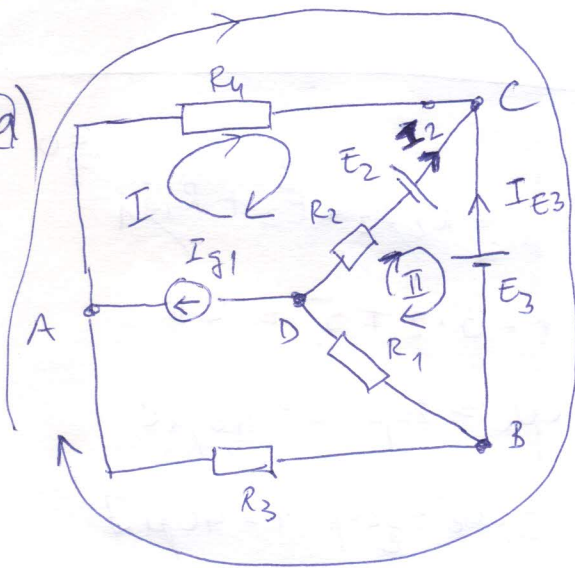
\Leftrightarrow



$$R_{BC} = \frac{1}{\frac{1}{R_3} + \frac{1}{R_{2456}}} = \frac{1}{\frac{1}{R} + \frac{1}{2R}} = \frac{1}{\frac{3}{2R}} = \frac{2R}{3}$$

$$R_{BC} = \frac{2R}{3} = 6 \Omega$$

4a



III

$$I_2 = I_{II} - I_I = 1 - 5 = -4 \text{ A}$$

$$P_{R2} = R_2 \cdot I_2^2 = 2 \cdot (-4)^2 = 2 \cdot 16 = 32 \text{ W}$$

$$I_I = I_{g1} = 5 \text{ A}$$

$$R_{21} I_I + R_{22} I_{II} + R_{23} I_{III} = \sum E_{II}$$

$$R_{31} I_I + R_{32} I_{II} + R_{33} I_{III} = \sum E_{III}$$

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

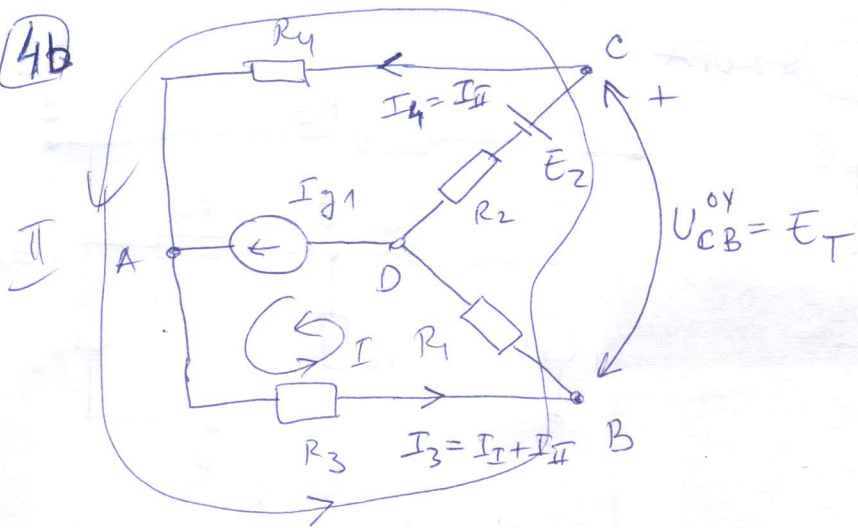
$$R_4 I_{g1} + 0 \cdot I_{II} + (R_3 + R_4) I_{III} = -E_3$$

$$-2 \cdot 5 + 4 I_{II} = 8 - 14 \Rightarrow I_{II} = \frac{4}{4} = 1 \text{ A}$$

$$2 \cdot 5 + 4 I_{III} = -14 \Rightarrow I_{III} = \frac{-24}{4} = -6 \text{ A}$$

$$I_{E3} = -I_{II} - I_{III} = -1 + 6 = 5 \text{ A}$$

4b



$$I_I = I_{g1} = 5A$$

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

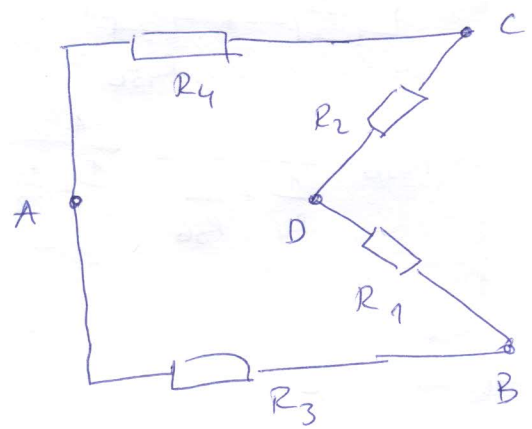
$$(R_1 + R_3) I_{g1} + (R_1 + R_2 + R_3 + R_4) I_{II} = E_2$$

$$4 \cdot 5 + 8 I_{II} = 8$$

$$I_{II} = \frac{8 - 20}{8} = -\frac{12}{8} = -\frac{3}{2} A$$

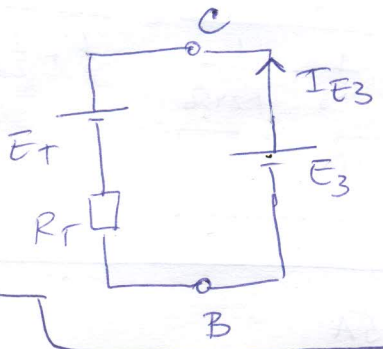
$$I_4 = I_{II} = -\frac{3}{2} A \quad I_3 = I_I + I_{II} = 5 - \frac{3}{2} = \frac{7}{2} A$$

$$E_T = U_{CB}^{ov} = R_3 I_3 + R_4 I_4 = 2 \cdot \frac{7}{2} + 2 \cdot \left(-\frac{3}{2}\right) = 4V = E_T$$



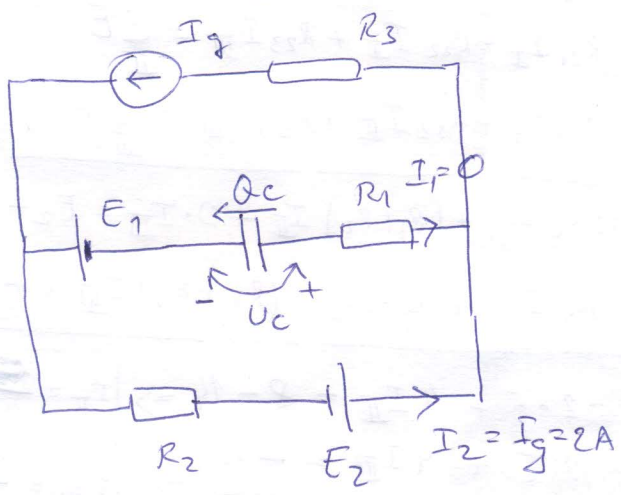
$$R_T = R_{CB} = (R_3 + R_4) \parallel (R_1 + R_2)$$

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



$$I_{E3} = \frac{E_3 - E_T}{R_T} = \frac{14 - 4}{2} = 5A$$

5



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

$$U_c = 7 - 5 \cdot 2 + 5 = 2V$$

$$Q_c = C U_c = 20\mu \cdot 2 = 40\mu C$$

$$W_c = \frac{1}{2} C U_c^2 = \frac{1}{2} \cdot 20\mu \cdot 4 = 40\mu J$$