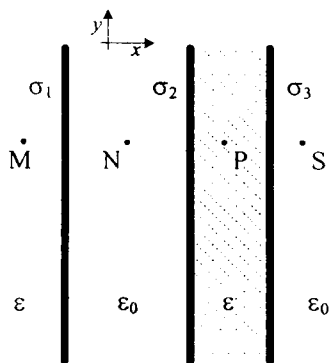


PRVI KOLOKVIJUM IZ ELEKTROTEHNIKE

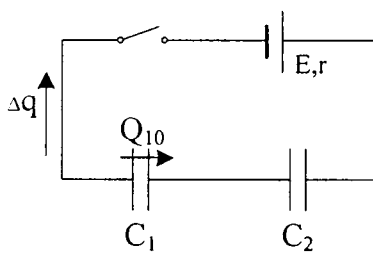
24. novembar 2016.

GRUPA 1

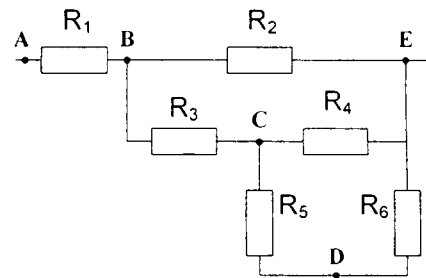
1. Na Slici 1 prikazane su tri paralelne, veoma velike, ravnomerno naelektrisane površi, površinskih gustina naelektrisanja $\sigma_1 = \sigma = 4 \mu\text{C}/\text{m}^2$, $\sigma_2 = -\sigma$ i $\sigma_3 = -2\sigma$. Levo od prve ravni i između druge i treće ravni nalazi se dielektrik dielektrične konstante $\epsilon = 10^{-9} \text{ F/m}$, dok je u ostalom delu prostora vazduh ($\epsilon_0 = 8.85 \cdot 10^{-12} \text{ F/m}$). Odrediti **vektor** električnog polja u tački M. (4 poena)



Slika 1

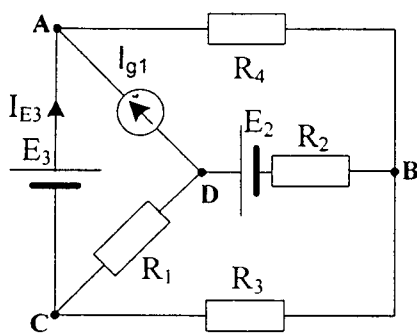


Slika 2

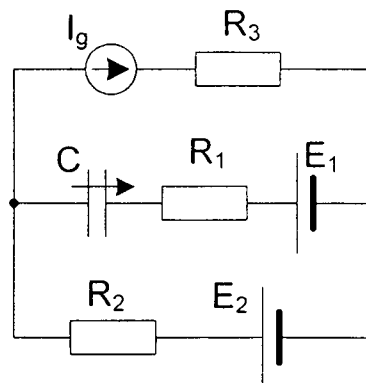


Slika 3

3. Na Slici 3 prikazana je grupa od šest jednakih otpornika, $R_1 = R_2 = R_3 = R_4 = R_5 = R_6 = R = 20 \Omega$. Odrediti ekvivalentnu otpornost između tačaka C-E. (6 poena)



Slika 4



Slika 5

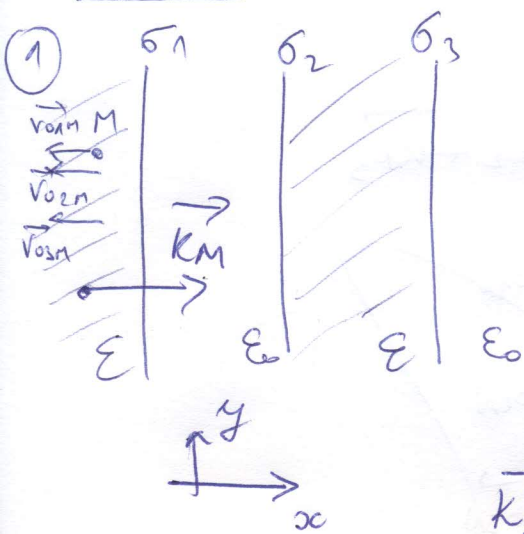
4. U kolu na Slici 4 poznato je: $R_1 = R_2 = R_3 = R_4 = 30 \Omega$, $E_2 = 60 \text{ V}$, $E_3 = 70 \text{ V}$, $I_{g1} = 1 \text{ A}$.

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: $R_1 = 10 \Omega$, $R_2 = 5 \Omega$, $R_3 = 20 \Omega$, $E_1 = 3 \text{ V}$, $E_2 = 15 \text{ V}$, $I_g = 2 \text{ A}$, $C = 10 \mu\text{F}$. 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.



$$\vec{K}_M = \vec{K}_{M1} + \vec{K}_{M2} + \vec{K}_{M3}$$

$$\vec{K}_{M1} = \frac{\sigma_1}{2\epsilon} \vec{v}_{01M} = \frac{\sigma}{2\epsilon} (-\vec{i}) = -\frac{\sigma}{2\epsilon} \vec{i}$$

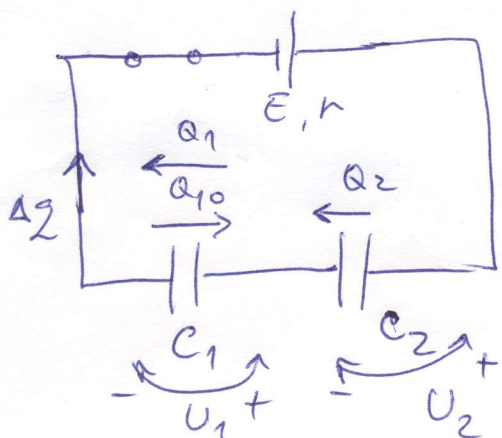
$$\vec{K}_{M2} = \frac{\sigma_2}{2\epsilon} \vec{v}_{02M} = \frac{-\sigma}{2\epsilon} (-\vec{i}) = \frac{\sigma}{2\epsilon} \vec{i}$$

$$\vec{K}_{M3} = \frac{\sigma_3}{2\epsilon} \vec{v}_{03M} = \frac{-2\sigma}{2\epsilon} (-\vec{i}) = \frac{2\sigma}{2\epsilon} \vec{i}$$

$$\vec{K}_M = -\frac{\sigma}{2\epsilon} \vec{i} + \frac{\sigma}{2\epsilon} \vec{i} + \frac{2\sigma}{2\epsilon} \vec{i} = \frac{\sigma}{\epsilon} \vec{i}$$

$$K_M = \frac{4 \cdot 10^{-6}}{10^{-9}} = 4 \cdot 10^3 \frac{V}{m} = 4 \text{ kV/m}$$

②



$$E - U_2 - U_1 = 0$$

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

$$Q_1 = -Q_{10} + \Delta Q$$

$$Q_2 = \Delta Q$$

$$E - \frac{\Delta Q}{C_2} - \frac{-Q_{10} + \Delta Q}{C_1} = 0$$

$$E + \frac{Q_{10}}{C_1} = \Delta Q \left(\frac{1}{C_1} + \frac{1}{C_2} \right)$$

$$\Delta Q = \frac{E + Q_{10}/C_1}{\frac{1}{C_1} + \frac{1}{C_2}}$$

$$\Delta Q = \frac{10 + \frac{40\mu}{20\mu}}{\frac{1}{40\mu} + \frac{1}{20\mu}} = \frac{10 + 2}{\frac{2}{20\mu}}$$

$$\Delta Q = 120 \mu C$$

$$Q_1 = \Delta Q - Q_{10} = 120 - 40$$

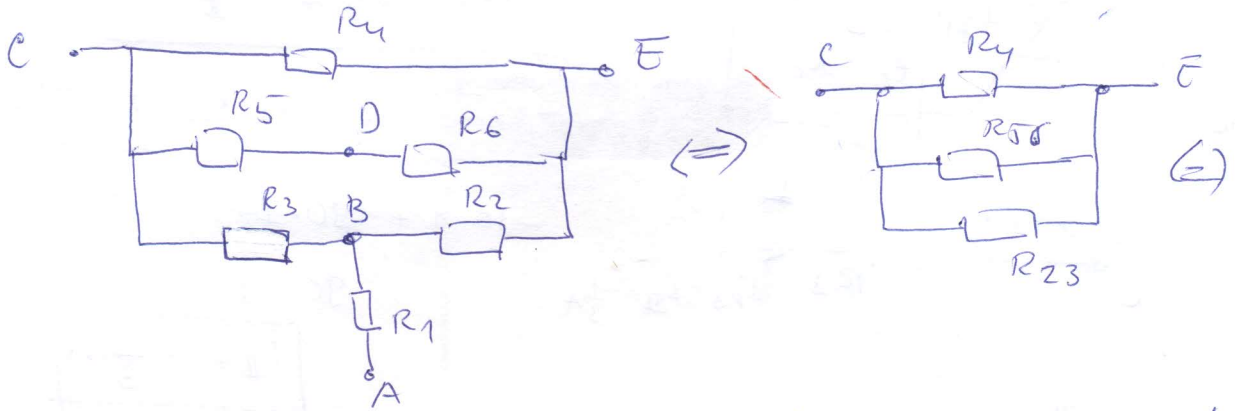
$$Q_1 = 80 \mu C$$

$$Q_2 = \Delta Q = 120 \mu C$$

$$U_2 = \frac{Q_2}{C_2} = \frac{120\mu}{20\mu} = 6V$$

I GRUPA

3)



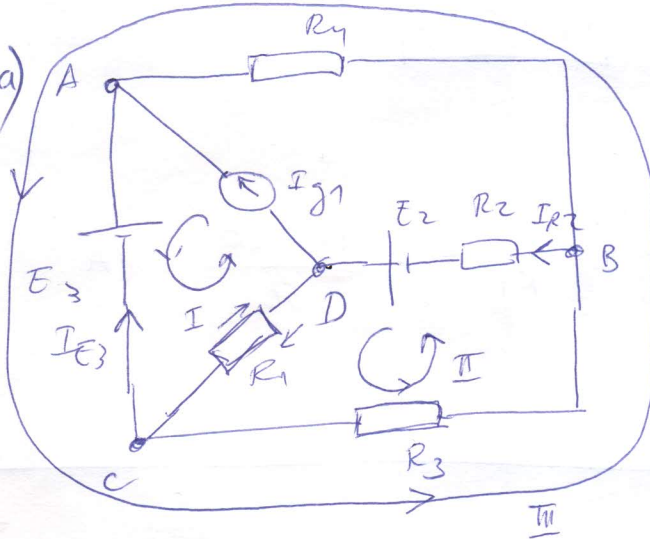
$$R_{ce} = \frac{1}{\frac{1}{R_4} + \frac{1}{R_{56}} + \frac{1}{R_{23}}} = \frac{1}{\frac{1}{R} + \frac{1}{2R} + \frac{1}{2R}}$$

$$R_{56} = R_5 + R_6 = 2R$$

$$R_{23} = R_2 + R_3 = 2R$$

$$R_{ce} = \frac{1}{\frac{2+1+1}{2R}} = \frac{2R}{4} = \frac{R}{2} = 10 \Omega$$

4) a)



$$I_{E3} = -I_I - I_{III} = -1 - (-2) = 1A$$

$$I_{R2} = I_{II} = \frac{5}{3} A$$

$$P_{R2} = R_2 \cdot I_{R2}^2 = 30 \cdot \left(\frac{5}{3}\right)^2 = 30 \cdot \frac{25}{9} = \frac{250}{3} W$$

$$I_I = I_{g1} = 1A$$

$$R_{21} I_I + R_{22} I_{II} + R_{23} I_{III} = \frac{\Sigma}{I} E$$

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

$$-R_1 I_I + (R_1 + R_2 + R_3) I_{II} + R_3 I_{III} = E_2$$

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

$$-30 + 90 I_{II} + 30 I_{III} = 60$$

$$90 I_{II} + 30 I_{III} = 90 \quad /: 30$$

$$3 I_{II} + I_{III} = 3 \quad (*)$$

$$30 I_{II} + 60 I_{III} = -70 \quad /: 10$$

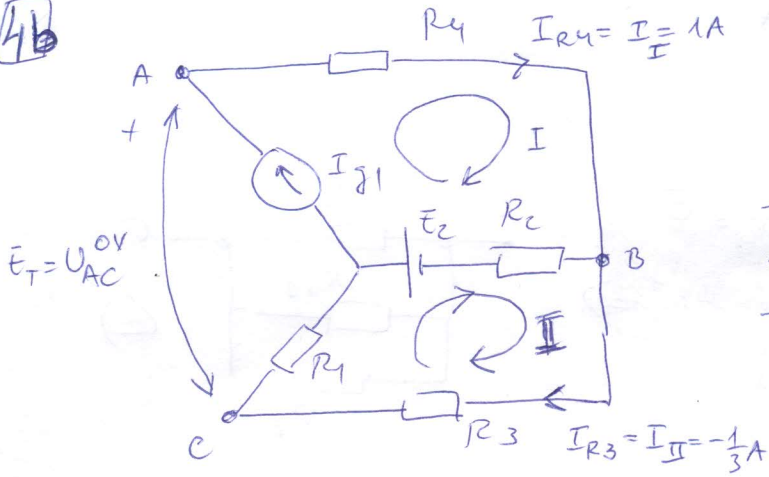
$$3 I_{II} + 6 I_{III} = -7 \quad (**)$$

$$(*) - (***) \Rightarrow -5 I_{III} = 10$$

$$I_{III} = -\frac{10}{5} = -2A$$

$$I_{II} = \frac{3 - (-2)}{3} = \frac{5}{3} A$$

4b



$$I_I = I_{g1} = 1A$$

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

$$-R_2 I_I + (R_1 + R_2 + R_3) I_{II} = -E_2$$

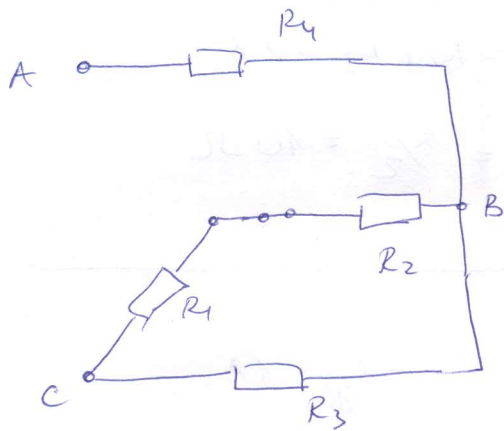
$$-30 \cdot 1 + 90 \cdot I_{II} = -60$$

$$90 I_{II} = -30$$

$$I_{II} = -\frac{1}{3} A$$

$$E_T = U_{AC}^{0V} = R_3 I_{R3} + R_4 I_{R4} = 30 \cdot \left(-\frac{1}{3}\right) + 30 \cdot 1$$

$$E_T = 30 - 10 = 20V$$

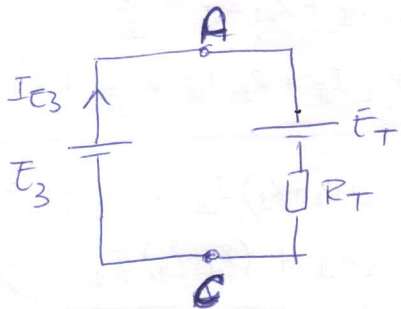


$$R_T = R_{AC} = R_4 + R_3 \parallel (R_1 + R_2)$$

$$R_T = R + R \parallel (2R)$$

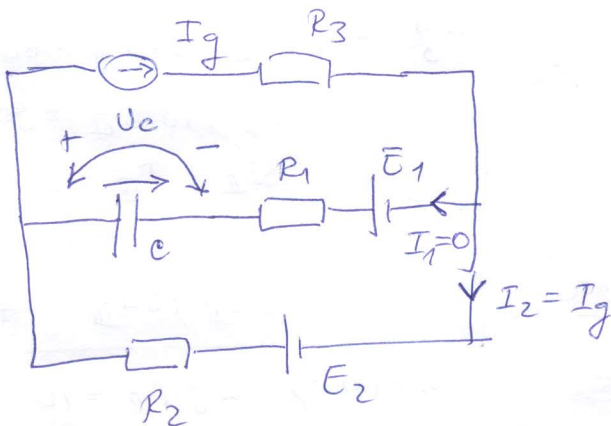
$$R_T = R + \frac{R \cdot 2R}{R + 2R} = R + \frac{2}{3}R = \frac{5}{3}R =$$

$$R_T = 50 \Omega$$



$$I_{E3} = \frac{E_3 - E_T}{R_T} = \frac{70 - 20}{50} = 1A$$

5



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

$$U_c = -3 + 15 - 5 \cdot 2 = 2V$$

$$Q_c = C U_c = 10 \mu \cdot 2 = 20 \mu C$$

$$W_c = \frac{1}{2} C U_c^2 = \frac{1}{2} \cdot 10 \mu \cdot 4 = 20 \mu J$$