(rukom dopisano) GREŠKA NA SLICI, TREBA ε_0
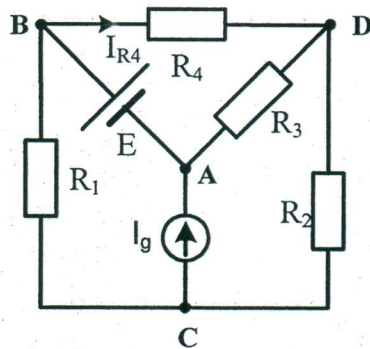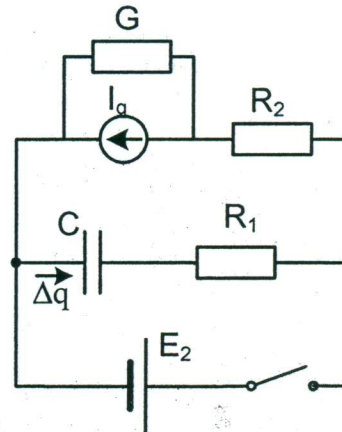PRIZNAJU SE I ZRAZI SA ε_0 ili SA ε_4, ALI NE SA $\varepsilon_0 \cdot \varepsilon_4$

1. Na Slici 1 prikazan je sistem sa tri tačkasta naelektrisanja: $Q_1 = -Q$, $Q_2 = 4Q$ i $Q_3 = Q$, $Q > 0$, koja se nalaze u vazduhu, na istoj pravoj.

a) Odrediti i nacrtati vektor električnog polja u tački D.
(6 poena)
b) Odrediti potencijal električnog polja u tački D.
(4 poena)

Slika 1

Slika 2

Slika 3

2. U kolu na Slici 2 poznato je: : $R_1 = R_2 = R_3 = R_4 = R = 12\ \Omega$, $E = 24\ V$, $I_g = 6\ A$.

a) Primenom Tevenenove teoreme odrediti intenzitet struje I_{R4} kroz otpornik R_4. **(10 poena)**
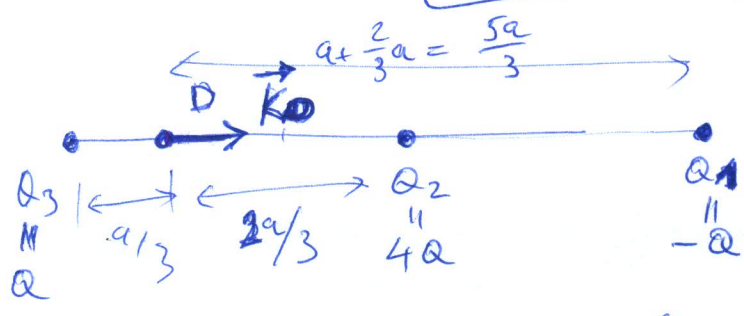b) Primenom metode superpozicije odrediti napon U_{AC} **(12 poena)**

3. U kolu na Slici 3 poznato je: $R_1 = 10\ \Omega$, $R_2 = 5\ \Omega$, $E_2 = 5\ V$, $I_g = 2\ A$, $G = 0.2\ S$, $C = 20\ nF$. Prekidač je otvoren. Odrediti količinu naelektrisanja Δq koja će proteći kroz granu sa kondenzatorom nakon zatvaranja prekidača.
(8 poena)

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

①

Diagram: points with charges Q_3 (M, Q), $Q_2 = 4Q$, $Q_1 = -Q$, with D, K_D, distances $a/3$, $2a/3$, and $a + \frac{2}{3}a = \frac{5a}{3}$

a)
$$\vec{K}_{D1} = \frac{-Q}{4\pi\varepsilon_0 \left(\frac{5a}{3}\right)^2} \cdot (-\vec{i}) = \frac{9Q}{4\pi\varepsilon_0 \, 25a^2}\vec{i} = \frac{9Q}{100\pi\varepsilon_0 a^2}\vec{i}$$

$$\vec{K}_{D2} = \frac{4Q}{4\pi\varepsilon_0 \left(\frac{2a}{3}\right)^2}(-\vec{i}) = -\frac{9Q}{4\pi\varepsilon_0 a^2}\vec{i}$$

$$\vec{K}_{D3} = \frac{Q}{4\pi\varepsilon_0 \left(\frac{a}{3}\right)^2}\vec{i} = \frac{9Q}{4\pi\varepsilon_0 a^2}\vec{i}$$

$$\vec{K}_D = \vec{K}_{D1} + \vec{K}_{D2} + \vec{K}_{D3}$$

$$\vec{K}_D = \left(\frac{9Q}{100\pi\varepsilon_0 a^2} - \frac{9Q}{4\pi\varepsilon_0 a^2} + \frac{9Q}{4\pi\varepsilon_0 a^2}\right)\vec{i} = \frac{9Q}{100\pi\varepsilon_0 a^2}\vec{i}$$

b)
$$V_{D1} = \frac{-Q}{4\pi\varepsilon_0 \frac{5a}{3}} = \frac{-3Q}{20\pi\varepsilon_0 a}$$
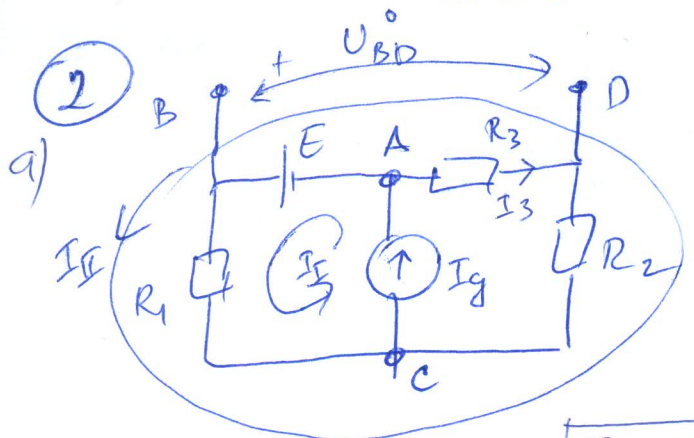
$$V_{D2} = \frac{4Q}{4\pi\varepsilon_0 \frac{2a}{3}} = \frac{3Q}{2\pi\varepsilon_0 a}$$

$$V_{D3} = \frac{Q}{4\pi\varepsilon_0 \frac{a}{3}} = \frac{3Q}{4\pi\varepsilon_0 a}$$

$$V_D = V_{D1} + V_{D2} + V_{D3} = \frac{-3Q}{20\pi\varepsilon_0 a} + \frac{3Q}{2\pi\varepsilon_0 a} + \frac{3Q}{4\pi\varepsilon_0 a}$$

$$V_D = \frac{-3Q + 30Q + 15Q}{20\pi\varepsilon_0 a} = \frac{42Q}{20\pi\varepsilon_0 a} = \frac{21Q}{10\pi\varepsilon_0 a}$$

② a)

$$\varepsilon_T = \overset{\circ}{U}_{BD}$$
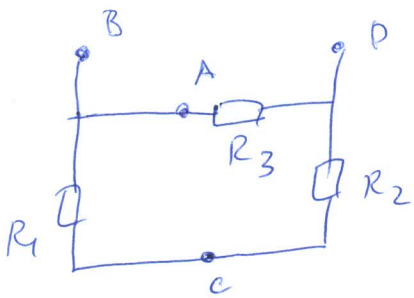
$$I_I = I_g = 6A$$

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

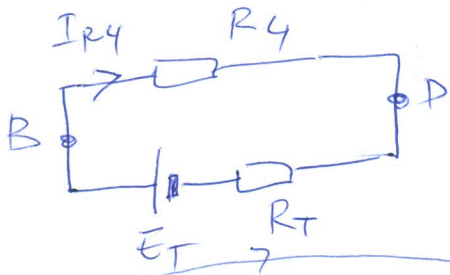$$I_{II} = \frac{E - RI_g}{3R} = -4/3\, A$$

$$I_3 = -I_{II} = 4/3\, A$$

$$\boxed{\varepsilon_T = \overset{\circ}{U}_{BD} = E + R_3 I_3 = 24 + 12 \cdot \frac{4}{3} = 40V}$$
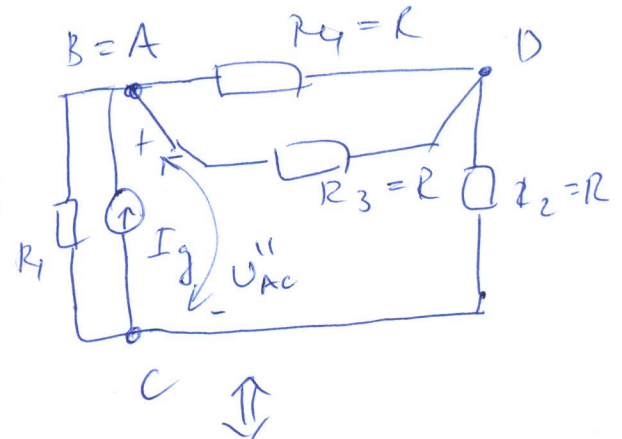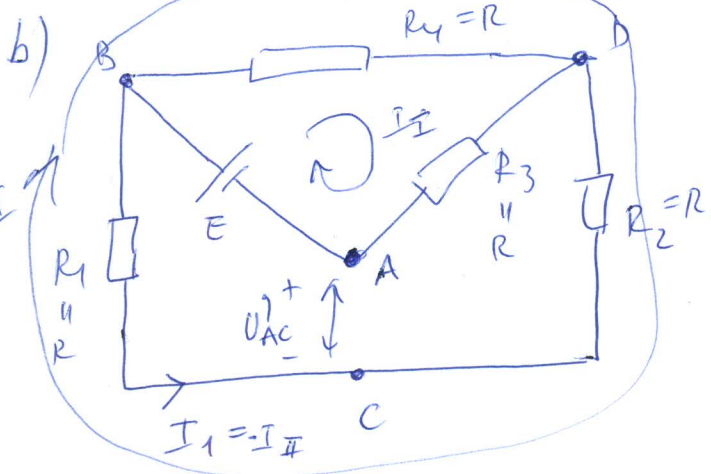
$$\Rightarrow \quad R_T = R_{BD} = R_3 \| (R_1 + R_2) = R \| 2R$$

$$R_T = \frac{R \cdot 2R}{3R} = \frac{2}{3}R = \frac{2}{3} \cdot 12$$

$$\boxed{R_T = 8\,\Omega}$$

$$\boxed{I_{R4} = \frac{E_T}{R_T + R_4} = \frac{40}{8+12} = \frac{40}{20} = 2A}$$

b)

$$(R_4 + R_3)\, I_I + R_4\, I_{II} = E$$

$$\underline{R_4\, I_I + (R_1 + R_2 + R_4)\, I_{II} = 0}$$

$$2R\, I_I + R\, I_{II} = E$$

$$\underline{R\, I_I + 3R\, I_{II} = 0}$$

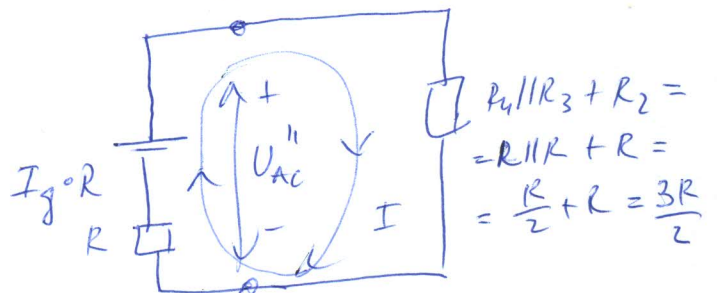$$\circlearrowright \quad I_I = -3\, I_{II}$$

$$2R(-3I_{II}) + R\, I_{II} = E$$

$$-6R\, I_{II} + R\, I_{II} = E$$

$$I_{II} = \frac{-E}{5R}$$

$$I_1 = -I_{II} = \frac{E}{5R}$$

$$U'_{AC} = -E + R_1 I_1 = -E + \frac{E}{5}$$

$$\boxed{U'_{AC} = -\frac{4E}{5}} \quad \boxed{= -\frac{4 \cdot 24}{5} = \frac{-96}{5}}$$

(+)

$$R_4 \| R_3 + R_2 =$$
$$= R \| R + R =$$
$$= \frac{R}{2} + R = \frac{3R}{2}$$

$$I = \frac{I_g R}{R + \frac{3R}{2}} = \frac{I_g R}{\frac{5R}{2}}$$

$$I = \frac{2}{5} I_g$$

$$U''_{AC} = \frac{3R}{2} \cdot I = \frac{3R I_g}{5}$$

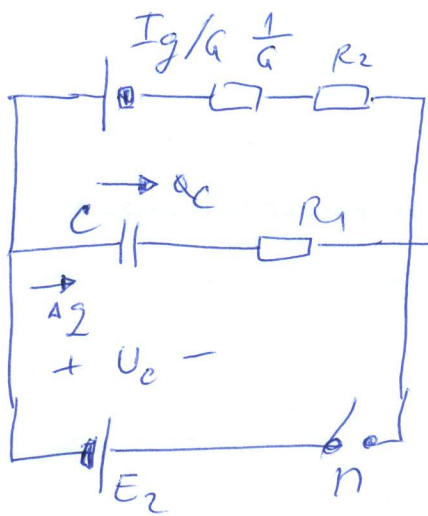$$\boxed{U''_{AC} = \frac{3 \cdot 12 \cdot 6}{5} = \frac{216}{5}}$$

$$U_{AC} = U'_{AC} + U''_{AC}$$

$$U_{AC} = -\frac{96}{5} + \frac{216}{5} = \frac{120}{5} = 24V$$
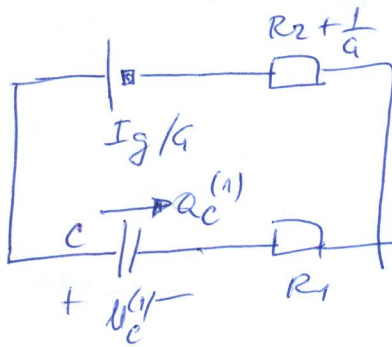
$$\boxed{U_{AC} = 24V}$$

③

$$\Delta q = Q_c^{(2)} - Q_c^{(1)}$$

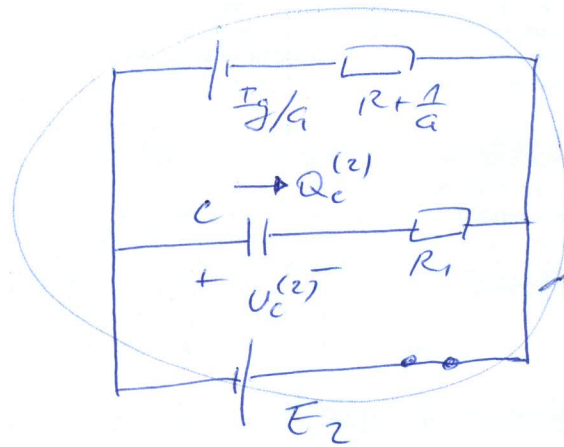$$\Delta q = -100 \mu C - 200 \mu C$$

$$\boxed{\Delta q = -300 \mu C}$$

1) $\Lambda = OFF$ ___/ Λ___

$$U_c^{(1)} = \frac{Ig}{G} = \frac{2}{0,2} = 10V$$

$$Q_c^{(1)} = C U_c^{(1)} = 200 \mu C$$

2) $\Lambda = ON$ ___•_•___ Λ

$$U_c^{(2)} = -E_2 = -5V$$

$$Q_c^{(2)} = C U_c^{(2)} = -100 \mu C$$