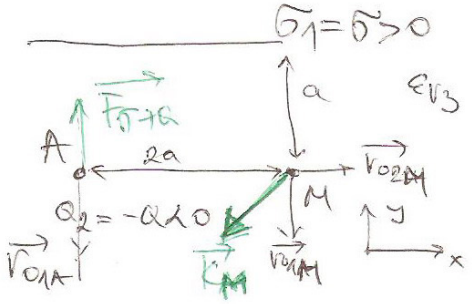
1.



a) $\vec{E}_M = \vec{E}_{M1} + \vec{E}_{M2}$

$$\vec{E}_{M1} = \frac{\sigma_1}{2\varepsilon_0\varepsilon_{r3}}\vec{r}_{01M} = \frac{\sigma_1}{2\varepsilon_0\varepsilon_{r3}}(-\vec{j}) = -\frac{\sigma}{2\varepsilon_0\varepsilon_{r3}}\vec{j}$$

$$\vec{E}_{M2} = \frac{Q_2}{4\pi\varepsilon_0\varepsilon_{r3}(2a)^2}\vec{r}_{02M} = \frac{-Q}{16\pi\varepsilon_0\varepsilon_{r3}a^2}\vec{i}$$

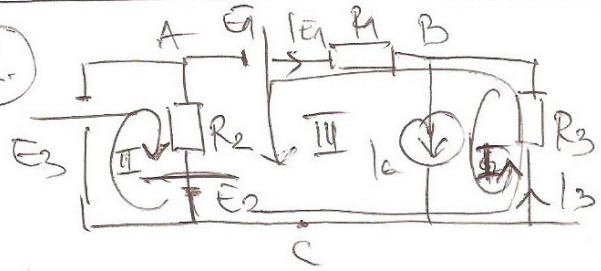
$$\vec{E}_M = \vec{E}_{M1} + \vec{E}_{M2} = -\frac{\sigma}{2\varepsilon_0\varepsilon_{r3}}\vec{j} - \frac{Q}{16\pi\varepsilon_0\varepsilon_{r3}a^2}\vec{i}$$

$$\boxed{\vec{E}_M = -\frac{Q}{16\pi\varepsilon_0\varepsilon_{r3}a^2}\vec{i} - \frac{\sigma}{2\varepsilon_0\varepsilon_{r3}}\vec{j}}$$

b) $\vec{F}_{\sigma_1 \to Q_2} = Q_2 \cdot \vec{E}_A = Q_2 \cdot \frac{\sigma_1}{2\varepsilon_0\varepsilon_{r3}}\vec{r}_{01A} = (-Q)\frac{\sigma}{2\varepsilon_0\varepsilon_{r3}}(-\vec{j}) = \frac{\sigma Q}{2\varepsilon_0\varepsilon_{r3}}\vec{j}$

$$\boxed{\vec{F}_{\sigma_1 \to Q_2} = \frac{\sigma Q}{2\varepsilon_0\varepsilon_{r3}}\vec{j}}$$

2.



КОНТУРНИМ СТРУЈАМА

$nč = 3$, $ng = 5 \Rightarrow ng - nč + 1 = 3$ конт. струје

1 идеалан струјни генератор:

$$I_I = I_g$$

$$0 \cdot I_I + R_2 I_{II} + R_2 I_{III} = -\mathcal{E}_2 - \mathcal{E}_3$$

$$R_3 I_I + R_2 I_{II} + (R_3 + R_1 + R_2) I_{III} = -\mathcal{E}_1 - \mathcal{E}_2$$

$$R_2 I_{II} + R_2 I_{III} = -\mathcal{E}_2 - \mathcal{E}_3$$

$$R_2 I_{II} + (R_1 + R_2 + R_3) I_{III} = -\mathcal{E}_1 - \mathcal{E}_2 - R_3 I_g$$

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

$$I_{III} = -3A$$

$$I_I = 1A$$

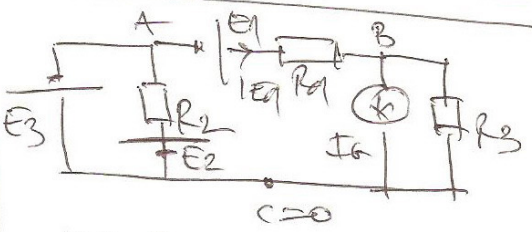
$$\boxed{I_{\mathcal{E}_1} = -I_{III} = 3A}$$

$$I_3 = I_{III} + I_I = -2A$$

$$\boxed{U_{CB} = R_3 I_3 = -6V}$$

$$\boxed{P_{\mathcal{E}_1} = \mathcal{E}_1 \cdot I_{\mathcal{E}_1} = 63W}$$

$$\boxed{P_{I_G} = I_G \cdot U_{CB} = -6W}$$



$nč = 3 \Rightarrow nč - 1 = 2$ једн.

НАПОНИМА ИЗМЕЂУ ЧВОРОВА

$$U_{A0} = -\mathcal{E}_3$$

$$-\frac{1}{R_1}U_{A0} + \left(\frac{1}{R_1} + \frac{1}{R_3}\right)U_{B0} = \frac{\mathcal{E}_1}{R_1} - I_G$$

$$\Rightarrow U_{A0} = -6V$$

$$U_{B0} = -6V$$

$$\boxed{U_{CB} = U_{0B} = -U_{B0} = -6V}$$

$$P_{I_G} = I_G \cdot U_{CB} = -6W$$

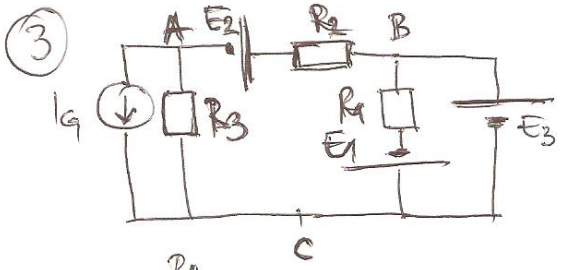
$$U_{AB} = U_{A0} - U_{B0} = -12V$$

$$= R_1 I_{\mathcal{E}_1} - \mathcal{E}_1$$

$$\Rightarrow \boxed{I_{\mathcal{E}_1} = \frac{U_{AB} + \mathcal{E}_1}{R_1} = 3A}$$

$$\boxed{P_{\mathcal{E}_1} = \mathcal{E}_1 \cdot I_{\mathcal{E}_1} = 63W}$$

③



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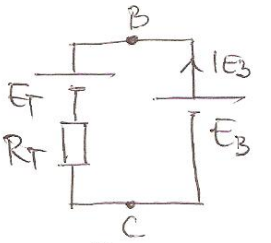
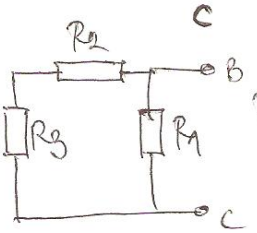


$$I_{E3} = \frac{E_3 - E_T}{R_T}$$

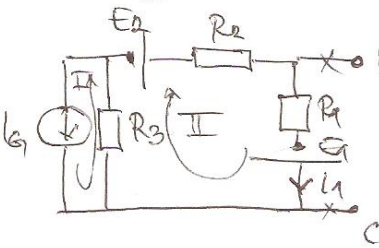
R_T:



$$R_T = R_4 \| (R_2 + R_3)$$

$$R_T = \frac{R_4(R_2+R_3)}{R_4+R_2+R_3}$$

$$R_T = \frac{10}{3}\,\Omega$$



$$I_I = I_g$$

$$R_3 I_I + (R_4+R_2+R_3) I_{II} = E_2 + E_1$$

$$I_{II} = \frac{E_1 + E_2 - R_3 I_g}{R_4+R_2+R_3}$$

$$I_4 = I_{II} = 1\,A$$

$$\boxed{I_{II} = 1\,A} \quad \boxed{I_I = 1\,A}$$

$$E_T = U_{BC}^{(ov)} = -E_1 + R_4 I_4 = -10\,V$$

$$I_{E3} = \frac{E_3 - E_T}{R_T} = \frac{10-(-10)}{\frac{10}{3}} = \frac{20}{\frac{10}{3}} = 6\,A$$

$$\boxed{I_{E3} = 6\,A}$$

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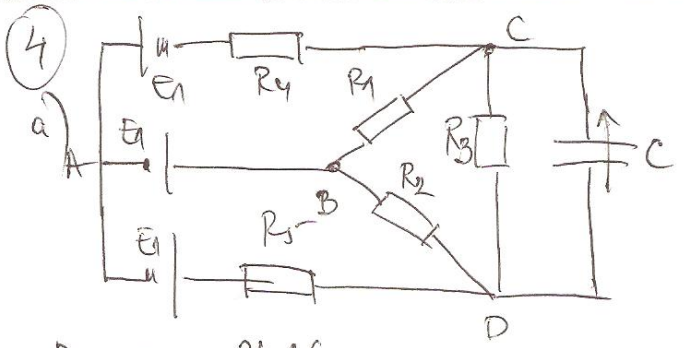
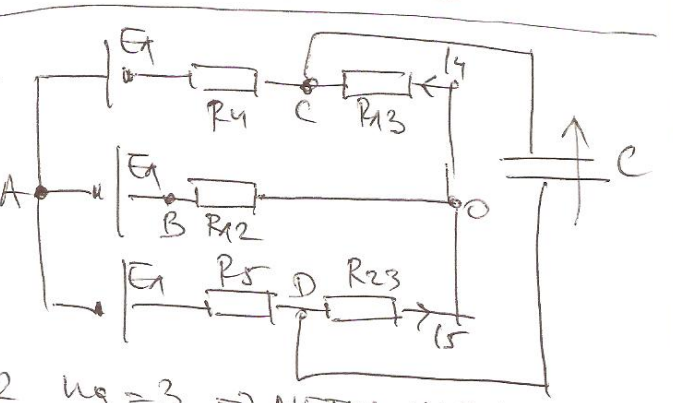
④



$\Rightarrow$



$$R_{13} = R_{23} = \frac{24\cdot 16}{24+16+24} = 6\,\Omega$$

$$R_{12} = \frac{24\cdot 24}{24+16+24} = 9\,\Omega$$

$$U_{AO} = -(R_4+R_{13})I_4 + E_1$$

$$I_4 = \frac{E_1 - U_{AO}}{R_4+R_{13}} = \frac{16}{3}\,A$$

$$U_{AO} = (R_5+R_{23})I_5 - E_1$$

$$I_5 = \frac{U_{AO}+E_1}{R_5+R_{23}} = \frac{8}{3}\,A$$

$$\boxed{U_C = U_{DC} = R_{23}I_5 + R_{13}\cdot I_4 = 48\,V}$$

$$\boxed{Q = U_C \cdot C = 480\,nC}$$

MC = 2 ug = 3 $\Rightarrow$ МЕТОД НАПОНА ИЗМЕЂУ ЧВОРОВА

MC − 1 = 1 jed.

$$U_{AO}\left(\frac{1}{R_4+R_{13}} + \frac{1}{R_{12}} + \frac{1}{R_5+R_{23}}\right) = \frac{E_1}{R_4+R_{13}} - \frac{E_1}{R_{12}} - \frac{E_1}{R_5+R_{23}}$$

$$U_{AO}\left(\frac{1}{9}+\frac{1}{9}+\frac{1}{9}\right) = \frac{36}{9} - \frac{36}{9} - \frac{36}{9} = -4$$

$$\frac{1}{3}U_{AO} = -4 \Rightarrow \underline{U_{AO} = -12\,V}$$

b) $$K = \frac{U_C}{d} = \frac{48\,V}{10\,\mu m} = 480\,\frac{kV}{m}$$

$$C = \varepsilon \frac{S}{d} \Rightarrow \varepsilon = \frac{Cd}{S} = 10^{-11}\,\frac{F}{m}$$