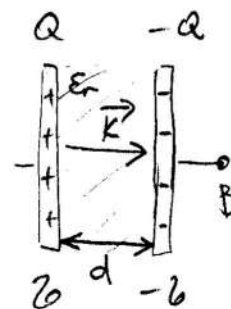


1. Pločasti kondenzator površine ploča $S = 100 \text{ cm}^2$ i rastojanja između njih $d = 1 \text{ mm}$, sa dielektrikom relativne dielektrične konstante $\epsilon_r = 4$, priključen je na napon napajanja $U = 10 \text{ V}$. Odrediti:

- Kapacitivnost kondenzatora;
- Količinu naelektrisanja na pločama kondenzatora;
- Površinsku gustinu naelektrisanja na pločama kondenzatora;
- Intenzitet vektora električnog polja u dielektriku;
- Energiju elektrostatičkog polja između ploča kondenzatora;
- Silu kojom se privlače ploče.



$$a) C = \frac{\epsilon S}{d} = \frac{\epsilon_r \epsilon_0 S}{d} = \frac{4 \cdot 8,85 \cdot 10^{-12} \frac{\text{F}}{\text{m}} \cdot 100 \cdot 10^{-4} \text{m}^2}{1 \cdot 10^{-3} \text{m}}$$

$$C = 354 \text{ pF} = 0,354 \text{ nF}$$

$$b) Q = C \cdot U = 3,54 \text{ nC}$$

$$b) \sigma = \frac{Q}{S} = \frac{3,54 \text{ nC}}{10^{-2} \text{m}^2} = 354 \frac{\mu\text{C}}{\text{m}^2} = 0,354 \frac{\mu\text{C}}{\text{m}^2}$$

$$c) K = \frac{U}{d} = \frac{10 \text{V}}{10^{-3} \text{m}} = 10 \frac{\text{kV}}{\text{m}}$$

$$g) W_c = \frac{1}{2} Q U = \frac{1}{2} C U^2 = \frac{1}{2} \frac{Q^2}{C}$$

$$W_c = \frac{1}{2} 3,54 \text{ nC} \cdot 10 \text{V} = 17,7 \text{ nJ}$$

$$g) F = \frac{Q^2}{2 \epsilon S} = 17,7 \mu\text{N}$$

$$|K| = K = 2 \cdot \frac{\sigma}{2 \epsilon} = \frac{\sigma}{\epsilon}$$

$$U = K \cdot d$$

$$C = \frac{Q}{U}, C = \frac{\epsilon S}{d}$$

$$F = \frac{Q^2}{2 \epsilon S} (= \frac{K}{2} \cdot Q)$$

3. Na Slici 1 je prikazana grupa od šest kondenzatora. Odrediti ekvivalentnu kapacitivnost između tačaka A-B, A-C i B-C.

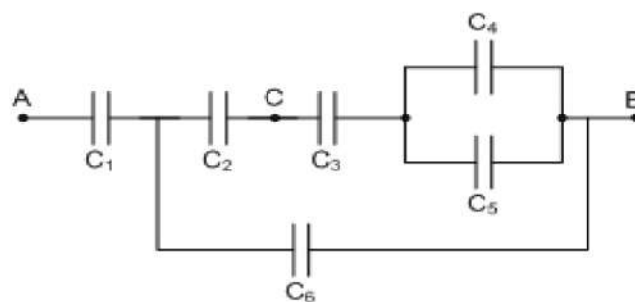
Poznato je:

$$C_1 = C_2 = C_3 = C = 10 \text{ nF},$$

$$C_3 = 3C / 2 = 15 \text{ nF},$$

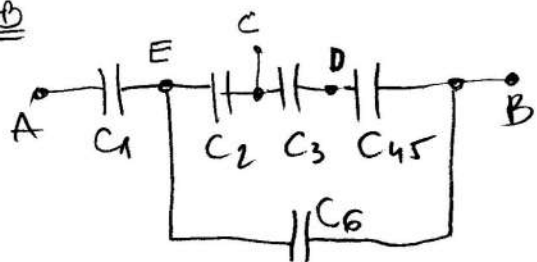
$$C_4 = 2C = 20 \text{ nF},$$

$$C_6 = 3C = 30 \text{ nF}.$$



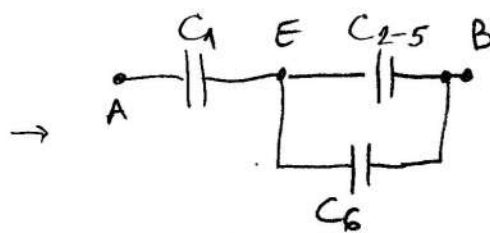
Slika 1

C_{AB}



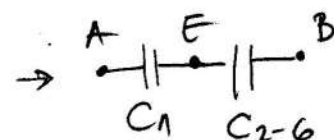
$$C_{45} = C_4 + C_5 = 3C$$

(ПАРАЛЕЛНА ВЕЗА)

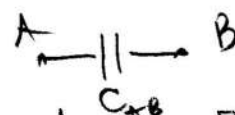


$$C_{25} = \frac{1}{\frac{1}{C_2} + \frac{1}{C_3} + \frac{1}{C_{45}}} = \frac{C}{2}$$

(РЕДНА ВЕЗА)



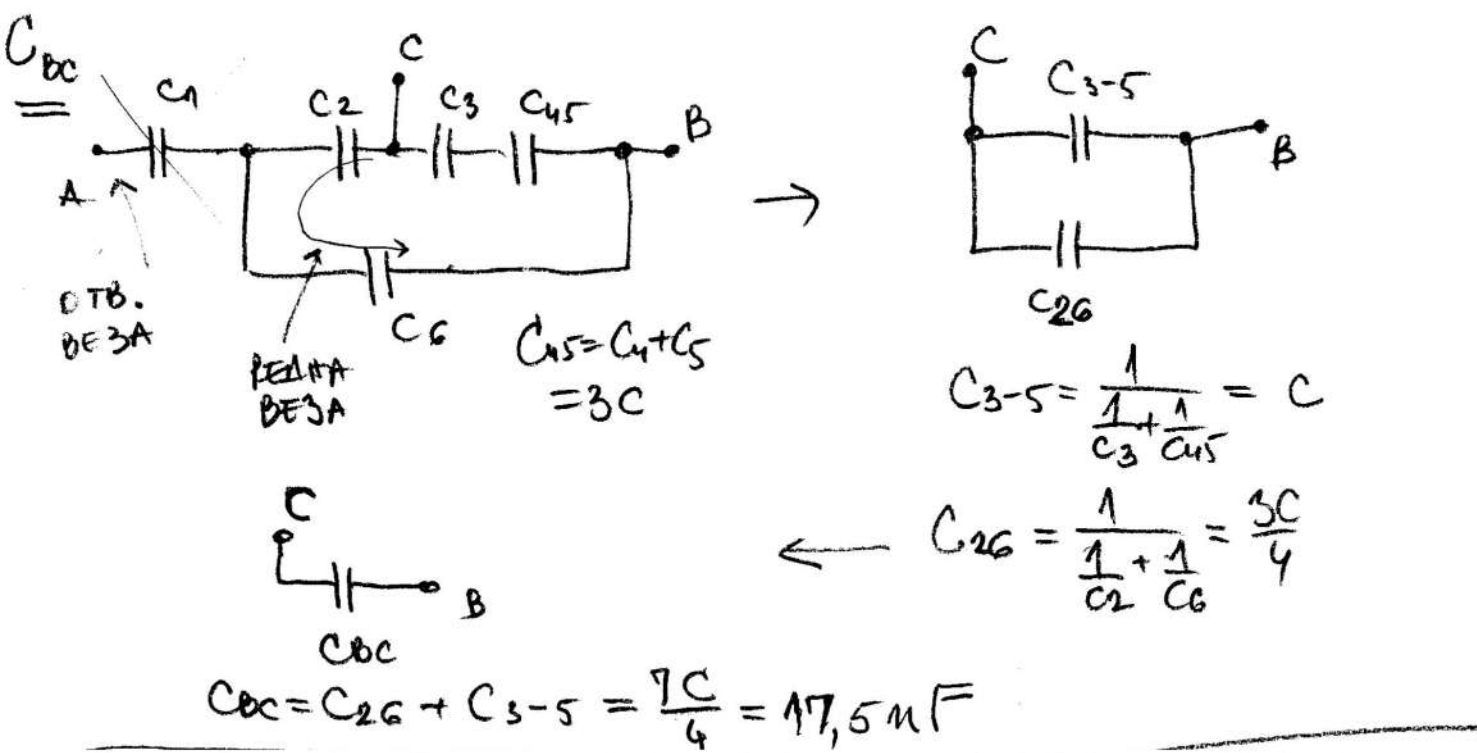
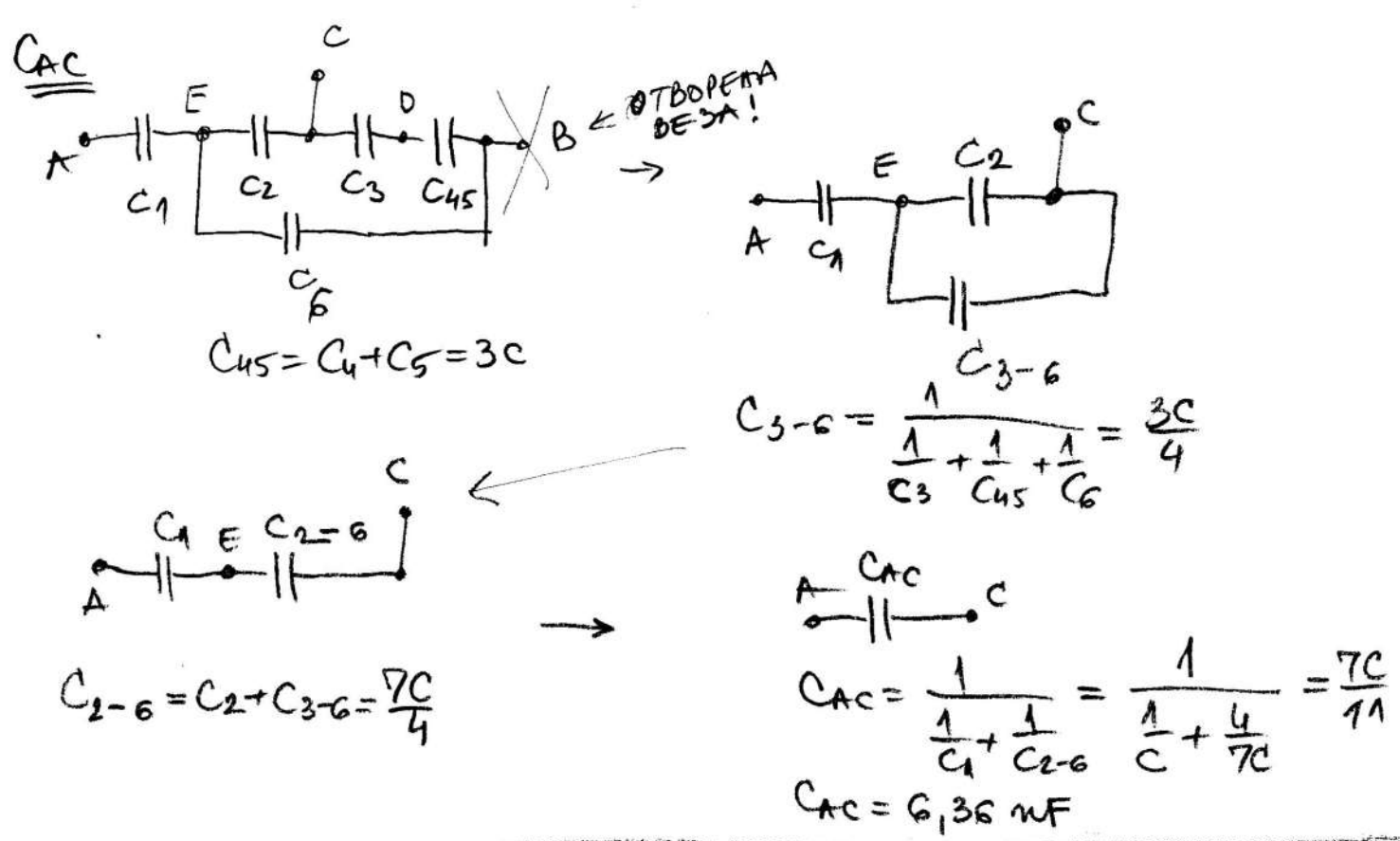
$$C_{26} = C_{2-5} + C_6 = \frac{7}{2} C$$



$$C_{AB} = 7,77 \dots \text{ nF}$$

$$C_{AB} = \frac{1}{\frac{1}{C_1} + \frac{1}{C_{2-6}}} = \frac{7}{9} C$$

СТРАНА 1

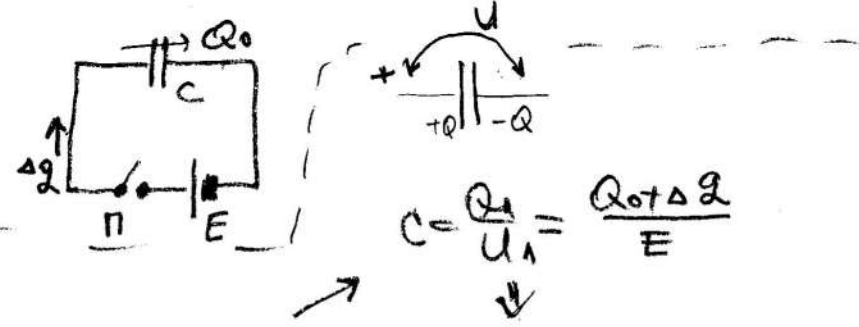


4. Kondenzator kapacitivnosti $C = 5 \text{ nF}$ u kolu na Slici 2 opterećen je količinom naelektrisanja Q_0 u smeru koji je naznačen na slici. Odrediti količinu naelektrisanja q koja će proteći kroz granu sa naponskim izvorom elektromotorne sile $E = 15 \text{ V}$ po zatvaranju prekidača Π ako je:

- a) $Q_0 = 0$;
- b) $Q_0 = -5 \text{ nC}$;
- c) $Q_0 = 100 \text{ nC}$;
- d) $Q_0 = 75 \text{ nC}$.

ПРИ \downarrow : $Q = Q_0, U = U_0$

НАРОТ \rightarrow , $C \Delta q \dots U_1 = E, Q_1 = Q_0 + \Delta q$



$$a) U_0 = \frac{Q_0}{C} = 0 < E, \Delta Q = CE - Q_0 = 75 \mu C$$

$$b) U_0 = \frac{Q_0}{C} = -1V, \Delta Q = CE - Q_0 = 80 \mu C$$

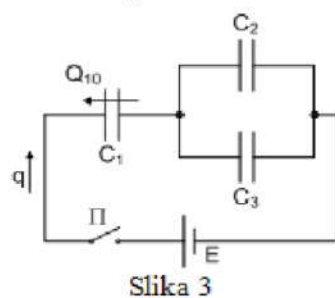
$$c) U_0 = \frac{Q_0}{C} = 20V > E \Rightarrow \Delta Q = CE - Q_0 = -25 \mu C < 0!$$

$$d) U_0 = \frac{Q_0}{C} = 15V = E \Rightarrow \Delta Q = 0!$$

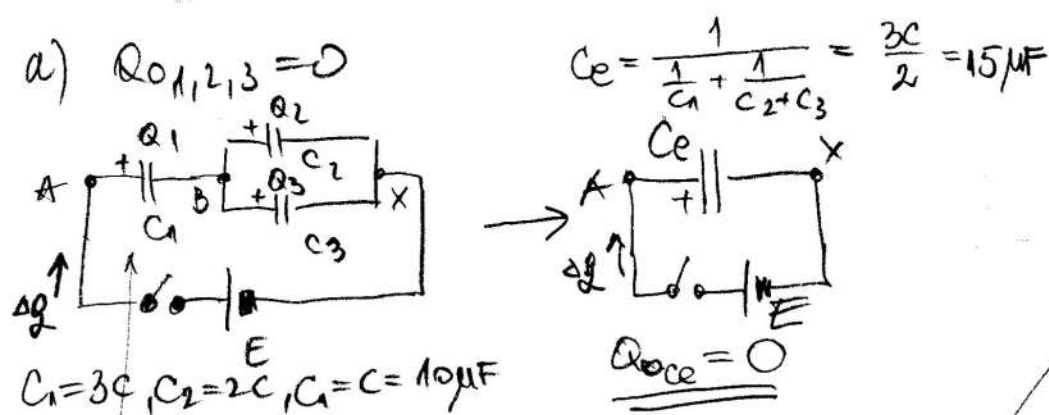
5. U kolu na Slici 3 poznate su kapacitivnosti kondenzatora $C_1 = 30 \mu F$, $C_2 = 20 \mu F$, $C_3 = 10 \mu F$ kao i elektromotorna sila $E = 6V$. Odrediti količinu naelektrisanja q koja će proteći kroz granu sa naponskim izvorom, nakon zatvaranja prekidača Π . Odrediti napon, količinu naelektrisanja i elektrostatičku energiju svakog od kondenzatora po uspostavljanju stacionarnog stanja, ako su:

a) kondenzatori C_1 , C_2 i C_3 neopterećeni;

b) kondenzatori C_2 i C_3 neopterećeni, dok je kondenzator C_1 opterećen količinom naelektrisanja $Q_{10} = 40 \mu C$ u smeru naznačenom na slici.



Slika 3



$$\downarrow_e \rightarrow Q = Q_0 = 0$$

$$\downarrow_x: Q = Q_0 + \Delta Q = CE$$

$$\Delta Q = CE = 90 \mu C$$

$$Q_1 = Q_{10} + \Delta Q = 90 \mu C$$

$$U_1 = \frac{Q_1}{C_1} = 3V \quad (U_1 = U_{AB})$$

$$U_2 = U_3 = U_{BX} = E - U_1 = 3V$$

$$Q_2 = C_2 U_2 = 60 \mu C$$

$$Q_3 = C_3 U_3 = 30 \mu C$$

$$W_{C1} = \frac{1}{2} C_1 U_1^2 = 135 \mu J$$

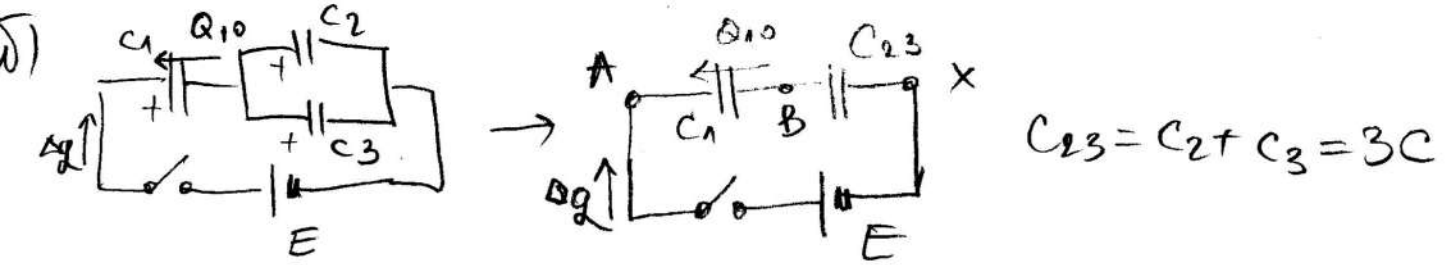
$$W_{C2} = \frac{1}{2} C_2 U_2^2 = 90 \mu J$$

$$W_{C3} = \frac{1}{2} C_3 U_3^2 = 45 \mu J$$

⊗ МОЖЕ И ОВАКО:

$$C_{BX} = C_2 \parallel C_3 = C_2 + C_3 = 3C = 30 \mu F$$

$$Q_{BX} = \Delta Q = 90 \mu C \rightarrow U_{BX} = \frac{Q_{BX}}{C_{BX}} = 3V$$



$$C_{23} = C_2 + C_3 = 3C$$

• : $Q_1 = -Q_{10}, Q_2 = Q_3 = 0$

• : $Q_1 = -Q_{10} + \Delta q, Q_{23} = \Delta q$

$$U_{AX} = U_{AB} + U_{BX}$$

$$E = U_1 + U_{23} = \frac{Q_1}{C_1} + \frac{Q_{23}}{C_{23}}$$

$$E = \frac{-Q_{10} + \Delta q}{C_1} + \frac{\Delta q}{C_{23}}$$

$$E = \Delta q \left(\frac{1}{C_1} + \frac{1}{C_{23}} \right) - \frac{Q_{10}}{C_1}$$

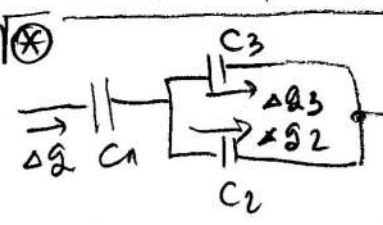
$$\Delta q = C_e \left(E + \frac{Q_{10}}{C_1} \right) = 110 \mu C$$

$$Q_1 = -Q_{10} + \Delta q = 70 \mu C \rightarrow U_1 = \frac{Q_1}{C_1} = \frac{7}{3} V$$

$$U_2 = U_3 = E - U_1 = \frac{11}{3} V$$

$$Q_2 = C_2 U_2 = \frac{220}{3} \mu C, Q_3 = C_3 U_3 = \frac{110}{3} \mu C$$

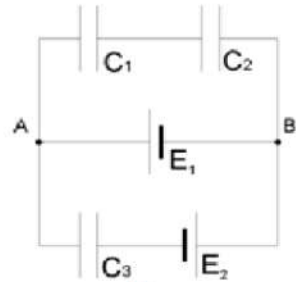
$$W_{C1}, W_{C2}, W_{C3} = \dots$$

⊗ 

$\Delta q_3 = Q_3 = \frac{220}{3} \mu C$
 $\Delta q_2 = Q_2 = \frac{110}{3} \mu C$

$\Delta q = \Delta q_2 + \Delta q_3 ?$
 W

11. Kondenzatori kapacitivnosti $C_1 = 20 \text{ nF}$, $C_2 = 30 \text{ nF}$ i $C_3 = 10 \text{ nF}$ i idealni naponski generatori elektromotomih sila $E_1 = 5 \text{ V}$ i $E_2 = 10 \text{ V}$, povezani su u kolo kaona Slici 8. Pre povezivanja u kolo, kondenzatori su bili neopterećeni. Odrediti napone, količine naelektrisanja na pločama, kao i elektrostatičku energiju svakog kondenzatora.

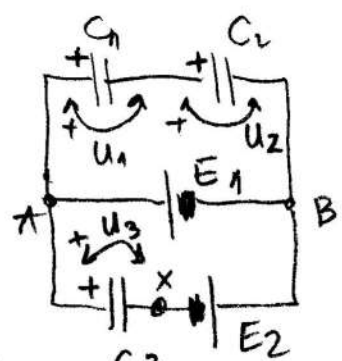


$$Q_1 = Q_2 = C_{12} \cdot E = (C_1^{-1} + C_2^{-1})^{-1} \cdot E = 60 \text{ nC}$$

$$U_1 = \frac{Q_1}{C_1} = 3 \text{ V}, U_2 = \frac{Q_2}{C_2} = 2 \text{ V}$$

$$U_3 = U_{AX} = U_{AB} + U_{BX} = E_1 + E_2 = 15 \text{ V}$$

$$Q_3 = C_3 U_3 = 150 \text{ nC}$$



$$W_{C1}, W_{C2}, W_{C3} = \dots$$