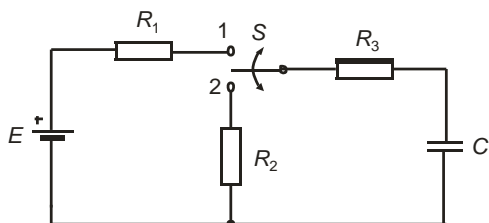


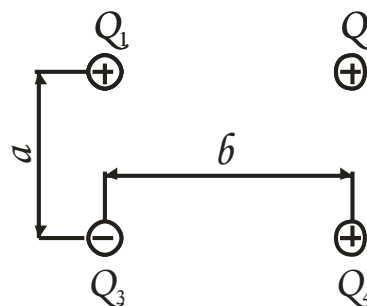
6. domaća zadaća iz Osnova elektrotehnike i elektronike

- U trenutku $t_1 = 0$ sklopka S preklopi iz položaja 2 u položaj 1. Nakon $t_2 = 120 \mu\text{s}$ sklopka preklopi u položaj 2 i tako ostane trajno. Kondenzator je početno prazan. Izračunajte napon na kondenzatoru u trenutku $t_3 = 200 \mu\text{s}$. Zadano je: $E = 5 \text{ V}$, $R_1 = 2 \text{ k}\Omega$, $R_2 = 5 \text{ k}\Omega$, $R_3 = 4 \text{ k}\Omega$, $C = 10 \text{ nF}$.
- Naboj Q_2 nalazi se u polju naboja Q_1 , Q_3 i Q_4 kao na slici. Izračunajte iznos i smjer sile kojom naboji Q_1 , Q_3 i Q_4 djeluju na naboj Q_2 . Poznato je: $Q_1 = 5 \text{ nC}$, $Q_2 = 10 \text{ nC}$, $Q_3 = 20 \text{ nC}$, $Q_4 = 6 \text{ nC}$, $a = 3 \text{ cm}$, $b = 5 \text{ cm}$, $\epsilon_r = 1$.

1.



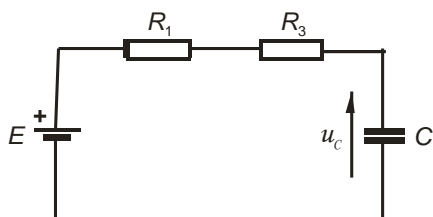
2.



Rješenja

1.

$$\underline{0 \leq t \leq t_2}$$

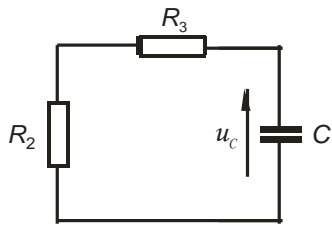


$$\tau_1 = (R_1 + R_3) \cdot C = 60 \mu\text{s}$$

$$u_c = E \cdot \left(1 - e^{-\frac{t}{\tau_1}}\right)$$

$$u_c(t_2) = E \cdot \left(1 - e^{-\frac{t_2}{\tau_1}}\right) = 5 \cdot \left(1 - e^{-\frac{120 \cdot 10^{-6}}{60 \cdot 10^{-6}}}\right) = 5 \cdot 0,8647 =$$

$$\boxed{u_c(t_2) = 4,323 \text{ V}}$$



$$t \geq t_2$$

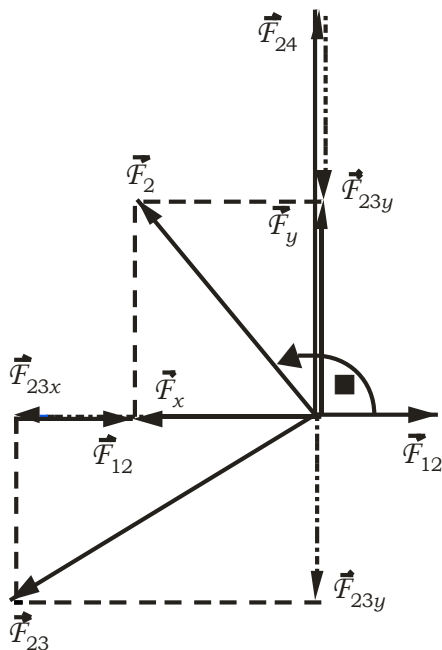
$$\tau_2 = (R_2 + R_3) \cdot C = 90 \mu s$$

$$u_C = u_C(t = t_2) \cdot e^{-\frac{t-t_2}{\tau_2}}$$

$$u_C(t_3) = u_C(t = t_2) \cdot e^{-\frac{t_3-t_2}{\tau_2}} = 4,323 \cdot e^{-\frac{200-120}{90}} = 4,323 \cdot 0,4111 =$$

$$u_C(t_3) = 1,777 \text{ V}$$

2.



$$F_{12} = \frac{Q_1 Q_2}{4\pi \epsilon_0 r^2} = \frac{5 \cdot 10^{-9} \cdot 10 \cdot 10^{-9}}{4\pi \cdot 8,854 \cdot 10^{-12} \cdot (5 \cdot 10^{-2})^2} = 179,8 \mu N$$

$$F_{24} = \frac{Q_2 Q_4}{4\pi \epsilon_0 r^2} = \frac{10 \cdot 10^{-9} \cdot 6 \cdot 10^{-9}}{4\pi \cdot 8,854 \cdot 10^{-12} \cdot (3 \cdot 10^{-2})^2} = 599,2 \mu N$$

$$F_{23} = \frac{|Q_2 Q_3|}{4\pi \epsilon_0 (a^2 + b^2)} = \frac{10 \cdot 10^{-9} \cdot 20 \cdot 10^{-9}}{4\pi \cdot 8,854 \cdot 10^{-12} \cdot [(3 \cdot 10^{-2})^2 + (5 \cdot 10^{-2})^2]} =$$

$$F_{23} = 528,7 \mu N$$

$$F_{23x} = F_{23} \cdot \frac{b}{\sqrt{a^2 + b^2}} = 453,3 \mu N$$

$$F_{23y} = F_{23} \cdot \frac{a}{\sqrt{a^2 + b^2}} = 272,0 \mu N$$

$$F_x = F_{23x} - F_{12} = 273,6 \mu N$$

$$F_y = F_{24} - F_{23y} = 327,2 \mu N$$

$$F_2 = \sqrt{F_x^2 + F_y^2} = 426,5 \mu N$$

$$\varphi = 180 - \arctg \frac{F_y}{F_x} = 129,9^\circ$$