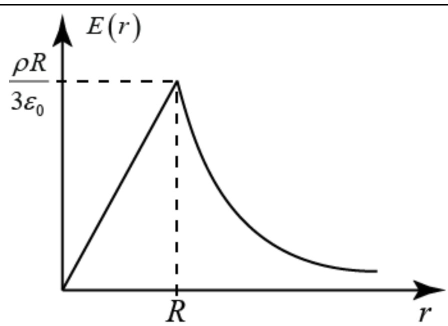
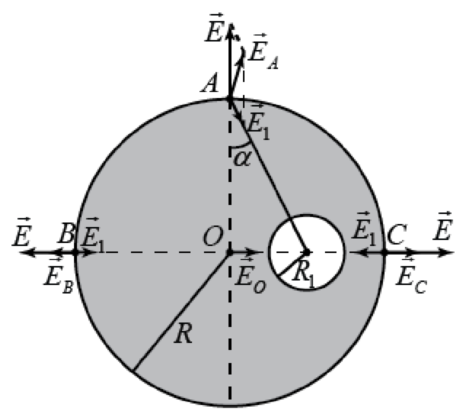
**4.**

| Nr/o | Soluţie | Pun-ctaj |
|---|---|---|
| **a)** | Teorema Gauss<br>$\oint\limits_{(S)}\left(\vec{E}\cdot d\vec{S}\right)=\frac{1}{\varepsilon_0}\int\limits_{(V)}\rho dV,$ **(0.5 p.)**<br>$\oint\limits_{(S)}\left(\vec{E}\cdot d\vec{S}\right)=\oint\limits_{(S)}EdS\cos 0^\circ=E\oint\limits_{(S)}dS=E\cdot 4\pi r^2$ **(0.5 p.)**<br>$\int\limits_{(V)}\rho dV=\rho\int\limits_{(V)}dV=\begin{cases}\rho\cdot\frac{4}{3}\pi r^3, & r\le R\\ \rho\cdot\frac{4}{3}\pi R^3, & r\ge R\end{cases}$ **(0.5 p.)** $E(r)=\begin{cases}\frac{\rho}{3\varepsilon_0}r, & r\le R\\ \frac{\rho}{3\varepsilon_0}\frac{R^3}{r^2}, & r\ge R\end{cases}$ **(0.5 p.)** | **2,0 p.** |
| **b)** |  **(0.5 p.)** | **0.5 p.** |
| **c)** | Pentru determinarea sensului vectorului intensităţii câmpului electric utilizând principiul superpoziţiei câmpurilor (vezi figura alăturată)<br>Câte **0,5 p.** pentru sensul vectorilor $\vec{E}_B$, $\vec{E}_O$, $\vec{E}_C$ şi **1,0 p.** pentru sensul vectorului $\vec{E}_A$.<br> | **2,5 p.** |
| **d)** | În punctul *B*: **(1.5 p.)**<br>$E_B=E-E_1,\quad E=\frac{\rho}{3\varepsilon_0}\frac{R^3}{(R)^2}=\frac{\rho R}{3\varepsilon_0},\qquad E_1=\frac{\rho}{3\varepsilon_0}\frac{R_1^3}{(R+R/2)^2}=\frac{\rho R}{432\varepsilon_0},$<br>$E_B=\frac{\rho R}{3\varepsilon_0}-\frac{\rho R}{432\varepsilon_0}=\frac{143\rho R}{432\varepsilon_0}=\frac{143\cdot 10^{-5}\cdot 2\cdot 10^{-1}}{432\cdot 8,85\cdot 10^{-12}}\approx 74,8\ \frac{\text{kV}}{\text{m}}$<br>În punctul *O*: **(0.5 p.)**<br>$E_O=E_1=\frac{\rho}{3\varepsilon_0}\frac{R_1^3}{(R/2)^2}=\frac{\rho R}{48\varepsilon_0}=\frac{10^{-5}\cdot 2\cdot 10^{-1}}{48\cdot 8,85\cdot 10^{-12}}\approx 4,7\frac{\text{kV}}{\text{m}}$<br>În punctul *C*: **(1.0 p.)** | **5,0 p.** |

| | | |
|---|---|---|
| | $E_C = E - E_1 = \frac{\rho}{3\varepsilon_0}\frac{R^3}{(R)^2} - \frac{\rho}{3\varepsilon_0}\frac{R_1^3}{(R/2)^2} = \frac{\rho R}{3\varepsilon_0} - \frac{\rho R}{48\varepsilon_0} = \frac{15\rho R}{48\varepsilon_0} = 70,5\ \frac{\text{kV}}{\text{m}}$<br>În punctul *A*: **(2.0 p.)**<br>Utilizarea teoremei cosinusurilor: $E_A^2 = E^2 + E_1^2 - 2EE_1\cos\alpha$<br>$\cos\alpha = \frac{OA}{O_1A} = \frac{R}{\sqrt{R^2 + R^2/4}} = \frac{2}{\sqrt{5}}$; $E = \frac{\rho R}{3\varepsilon_0}$; $E_1 = \frac{\rho}{3\varepsilon_0}\frac{R_1^3}{\left(\sqrt{R^2 + R^2/4}\right)^2} = \frac{\rho R}{240\varepsilon_0}$<br>$E_A = \sqrt{\left(\frac{\rho R}{3\varepsilon_0}\right)^2 + \left(\frac{\rho R}{240\varepsilon_0}\right)^2 - 2\frac{\rho R}{3\varepsilon_0}\cdot\frac{\rho R}{240\varepsilon_0}\cdot\frac{2}{\sqrt{5}}} = \frac{\rho R}{3\varepsilon_0}\sqrt{1 + \frac{1}{6400} - \frac{1}{20\sqrt{5}}}$<br>$E_A = \frac{10^{-5}\cdot 2\cdot 10^{-1}}{3\cdot 8,85\cdot 10^{-12}}\sqrt{1 + \frac{1}{6400} - \frac{1}{20\sqrt{5}}} \approx 74,5\ \frac{\text{kV}}{\text{m}}$ | |
| | **Total:** | **10 p.** |