N 1

Дано

$q = 50$ мкКл

$\bar{r}_0 = 2\bar{i} - 4\bar{j}$

$\bar{r} = 8\bar{i} - 5\bar{j}$

$E - ?$

Решение

1) $E = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q}{|\bar{r} - \bar{r}_0|^2}$

$|r - r_0| = \sqrt{36+1} = \sqrt{37}$ м

$E = 9 \cdot 10^9 \cdot \frac{5 \cdot 10^{-5}}{37} = \frac{45 \cdot 10^4}{37} = 12 \cdot 10^3 \, \frac{кВ}{м}$

2) Направление:

$\bar{E} = \frac{\bar{r} - \bar{r}_0}{|\bar{r} - \bar{r}_0|} \cdot E = \frac{6\bar{i} - \bar{j}}{\sqrt{37}} \cdot 12 \cdot 10^3$

№ 2

Дукин, работа на паре

№3

Дано

$q, -q$

$S_1 = 1$

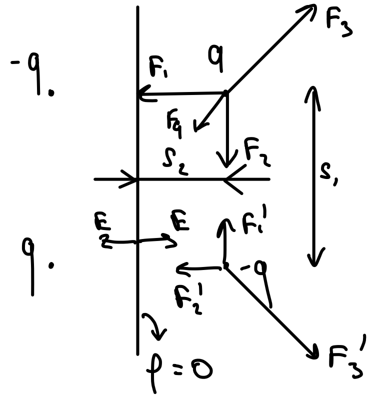
$S_2 = 0{,}5$

Решение

а) $F_1 = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q^2}{1} = \frac{q^2}{4\pi\varepsilon_0}$

$F_2 = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q^2}{1} = \frac{q^2}{4\pi\varepsilon_0}$

$F_3 = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q^2}{2} = \frac{q^2}{8\pi\varepsilon_0}$



$F_1^2 + F_2^2 = 2F_1^2 \Rightarrow F = \sqrt{2} F_1$

$F_q = F - F_3 = \frac{\sqrt{2} q^2}{4\pi\varepsilon_0} - \frac{q^2}{8\pi\varepsilon_0} = \frac{q^2}{4\pi\varepsilon_0}(2\sqrt{2} - 1)$

$$\left.\begin{aligned} |F_1'| &= \frac{q^2}{4\pi\varepsilon_0} \\ |F_2'| &= \frac{q^2}{4\pi\varepsilon_0} \end{aligned}\right\} F_1' + F_2' = \frac{\sqrt{2} q^2}{4\pi\varepsilon_0} = F'$$

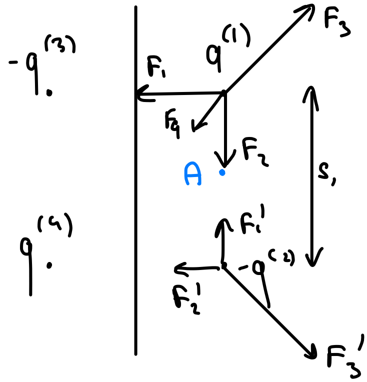
$|F_q| = |F' - F_1'| = \frac{\sqrt{2} q^2}{4\pi\varepsilon_0} - \frac{q^2}{8\pi\varepsilon_0} = \frac{q^2}{8\pi\varepsilon_0}(2\sqrt{2} - 1)$

Численно равны, но направления разные

b)

$$E_1 = \frac{q}{\pi \varepsilon_0} \qquad E_3 = \frac{-q}{2\sqrt{5}\pi \varepsilon_0}$$

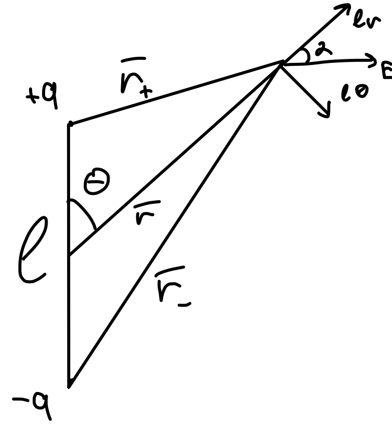
$$E_2 = \frac{-q}{\pi \varepsilon_0} \qquad E_4 = \frac{q}{2\sqrt{5}\pi \varepsilon_0}$$



$$\bar{E}_A = \bar{E}_4 + \bar{E}_3$$

$$E_A = \sqrt{E_4^2 + E_3^2} = \frac{q}{2\sqrt{10}\pi \varepsilon_0} = \frac{q\sqrt{10}}{20\pi \varepsilon_0}$$

N 4



$$\varphi(r) = \frac{q}{4\pi\varepsilon_0 r_+} + \frac{-q}{4\pi\varepsilon_0 r_-} = \frac{q}{4\pi\varepsilon_0}\left(\frac{r_- - r_+}{r_+ r_-}\right)$$

$$r_- - r_x = l\cos\theta$$

$$r_- r_x = r^2$$

$$\varphi(r) = \frac{q l \cos\theta}{4\pi\varepsilon_0 r^2} = \frac{p\cos\theta}{4\pi\varepsilon_0 r^2} \quad \varphi = \frac{\bar{p}\cdot\bar{r}}{4\pi\varepsilon_0 r^3}$$

$$E(r) = -\frac{d\varphi}{dr} = \frac{2p\cos\theta}{4\pi\varepsilon_0 r^3}$$

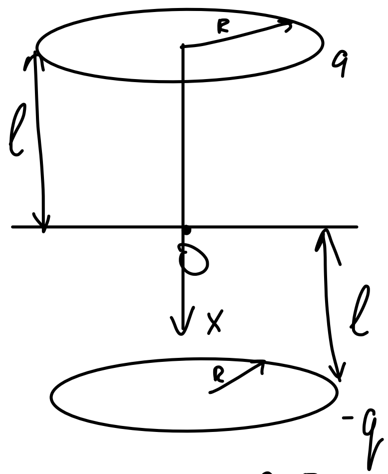
$$E(\theta) = -\frac{\partial\varphi}{r\,d\theta} = \frac{p\sin\theta}{4\pi\varepsilon_0 r^3}$$

$$\bar{E} = \bar{E}(\theta) + \bar{E}(r) = \frac{p}{4\pi\varepsilon_0 r^3}\sqrt{4\cos\theta + \sin^2\theta}$$

N 5

а) Напряженность кольца:

$$E(x) = \frac{q x}{4\pi \varepsilon_0 \sqrt{(R^2+x^2)^3}}$$



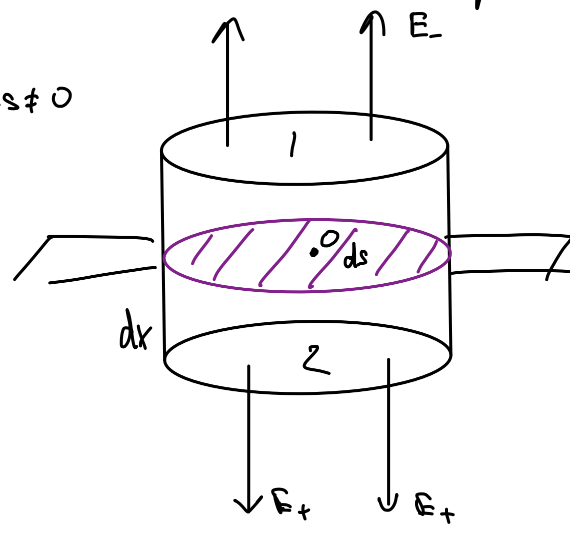
$$E(0) = 0$$

Π нии т. Гаусса в O

$$\Phi = E_- ds - E_+ ds = 0$$

σ - пов. плот. в •

$$\Phi = \sigma ds = q = 0 \Rightarrow \sigma = 0, \; ds \neq 0$$



b) $E_0 = E_+ + E_-$

$E_+ = 0$

$$|E_-| = \frac{q\,2l}{4\pi\varepsilon_0 \sqrt{(R^2+4l^2)^3}} = |E_0|$$

$$\varphi = \frac{q}{4\pi\varepsilon_0 \sqrt{x^2+R^2}}$$

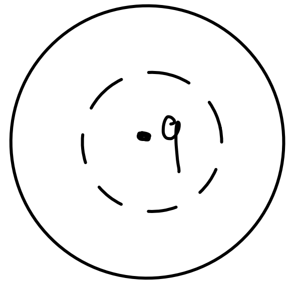
$$\varphi_0 = \varphi_- + \varphi_+ = \frac{-q}{4\pi\varepsilon_0\sqrt{2l^2+R^2}} + \frac{q}{4\pi\varepsilon_0 R}$$

N 6

q, ε $\quad \bar{P} = \varkappa \varepsilon_0 \bar{E} = \dfrac{\varkappa q}{4\pi r^2}$

$P(r) - ?$ $\quad \varkappa = \varepsilon - 1$

$q' - ?$ $\quad \int E ds = \dfrac{\sum_{i=1}^{N} q_i}{\varepsilon_0}$



$$4\pi r^2 E = \frac{q}{\varepsilon \varepsilon_0} \Rightarrow E = \frac{q}{4 \varepsilon_0 \pi r^2 \varepsilon}$$

$$\bar{P} = \frac{\varkappa q}{4\pi \varepsilon r^2} = \frac{(\varepsilon - 1) q}{4\pi \varepsilon r^2}$$