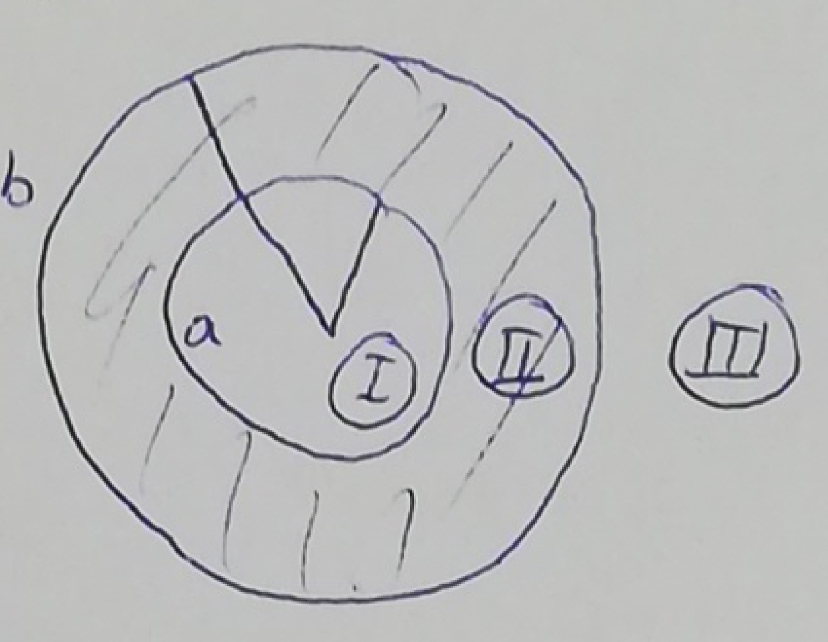
① guľ. vrstva s vnút. polomerom a a vonk. b je nab. nábojom
s obj. hust. $\rho(r) = Ar^4$
Priebeh intenzity I, II, III



I. $\oint \vec{E}\, d\vec{S} = \frac{Q'}{\varepsilon_0} = 0 \Rightarrow E = 0$

$(0 \le r \le a)$

II. $\oint \vec{E}\, d\vec{S} = \frac{Q'}{\varepsilon_0}$

$$E 4\pi r^2 = \frac{Q'}{\varepsilon_0}$$

$$E 4\pi r^2 = \frac{\int_a^r \rho 4\pi (r)^2\, dr}{\varepsilon_0} = \frac{\rho 4\pi \frac{(r^3 - a^3)}{3}}{\varepsilon_0}$$

$(a < r \le b)$

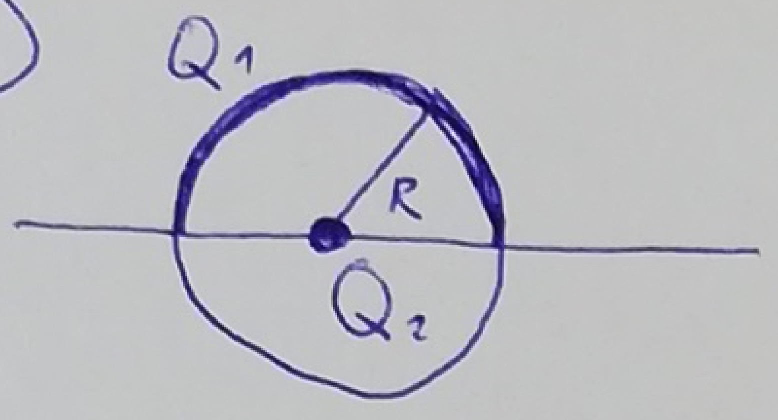
III. $\oint \vec{E}\, d\vec{S} = \frac{Q'}{\varepsilon_0}$

$$E 4\pi r^2 = \frac{\rho\left(\frac{4}{3}\pi R^3 - \frac{4}{3}\pi a^3\right)}{\varepsilon_0}$$

$$E = \frac{1}{4\pi r^2 \varepsilon_0} \rho \frac{4}{3} \pi \left(r^3 - a^3\right)$$

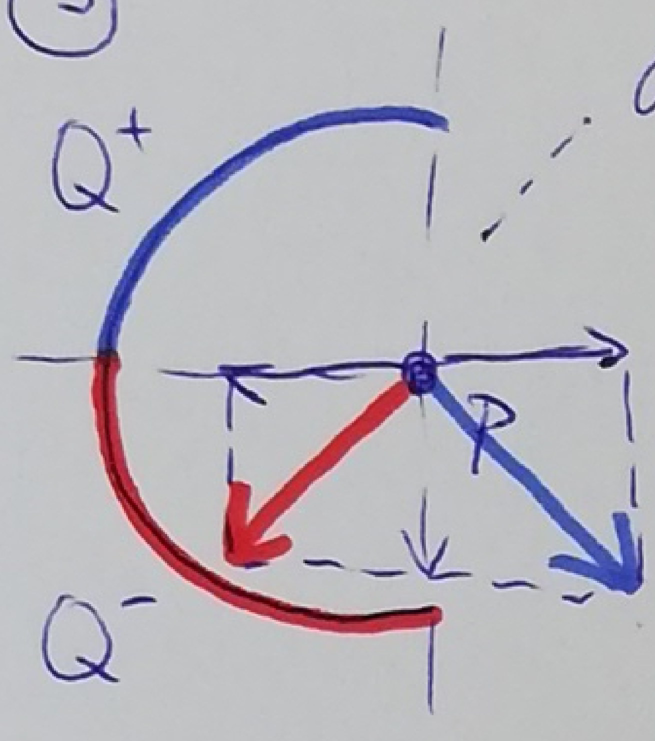
$(r > b)$

(2)



$$F_{12} = \frac{1}{4\pi\varepsilon_0}\cdot\frac{Q_1 Q_2}{R^2} = \frac{Qq}{4\pi\varepsilon_0 R^2}$$

(3)



$dl \to dq = \lambda dl$ $\quad \lambda = \frac{Q}{\pi R}$

$E_p = ?$

$$dE = \frac{dq}{4\pi\varepsilon_0}\cdot\frac{1}{R^2}$$

$$dE = \frac{\lambda dl}{4\pi\varepsilon_0}\cdot\frac{1}{R^2}$$

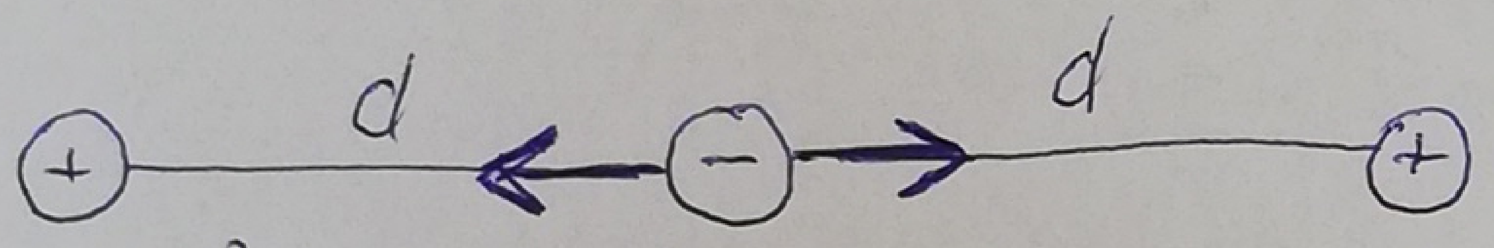
$$dE = \frac{\lambda R d\alpha}{4\pi\varepsilon_0 R^2}$$

$$= \cancel{\frac{\frac{Q}{\pi R}\, d\alpha}{4\pi\varepsilon_0 R^2}} =$$

$$E_y = \int dE \sin(\alpha) = \int \frac{\lambda R d\alpha}{4\pi\varepsilon_0 R} \sin\alpha =$$

$$= \frac{\lambda}{4\pi\varepsilon_0 R}\int \sin\alpha\, d\alpha = \frac{2\lambda}{4\pi\varepsilon_0 R} = \frac{2Q}{\pi^2\varepsilon_0 R^2}$$

(4) a)

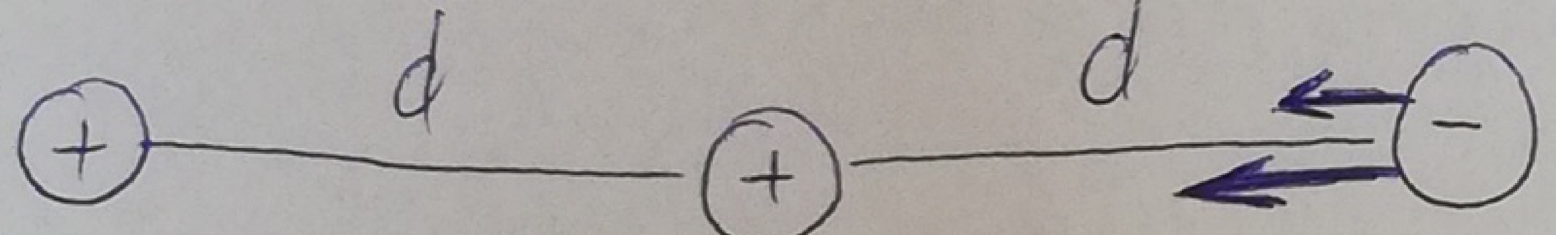


$F_1 = 0$

$$|F_e| = \frac{e^2}{4\pi\varepsilon_0 (d^2)} - \frac{e^2}{4\pi\varepsilon_0 (d^2)} = 0$$

$F_2 < F_1 < F_3$

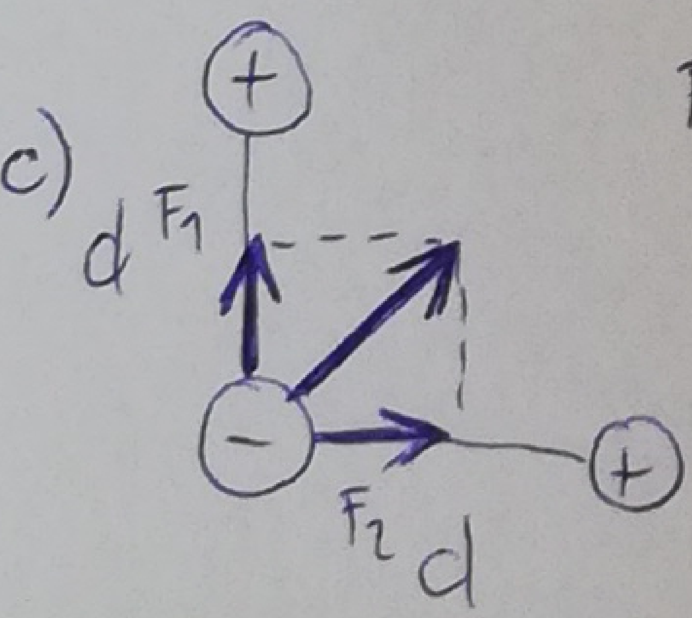
b)



$|F_3| > |F_2| > |F_1|$

$$|F_e| = -\frac{e^2}{4\pi\varepsilon_0 (d^2)} - \frac{e^2}{4\pi\varepsilon_0 (4d^2)} = -\frac{5e^2}{16\pi\varepsilon_0 d^2} = F_2$$

c)



$$F_1 = \frac{1}{4\pi\varepsilon_0}\cdot\frac{e^2}{d^2} \qquad F_2 = \frac{1}{4\pi\varepsilon_0}\cdot\frac{e^2}{(2d)^2}$$

$$|F_e| = \sqrt{F_1^2 + F_2^2} = \sqrt{\frac{17e^4}{(4\pi\varepsilon_0)^2 d^4 16}} = F_3$$