PÍSOMKA – 16. 3. 2010

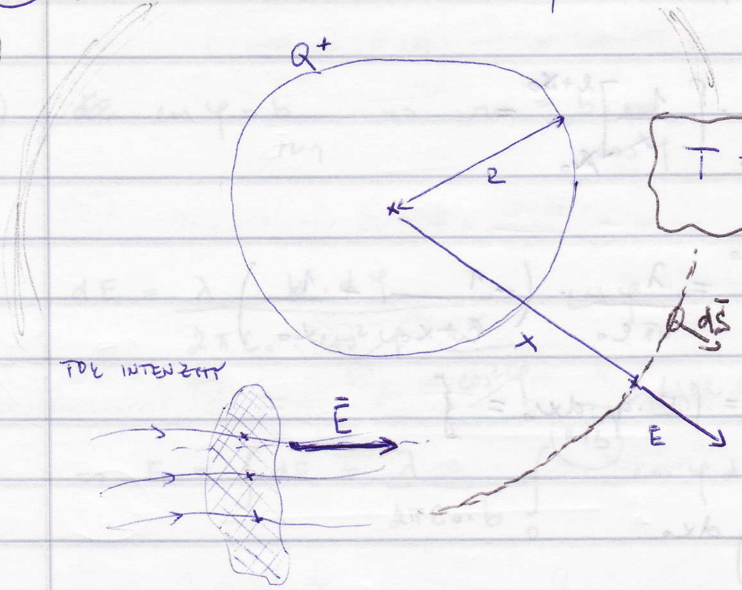
9. 3. 2010

SEMINÁR

(PR) (1.) ako bude intenzita – priebeh intenzity v závislosti od dĺžky.

x > R

$\bar{E}(x) = ?$



$$T = \oiint_S \bar{E}\, d\bar{S} = \frac{Q}{\varepsilon_0}$$ GAUSSOVA V.

$\bar{E} \parallel d\bar{S}$

$S \sim r^2$

$E \sim \frac{1}{r^2}$

$$\oiint_S E \cdot dS \cdot \cos\theta = \frac{Q}{\varepsilon_0} \Rightarrow E \cdot \oiint_S dS = \frac{Q}{\varepsilon_0} \Rightarrow E(x) = \frac{Q}{4\pi\varepsilon_0 \cdot x^2}$$

($\oiint_S dS = 4\pi x^2$)

x < R

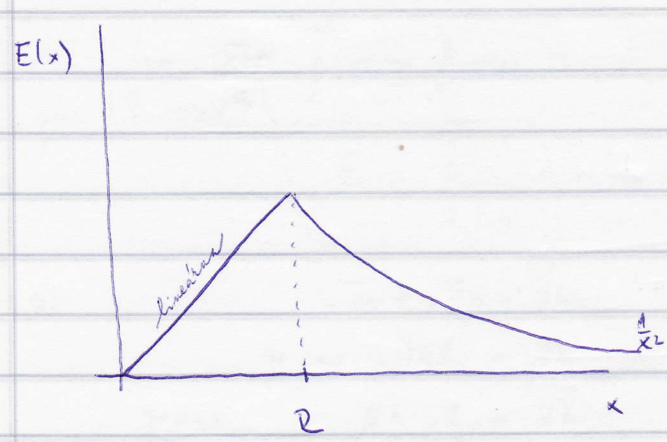
$$\oiint \bar{E} \cdot d\bar{S} = \frac{Q'}{\varepsilon_0}$$

$$Q = \frac{4}{3}\pi R^3 \cdot \rho$$

$$Q' = \frac{4}{3}\pi x^3 \cdot \rho$$

$$Q' = \frac{x^3}{R^3} \cdot Q$$

$$E \cdot 4\pi x^2 = \frac{x^3 \cdot Q}{R^3 \cdot \varepsilon_0} \Rightarrow E = \frac{Q \cdot x}{4\pi\varepsilon_0 R^3}$$



Intenzita vnútri -> $E = 0$. (vnútri sa nenachádza náboj)

Ak je náboj len na povrchu a nie je rozložený aj vnútri.

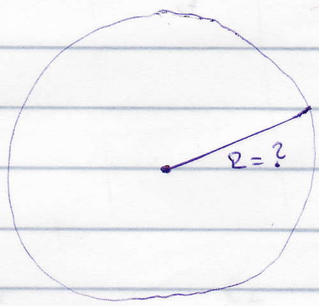
$x < R$: $E = 0$

$x > R$: $E = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q}{x^2}$

Ak je náboj rozložený v objeme $\boxed{Q = \frac{4}{3}\pi \cdot R^3 \cdot \rho}$

↳ na povrchu $\boxed{Q = 4\pi R^2 \cdot \sigma}$

(PR. 2) Aký je R? gule, aby sa naň umiestnil $Q = 1C$ (na povrchu) bez toho aby nastalo srsanie, lebo ... E_{MAX} poznáme, ε_0 tiež!!



$$\iint E\, d\bar{S} = \frac{Q}{\varepsilon_0}$$

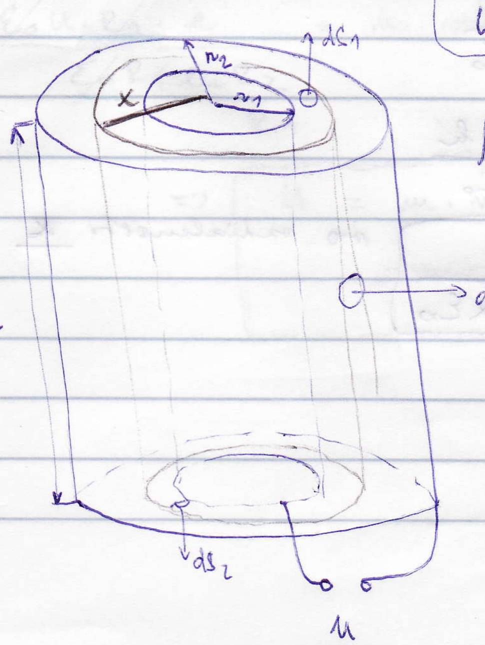
$$E \cdot 4\pi x^2 = \frac{Q}{\varepsilon_0}$$

$$E = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q}{x^2}$$

$$\Rightarrow \boxed{R = \sqrt{\frac{Q}{4\pi\varepsilon_0 \cdot E_M}}}$$

(PR. 3) Určte $U_p = ?$ ak sú ... r_1, r_2 $(r_1 < r_2)$, E_p. (koaxiál)

$$\boxed{U = \varphi(r_2) - \varphi(r_1) = \int E\, d\bar{r}}$$



$$\underbrace{\iint \bar{E}_1 d\bar{S}_1}_{0} + \underbrace{\iint \bar{E}_2 d\bar{S}_2}_{0} + \boxed{\iint \bar{E}_3 d\bar{S}_3 = \frac{Q}{\varepsilon_0}}$$

(lebo skalárny súčin sa rovná 0)

$\frac{\sigma \cdot 2\pi r_1 \cdot l}{\varepsilon_0}$ – len na vnútornom valčeku

$$E_3 \iint dS_3 = \frac{Q}{\varepsilon_0}$$

$$E \cdot 2\pi x \cdot l = \frac{\sigma \cdot 2\pi r_1 \cdot l}{\varepsilon_0}$$

intenzita medzi r_1 a r_2

$$\boxed{E = \frac{\sigma \cdot r_1}{\varepsilon_0 \, x}}$$

$$U = \int E\,dr = \int_{r_1}^{r_2} \underbrace{\frac{\sigma \cdot r_1}{\varepsilon_0 x}}_{E} \cdot dx = \frac{\sigma \cdot r_1}{\varepsilon_0} \int_{r_1}^{r_2} \frac{dx}{x} = \frac{\sigma \cdot r_1}{\varepsilon_0} \cdot \ln \frac{r_2}{r_1}$$

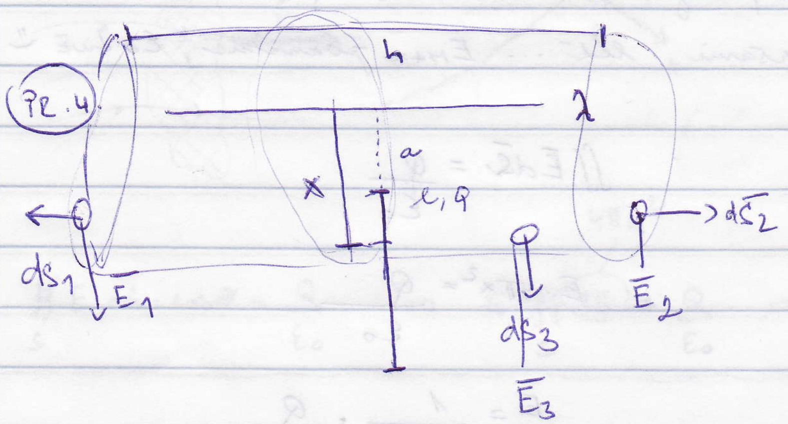
prírazná intenzita ak $x = r_1$

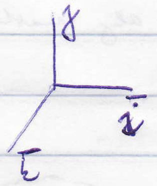
$$E_p = \frac{\sigma \cdot r_1}{\varepsilon_0 \cdot r_1} = \frac{\sigma}{\varepsilon_0}$$

$$\Rightarrow \boxed{U_p = E_p \cdot r_1 \cdot \ln \frac{r_2}{r_1}}$$

aj nekonečne dlhý drôt

Pr. 4





$$\bar{F} = \bar{E} \cdot q$$

$$\iint E\,dS = \frac{Q}{\varepsilon_0}$$

$$\iint \bar{E}_1 \cdot d\bar{S}_1 + \iint \bar{E}_2\, d\bar{S}_2 + \underbrace{\iint \bar{E}_3\, d\bar{S}_3}_{\Downarrow} = \frac{Q}{\varepsilon_0}$$

$$\iint E_3 \cdot dS_3 = \frac{Q}{\varepsilon_0}$$

$$E_3 \cdot 2\pi x \cdot h = \frac{\lambda \cdot h}{\varepsilon_0}$$

$$\boxed{E_3 = \frac{\lambda}{2\pi x \varepsilon_0}}$$ vo vzdialenosti x

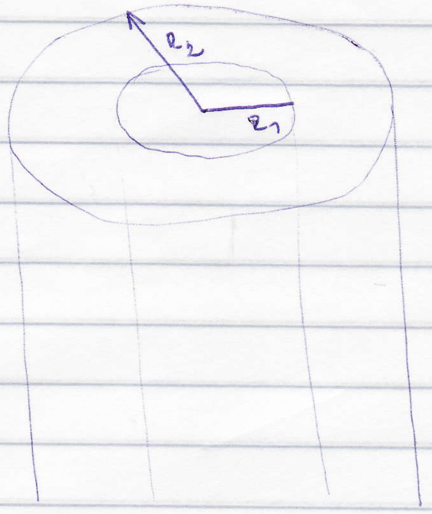
$$\int \frac{1}{x} = \ln x$$

$$d\bar{F} = \bar{E}(x) \cdot dQ \qquad dQ = dx \cdot \lambda^*$$

$$\int F = \int \frac{\lambda}{2\pi\varepsilon_0 x} \cdot \lambda^* \cdot dx \Rightarrow F = \frac{\lambda \cdot \lambda^*}{2\pi\varepsilon_0} \cdot \int_a^{a+l} \frac{dx}{x} = \frac{\lambda \cdot Q}{2\pi l \varepsilon_0} \cdot \ln \frac{a+l}{a} \qquad \lambda^* = \frac{Q}{l}$$

$$\boxed{\bar{F} = \frac{\lambda \cdot Q}{2\pi\varepsilon_0 \cdot l} \cdot \ln \frac{a+l}{a} \cdot (-\bar{j})}$$

PR. 5 koaxiál – vstrelím elektrón, nech obieha po kružnici,
$m, v, e,$ (aké je $U = ?$)



$$E(R_1 < x < R_2) = \frac{\sigma \cdot R_1}{\varepsilon_0 \cdot x}$$

ODSTREDIVÁ

$$F = E \cdot e = \frac{\sigma \cdot R_1}{\varepsilon_0 \cdot x} \cdot e = \frac{m v^2}{x}$$

$$U = \int_{R_1}^{R_2} E \cdot dr = \int_{R_1}^{R_2} \frac{\sigma R_1}{\varepsilon_0 x} \cdot dx = \frac{\sigma R_1}{\varepsilon_0} \cdot \ln \frac{R_2}{R_1}$$

$$\Rightarrow \boxed{\sigma = \frac{\varepsilon_0 \cdot U}{R_1 \cdot \ln \frac{R_2}{R_1}}}$$

$$\frac{\sigma \cdot R_1}{\varepsilon_0 \cdot x} \cdot e = \frac{m \cdot v^2}{x}$$

$$\frac{\varepsilon_0 U \cdot R_1 \cdot e}{\varepsilon_0 R_1 \ln \frac{R_2}{R_1}} = m \cdot v^2$$

$$\Rightarrow \boxed{U = \frac{m \cdot v^2 \cdot \ln \frac{R_2}{R_1}}{e}}$$