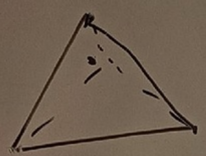
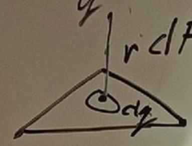
(1) $F = q \cdot E \cdot \frac{S}{S}$

$F = \sigma \cdot \Phi$

(2)



q



$r \quad dF = \frac{q\, dq}{r^2} \frac{d}{dS}$

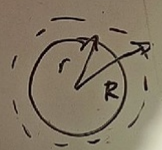
$= q \cdot \sigma \cdot d\Omega = \frac{1}{4} q \sigma \Omega_{\text{полн}} = q \pi \sigma$

(3) a)

$q \quad ES = 0 \Rightarrow E = 0$ (вн.)

$E = -\nabla \varphi \Rightarrow \varphi - \text{const}$

$\varphi(0) = 0$ ($\varphi = 0$ ($\varphi(0;r)$



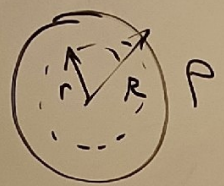
$E \cdot S = 4\pi q$

$E = \frac{q}{R^2}$

$\frac{d\varphi}{dr} = -E$

$\varphi = -\int E\, dr =$

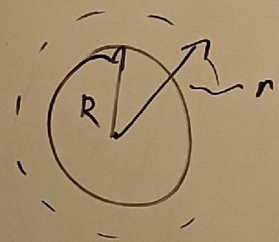
$= \frac{q}{R} + C \left(\begin{matrix} C = 0, \\ \varphi = 0 \; R \to \infty \end{matrix} \right)$



$$E\,S = 4\pi \int \rho \, dV$$

$$E r^2 = \rho \cdot \frac{4}{3} \pi r^3$$

$$E = \frac{4}{3} \rho \pi r$$



$$E\, 4\pi r^2 = 4\pi \rho \frac{4}{3} \pi R^3$$

$$E = \rho \frac{4}{3} \pi \frac{R^3}{r^2}$$

Возьмём диэл. однор. куб.

$$\Phi = 4\pi \cdot 6 l^2 \sigma \qquad dF_\perp = \sigma \cdot dS \cdot E$$

$$\Phi = 24\pi l^2 \sigma \qquad dF_\perp = \sigma \cdot d\Phi \qquad \Phi$$

(через все грани)

$$F_\perp = \sigma \cdot \Phi_{\text{полн.}}$$

$$\Phi_6 = 4\pi l^2 \sigma$$

(1 грань от 6 граней)

$$\Phi_5 = 4\pi l^2 \sigma - 2\pi \sigma l^2 = 2\pi l^2 \sigma$$

(от 5 граней)

$$F_\perp = 2\pi l^2 \sigma^2$$

$S_{тр} = \frac{l^2\sqrt{3}}{4}$

$\Phi_{полн} = 4\pi \cdot \sigma l^2 \sqrt{3}$

$\Phi_4 = \pi \sigma l^2 \sqrt{3}$ (1 грань от 4х)

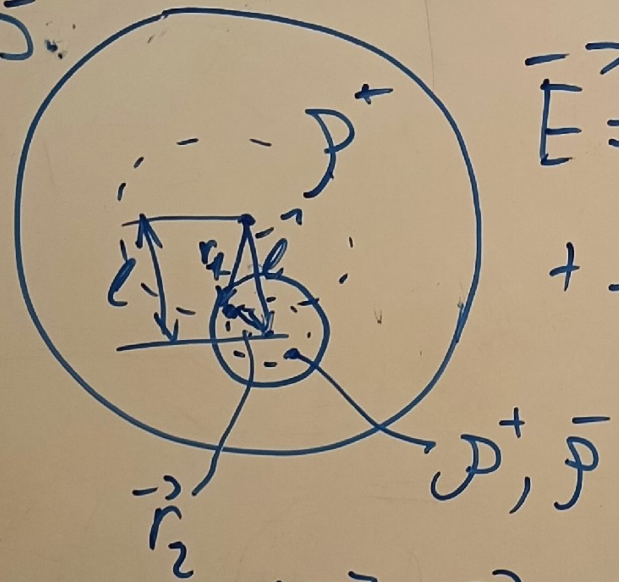
$\Phi_3 = \pi \sigma l^2 \sqrt{3} -$

$- \frac{1}{2} \pi \sigma l^2 \sqrt{3}$

(1 грань от 3х)

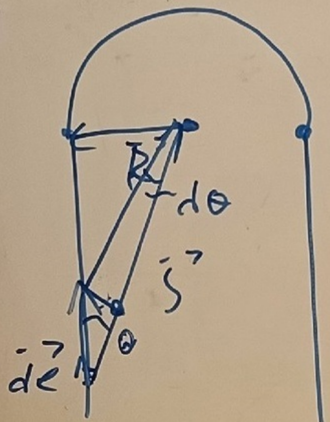
$F_1 = \frac{1}{2} \pi \sigma^2 l^2 \sqrt{3}$

$\rho^+ = -\rho^-$



$$\vec{E} = \frac{4}{3}\rho^+ \pi \vec{r}_1 + \frac{4}{3}\rho^- \pi \vec{r}_2 =$$

$$= \frac{4}{3}\pi \rho (\vec{r}_1 - \vec{r}_2) = \frac{4}{3}\pi \rho \vec{e}$$



$$dB = \frac{I}{c}\frac{d\vec{l}\times\vec{S}}{S^3}$$

$\odot$ F

$$S\cdot\sin\theta = R$$

$$dl\sin\theta = S\,d\theta$$

$$dl = S\frac{d\theta}{\sin\theta}$$

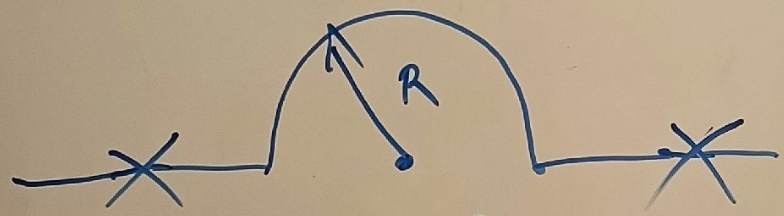
$$dB = \frac{I S\,dl\sin\theta}{c S^3} = \frac{I S^2 d\theta\,\cancel{\sin\theta}}{c S^3\,\cancel{\sin\theta}} =$$

$$= \frac{I}{c}\frac{d\theta}{S} = \frac{I}{cR}\int_0^{\frac{\pi}{2}}\sin\theta\,d\theta =$$

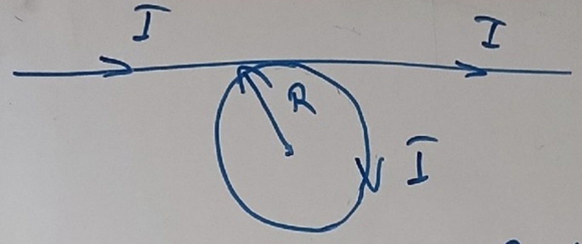
$$= \frac{I}{cR}$$

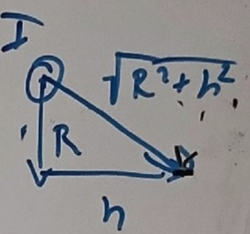
$$B_{наш} = \frac{I}{cR}+\frac{I}{cR}+\frac{I\pi R^2}{cR^3} =$$

$$= \frac{I}{cR}(2+\pi)$$



$$B = \frac{I}{c}\frac{\pi R^2}{R^3} = \frac{I\pi}{cR}$$





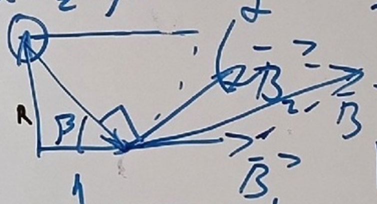
$$B_1(h) = \frac{I}{c}\oint \frac{R\,dl}{(R^2+h^2)^{3/2}} =$$

$$= 2\pi \frac{I}{c}\,\frac{R^2}{(R^2+h^2)^{3/2}}$$

$$\oint B\,dl = \frac{4\pi}{c} I \Rightarrow B_2 = \frac{2I}{c\sqrt{R^2+h^2}}$$

$\alpha = \frac{\pi}{2} + \beta$

$\sin\beta = \frac{R}{\sqrt{R^2+h^2}}$



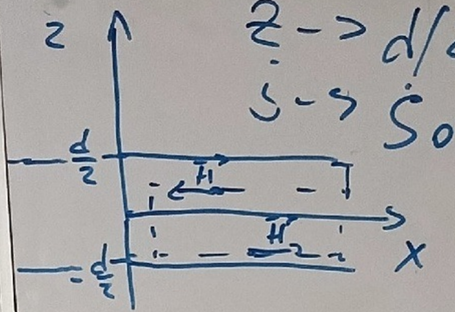
$$\vec{B} = \vec{B}_1 + \vec{B}_2$$

$$|B|^2 = |B_1|^2 + |B_2|^2 - 2|B|\cdot|B_2|\cdot\cos\alpha$$

$\cos\alpha = -\sin\beta$

$$B = \frac{2I}{c}\sqrt{\frac{\pi^2 R^4}{(R^2+h^2)^3} + \frac{1}{R^2+h^2} + 2\frac{\pi R^3}{(R^2+h^2)^{5/2}}}$$

$$B(0) = \frac{2I}{c}\sqrt{\frac{\pi^2}{R^2} + 2\pi\cdot\frac{1}{R^2} + \frac{1}{R^2}} = \frac{2I}{cR}(\pi+1)$$



$z \to d/2$

$j \to j_0$

$j = j_0 \frac{z^2}{d^2}$

$B(z) - ?$

$|z| < \frac{d}{2}$

$$\oint B\,dr = \frac{4\pi}{c} \int j\,ds$$

$$2Bl = \frac{4\pi}{c} \int_{-\frac{d}{2}}^{\frac{d}{2}} j_0 \frac{z^2}{d^2}\, l\, dz$$

$$B = \frac{2\pi j_0}{3cd^2} z^3 \Big|_{-\frac{d}{2}}^{\frac{d}{2}} = \frac{\pi j_0 d}{6c}$$

$|z| \geq \frac{d}{2}$

$$B = \frac{2\pi j_0}{3cd^2} z^3 + C^{0} \left(\begin{matrix} z=0 \\ H=0 \end{matrix} \right)$$

Магн момент: $M = I \cdot a^2$

$$\cancel{B(\vec{R}) = \frac{1}{c}\,\frac{3\vec{R}(\vec{M}\cdot\vec{R}) - \vec{M}R^2}{R^5}} =$$

$=$

Для диполя справедливо:

$$B_\perp = \frac{1}{c}\,\frac{M\sin\alpha}{r^3} \qquad B_\parallel = \frac{1}{c}\,\frac{2M\cos\alpha}{r^3}$$

$$B = \sqrt{\frac{4}{c^2}\,\frac{M^2\cos^2\alpha}{r^6} + \frac{1}{c^2}\,\frac{M^2\sin^2\alpha}{r^6}} =$$

$$= \frac{M}{cr^3}\sqrt{4\cos^2\alpha + \sin^2\alpha} = \frac{M}{cr^3}\sqrt{3\cos^2\alpha + 1}$$