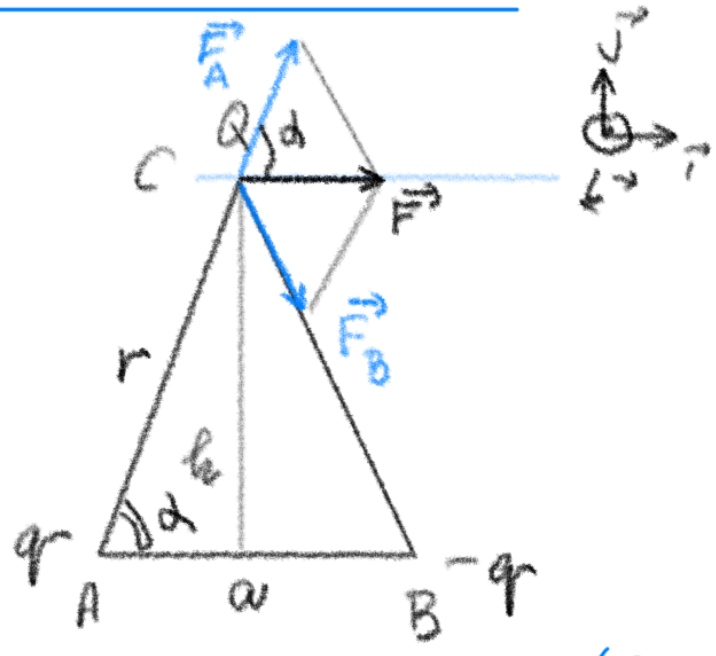
F2 2025 ZS NÁHRADNÁ PÍSOMKA – RIEŠENIE

1. $q_1 = q > 0$, $q_2 = -q_1$, $Q > 0$, $|AB| = a$, h

F)



$$F_A = F_B = \frac{1}{4\pi\varepsilon_0}\frac{Qq}{r^2}$$

$$\vec{F} = \vec{F}_A + \vec{F}_B$$

$$F_{Ay} + F_{By} = 0$$

$$F = F_{Ax} + F_{Bx} = 2F_{Ax}$$

$$\frac{a}{2} = r\cos\alpha \Rightarrow r^2 = \left(\frac{a}{2\cos\alpha}\right)^2$$

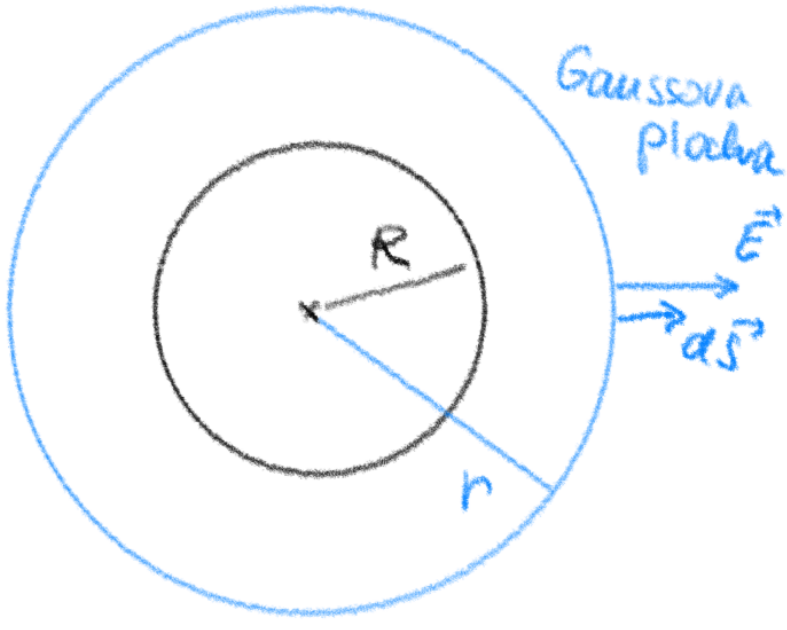
$$F_{Ax} = F_{Bx} = F_A\cos\alpha = \frac{1}{4\pi\varepsilon_0}\frac{Qq}{a^2}\,4\cos^2\alpha\cos\alpha = \frac{Qq}{\pi\varepsilon_0 a^2}\cos^3\alpha$$

$$\cos\alpha = \frac{a}{2r} = \frac{a}{2\sqrt{\frac{a^2}{4}+h^2}} = \frac{a}{\sqrt{a^2+4h^2}}$$

$$F = 2\frac{Qq}{\pi\varepsilon_0 a^2}\cdot\frac{a^3}{\left(\sqrt{a^2+4h^2}\right)^3} = \frac{2Qq}{\pi\varepsilon_0 a^2}\,\frac{1}{(1+4h^2/a^2)^{3/2}}$$

2. C)

R



$$C = \frac{Q}{\varphi}$$

$$\varphi = -\int_{\infty}^{R} E\,dr$$

$$\oint_S \vec{E}\cdot d\vec{S} = \frac{Q}{\varepsilon_0}$$

$$\vec{E} \parallel d\vec{S} \Rightarrow \vec{E}\cdot d\vec{S} = E\,dS$$

$$\oint_S \vec{E}\cdot d\vec{S} = \oint_S E\,dS = E\oint_S dS = E\,4\pi r^2$$

$$E 4\pi r^2 = \frac{Q}{\varepsilon} \Rightarrow \quad E = \frac{Q}{4\pi\varepsilon r^2}$$

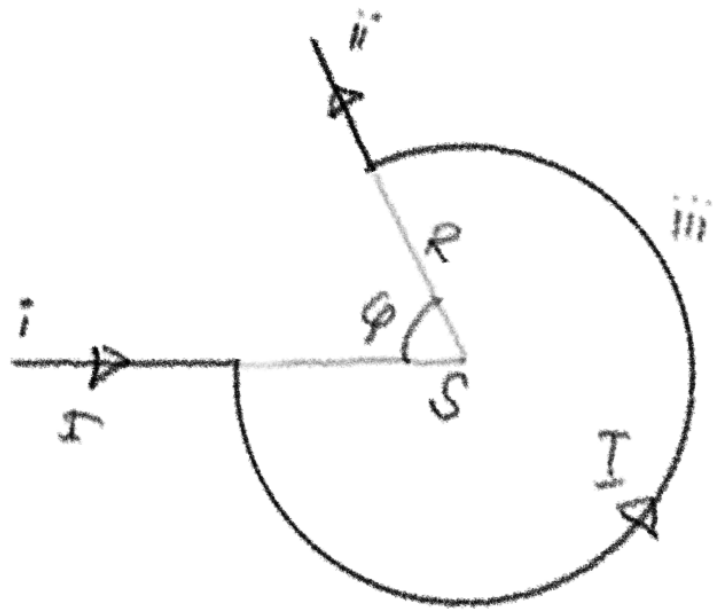
$$\varphi = -\int_{\infty}^{R} \frac{Q}{4\pi\varepsilon r^2}\, dr = -\frac{Q}{4\pi\varepsilon}\left[-\frac{1}{r}\right]_{\infty}^{R} = \frac{Q}{4\pi\varepsilon R}$$

$$C = \frac{Q}{\varphi} = \frac{Q\, 4\pi\varepsilon R}{Q} = 4\pi\varepsilon R$$

$$\underline{\underline{R = \frac{C}{4\pi\varepsilon}}}$$

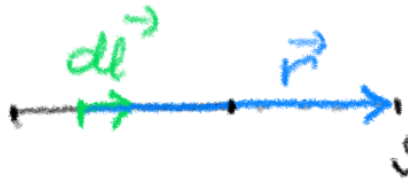
(3) $\dfrac{I_1 R_1 \varphi}{B_j}$

$$\vec{B} = \vec{B_i} + \vec{B_{ii}} + \vec{B_3}$$



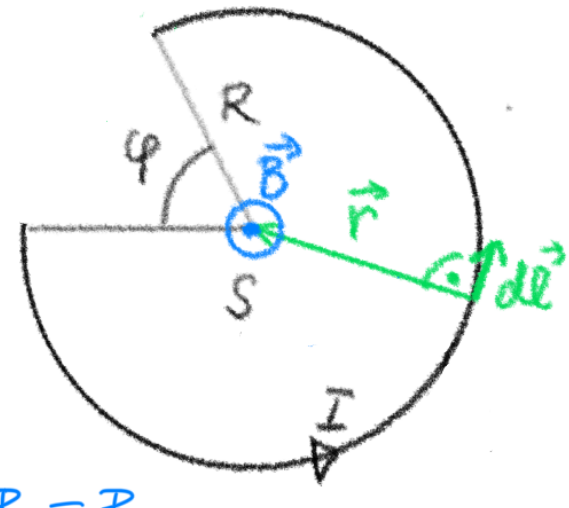
$$d\vec{B} = \frac{\mu_0}{4\pi} I \frac{d\vec{l} \times \vec{r}}{r^3}$$

i, ii) $\vec{B_i} = \vec{B_{ii}} = 0$ lebo $d\vec{l} \parallel \vec{r}$



iii) $\vec{B_{iii}}$ má smer z nákresne ⊙ $\vec{B_{iii}}$

a $\vec{r} \perp d\vec{l} \Rightarrow |d\vec{l} \times \vec{r}| = r\,dl = R\,dl$



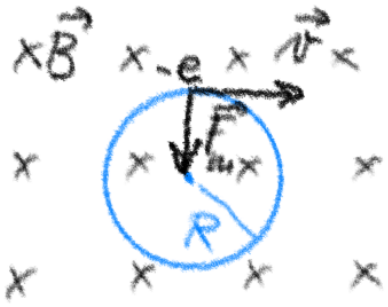
$$dB = \frac{\mu_0}{4\pi} I \frac{dl}{R^2} = \frac{\mu_0 I}{4\pi} \frac{R\,d\varphi}{R^2} = \frac{\mu_0 I}{4\pi R} d\varphi$$

$$B_{iii} = \frac{\mu_0 I}{4\pi R} \int_0^{2\pi-\varphi} d\varphi = \frac{\mu_0 I}{4\pi R}(2\pi - \varphi); \quad B = B_{iii}$$

$B = \frac{\mu_0 I}{4\pi R}(2\pi - \varphi)$ a smer má z nákresne ⊙.

4. $-e, m_e, v, B$

fj



$\vec{F_m} = -e\vec{v} \times \vec{B} \quad \vec{v} \perp \vec{B}$

$F_m = evB = F_d$

$F_d = m_e \frac{v^2}{R} =$ $\qquad v = R\omega = R2\pi f$

$evB = m_e \frac{v^2}{R} \Rightarrow v = \frac{eBR}{m_e} \Rightarrow \omega = \frac{eB}{m_e}$

$f = \frac{eB}{2\pi m_e}$