EMP – 2. labos – 2009/10
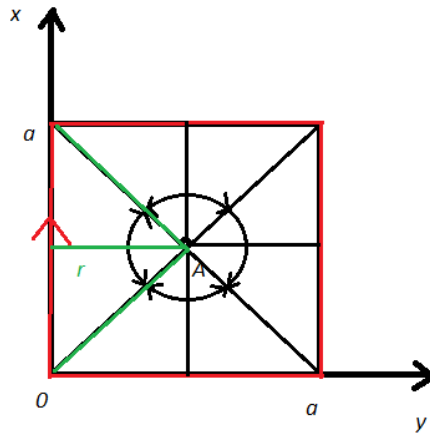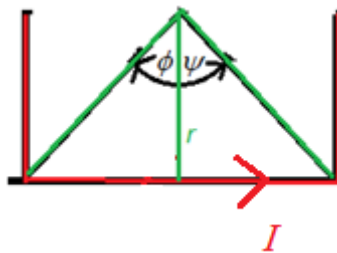
Priprema

Najprije za točku A. S time da sam krivo nacrtao x i y os :D

Sva četiri trokuta su ista, pa će ukupna indukcija bit 4 puta veća od one koju smo izračunali za jedan segment. I preko pravila desne ruke magnetska indukcija ima smjer $-\overrightarrow{a_z}$.
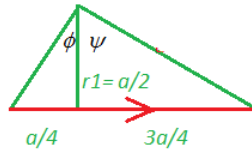

$$\overrightarrow{B_{A1}} = -\frac{\mu_0 I}{4\pi r}(\sin\varphi + \sin\psi)\overrightarrow{a_z} = -\frac{\mu_0 I}{\frac{4\pi a}{2}}\left(\sin\frac{\pi}{4} + \sin\frac{\pi}{4}\right)\overrightarrow{a_z} = -\frac{\mu_0 I\sqrt{2}}{2\pi a}\overrightarrow{a_z}$$

$$\overrightarrow{B_A} = 4\overrightarrow{B_{A1}} = -\frac{\mu_0 I 2\sqrt{2}}{\pi a}\overrightarrow{a_z}$$

Za točku B nije ista stvar, jer kutevi i r-ovi nisu svugdje isti. Pa ćemo napravit račun za sva četiri segmenta petlje.
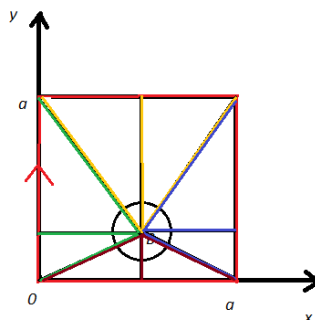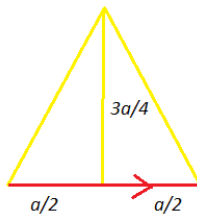
Za segment 1 vrijedi sljedeće:

$$\overrightarrow{B_{B1}} = -\frac{\mu_0 I}{4\pi r}(\sin\varphi + \sin\psi)\overrightarrow{a_z} = -\frac{\mu_0 I}{\frac{4\pi a}{2}}\left(\frac{\frac{a}{4}}{\sqrt{\frac{a^2}{16}+\frac{a^2}{4}}} + \frac{\frac{3a}{4}}{\sqrt{\frac{9a^2}{16}+\frac{a^2}{4}}}\right)\overrightarrow{a_z}$$

$$= -\frac{\mu_0 I}{2\pi a}\left(\frac{\sqrt{5}}{5} + \frac{3\sqrt{13}}{13}\right)\overrightarrow{a_z}$$

Ista takva stvar će biti i za segment 3 ☺

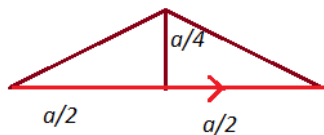$$\overrightarrow{B_{B3}} = -\frac{\mu_0 I}{2\pi a}\left(\frac{\sqrt{5}}{5} + \frac{3\sqrt{13}}{13}\right)\overrightarrow{a_z}$$

Idemo sada na segment 2 :D

$$\overrightarrow{B_{B2}} = -\frac{\mu_0 I}{4\pi r}(\sin\varphi + \sin\psi)\overrightarrow{a_z} = -\frac{\mu_0 I}{\frac{4\pi \cdot 3a}{4}}\left(\frac{\frac{a}{2}}{\sqrt{\frac{9a^2}{16}+\frac{a^2}{4}}} + \frac{\frac{a}{2}}{\sqrt{\frac{9a^2}{16}+\frac{a^2}{4}}}\right)\overrightarrow{a_z} = -\frac{\mu_0 I}{3\pi a}\frac{4\sqrt{13}}{13}\overrightarrow{a_z}$$

I još zadnji, segment 4:

$$\overrightarrow{B_{B2}} = -\frac{\mu_0 I}{4\pi r}(\sin\varphi + \sin\psi)\overrightarrow{a_z} = -\frac{\mu_0 I}{\frac{4\pi a}{2}}\left(\frac{\frac{a}{2}}{\sqrt{\frac{a^2}{16}+\frac{a^2}{4}}} + \frac{\frac{a}{2}}{\sqrt{\frac{a^2}{16}+\frac{a^2}{4}}}\right)\overrightarrow{a_z} = -\frac{\mu_0 I}{\pi a}\frac{4\sqrt{5}}{5}\overrightarrow{a_z}$$

Pa je konačno indukcija za točku B

$$\vec{B_B} = -2\frac{\mu_0 I}{2\pi a}\left(\frac{\sqrt{5}}{5} + \frac{3\sqrt{13}}{13}\right)\vec{a_z} - \frac{\mu_0 I}{3\pi a}\frac{4\sqrt{13}}{13}\vec{a_z} - \frac{\mu_0 I}{\pi a}\frac{4\sqrt{5}}{5}\vec{a_z} = -\frac{\mu_0 I}{\pi a}\left(\sqrt{5} + \frac{\sqrt{13}}{3}\right)\vec{a_z}$$

$$\frac{B_A}{B_B} = \frac{-\dfrac{\mu_0 I 2\sqrt{2}}{\pi a}}{-\dfrac{\mu_0 I}{\pi a}\left(\sqrt{5} + \dfrac{\sqrt{13}}{3}\right)} = \frac{2\sqrt{2}}{\sqrt{5} + \dfrac{\sqrt{13}}{3}} = 0.82$$