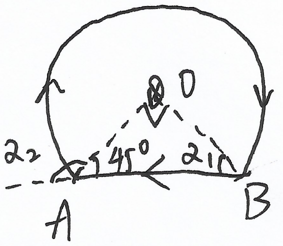
3. Дано: $\varphi = 45^\circ$, R | B – в центре



Магнитное поле из отрезка AB:

$$B_1 = \int_{\alpha_1}^{\alpha_2} \frac{\mu\mu_0 I}{4\pi} \cdot \frac{\frac{\sqrt{2}}{2}R\, d\alpha \sin\alpha}{\left(\frac{\sqrt{2}R}{2\sin\alpha}\right)^2 \sin^2\alpha} = \frac{\mu\mu_0 I}{4\pi}\int_{\alpha_1}^{\alpha_2} \frac{\sqrt{2}\sin\alpha\, d\alpha}{R}$$

$$= -\frac{\sqrt{2}\mu\mu_0 I}{4\pi R}\cos\alpha\Big|_{\alpha_1}^{\alpha_2}$$

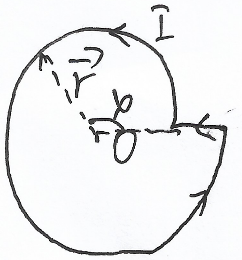
$$= \frac{\mu\mu_0 I}{2\pi R}$$

Из дуги $\overset{\frown}{AB}$:

$$B_2 = \int_0^{\frac{3}{2}\pi R} \frac{\mu\mu_0 I}{4\pi}\cdot\frac{dl}{R^2} = \frac{\mu\mu_0 I}{4\pi R^2}\cdot\frac{3}{2}\pi R = \frac{3\mu\mu_0 I}{8R}$$

$$B = B_1 + B_2 = \cancel{\frac{3+2\sqrt{2}}{8}\mu\mu_0 I}\ \frac{\mu\mu_0 I}{2\pi R} + \frac{3\mu\mu_0 I}{8R}$$

4. Дано: $r = r_0(1+\varphi)$ | B – в O?



$$dB = \frac{\mu\mu_0}{4\pi}\cdot\frac{I\,dl}{r^2} = \frac{\mu\mu_0 I}{4\pi}\cdot\frac{(r_0(1+\varphi))d\varphi}{(r_0(1+\varphi))^2}$$

$$= \frac{\mu\mu_0 I}{4\pi}\,\frac{d\varphi}{r_0(1+\varphi)}$$

$$= \frac{\mu\mu_0 I}{4\pi r_0}\ln(1+\varphi)\Big|_0^{2\pi}$$

$$= \frac{\mu\mu_0 I}{4\pi r_0}\left(\ln(1+2\pi) - \ln 1\right)$$

$$= \frac{\mu\mu_0 I}{4\pi r_0}\ln(2\pi+1)$$