HW #6

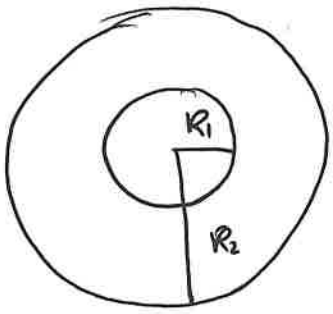
(1) $B = \frac{\mu_0 I}{2R}$

$B = 6\,mT = 6 \times 10^{-3}\,T$

$R = 0.5\,cm = 0.5 \times 10^{-2}\,m$

$$I = \frac{2RB}{\mu_0} = \frac{2 \times 0.5 \times 10^{-2} \cdot 6 \times 10^{-3}}{4 \times 3.14 \times 10^{-7}} = 47.7\,A$$

(2)

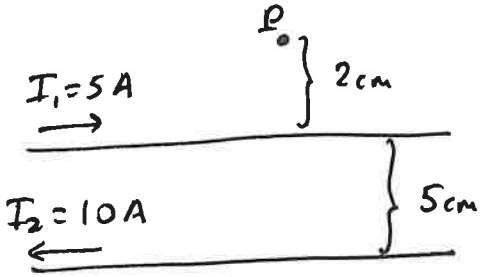


$B_1 = B_2$

$$\frac{\mu_0 I_1}{2R_1} = \frac{\mu_0 I_2}{2R_2} \Rightarrow \frac{20}{R_2} = \frac{12}{3}$$

then: $R_2 = 3 \cdot \frac{20}{12} = 5\,cm$

(3)



$$B_1 = \frac{\mu_0 I_1}{2\pi a_1} = \frac{4\pi \cdot 10^{-7} \cdot 5}{2\pi \cdot 0.02} = 5 \times 10^{-5}\,T$$

out of the page

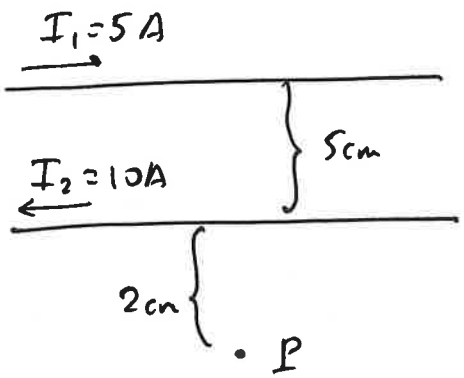
$$B_2 = \frac{\mu_0 I_2}{2\pi a_2} = \frac{4\pi \times 10^{-7} \cdot 10}{2\pi \cdot 0.07} = 2.85 \times 10^{-5}\,T$$

into the page

$B_p = B_1 - B_2 = (5 - 2.85)\,10^{-5} = 2.15 \times 10^{-5}\,T$ → out of the page

(4)

(4)



$$B_1 = \frac{\mu_0 I_1}{2\pi a_1} = \frac{4\pi \times 10^{-7} \cdot 5}{2\pi \cdot 0.07} =$$

$$= 1.43 \times 10^{-5} T$$

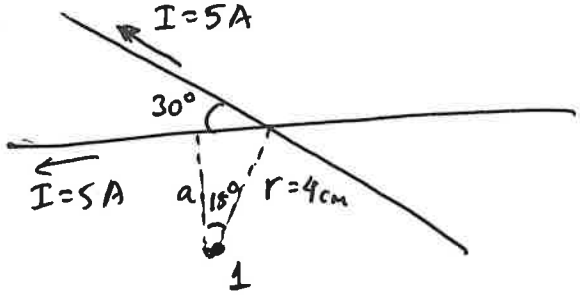
into the page

$$B_2 = \frac{\mu_0 I_2}{2\pi a_2} = \frac{4\pi \times 10^{-7} \cdot 10}{2\pi \cdot 0.02} = 10 \times 10^{-5} T$$

out of the page

$B_p = B_2 - B_1 = 8.57 \times 10^{-5}\ T$ out of the page

(5)



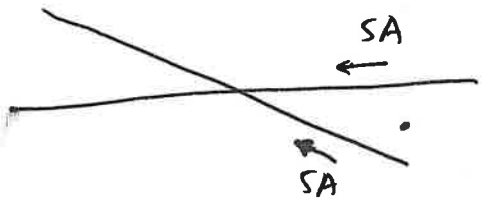
$$a = r \cdot \cos 15^\circ = 0.04 \times \cos 15^\circ =$$

$$= 0.038\ m$$

$$B = B_1 + B_2 = 2 \cdot \frac{\mu_0 I}{2\pi a} =$$

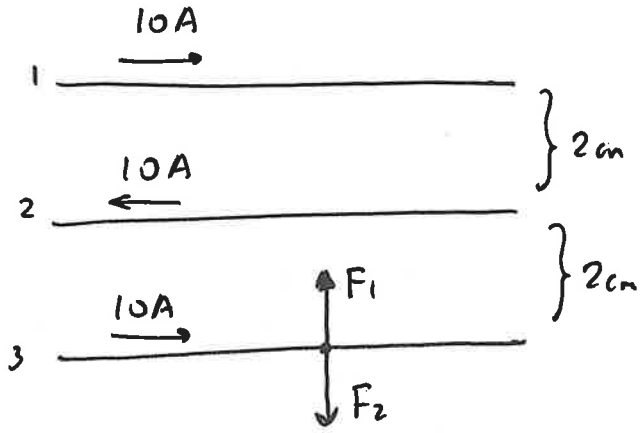
$$= \frac{2 \cdot 4\pi \times 10^{-7} \cdot 5}{2 \cdot \pi \cdot 0.038} = 5.26 \times 10^{-5}\ T$$

(6)



$B = B_1 - B_2 = 0$

(7)



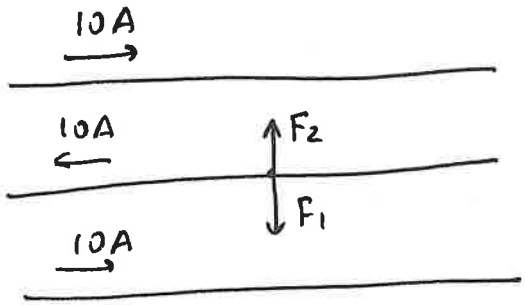
$$\frac{F}{L} = \frac{\mu_0 I_1 I_2}{2\pi a}$$

$$\frac{F_1}{L} = \frac{\mu_0 \cdot 10 \cdot 10}{2\pi \cdot 0.04} = \frac{4\pi \times 10^{-7} \cdot 100}{2\pi \cdot 0.04} = 5 \times 10^{-3} \ N/m$$

$$\frac{F_2}{L} = \frac{\mu_0 \cdot 10 \cdot 10}{2\pi \cdot 0.02} = 10 \times 10^{-3} \ N/m$$

$$\frac{F_{net}}{L} = \frac{F_2}{L} - \frac{F_1}{L} = 5 \times 10^{-3} \ N/m$$

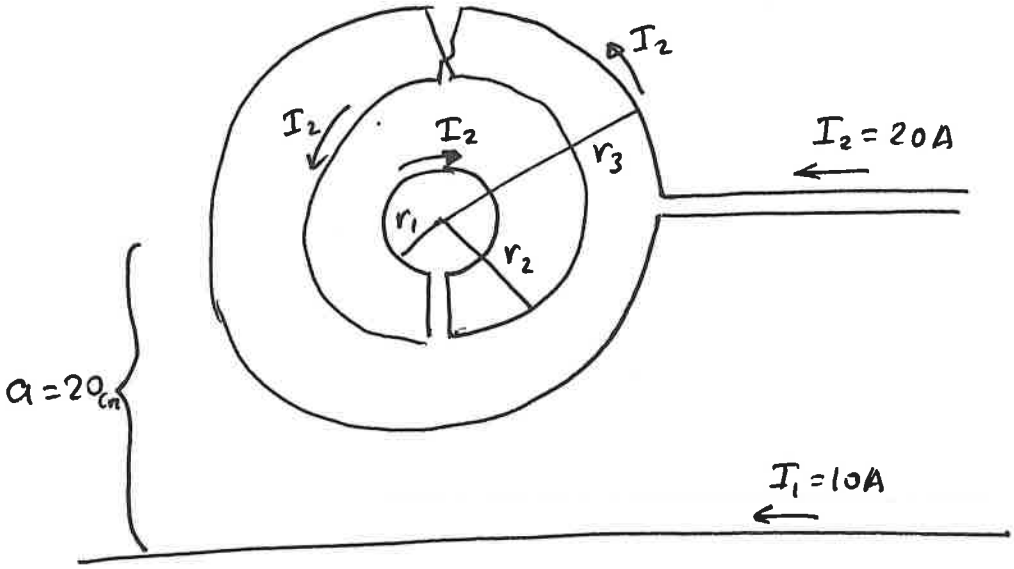
(8)



$F_1 = F_2$

$F_{net} = F_1 - F_2 = 0$

(9)



$$B_{wire} = \frac{\mu_0 I_1}{2\pi a} = \frac{4\pi \times 10^{-7} \cdot 10}{2\pi \cdot 0.2} = 10^{-5}\,T \rightarrow \underline{\text{into}} \text{ the page}$$

$$B_1 = \frac{\mu_0 I_2}{2 r_1} = \frac{4\pi \times 10^{-7} \cdot 20}{2 \cdot 0.03} = 41.9 \times 10^{-5}\,T - \underline{\text{into}} \text{ the page}$$

$$B_2 = \frac{\mu_0 I_2}{2 r_2} = \frac{4\pi \times 10^{-7} \cdot 20}{2 \cdot 0.06} = 21 \times 10^{-5}\,T - \underline{\text{out}} \text{ of the page}$$

$$B_3 = \frac{\mu_0 I_2}{2 r_3} = \frac{4\pi \times 10^{-7} \cdot 20}{2 \cdot 0.09} = 13.95 \times 10^{-5}\,T \rightarrow \underline{\text{out}} \text{ of the page}$$

$$B_{net} = |\, B_{wire} + B_1 - B_2 - B_3 \,| = \underline{7.95 \times 10^{-5}\,T}$$