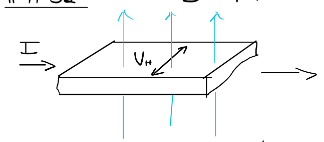
1

II-11-52

$B = 1\,T$



$\longrightarrow I = 2A$

Hall sensor

$V_H = 1{,}5\,\mu V$

Find $\underline{B}$ that gives $V_H = 2\,\mu V$ for $I = 1.7\,A$

$$V_H = \frac{IBl}{neA} = IB\left(\frac{l}{neA}\right) \longrightarrow \left(\frac{l}{neA}\right) = \frac{V_H}{IB} = \frac{1.5\,\mu V}{2A \cdot 1T}$$

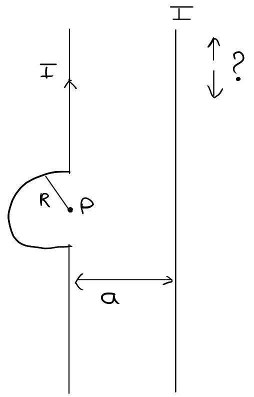
(..) parameters that are particular to the Hall sensor

$$= 0{,}75\,\frac{\mu V}{AT}$$

$$\longrightarrow B = \frac{V_H}{I\left(\frac{l}{neA}\right)} = \frac{2}{1{,}7 \cdot 0.75}\,T = \underline{1{,}57\,T}$$

2

II-12-21



Find a such that $B(P) = 0$

Magnetic field due to the arch is

$$B(P) = \frac{\mu_0 I}{4\pi R}\cdot\pi = \frac{\mu_0 I}{4R}$$ into the page

burfum I up the page to counteract this

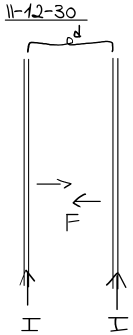
$$B = \frac{\mu_0 I}{2\pi a}$$

so we need

$$\frac{\mu_0 I}{4R} = \frac{\mu_0 I}{2\pi a} \longrightarrow 4R = 2\pi a \longrightarrow \underline{a = \frac{2R}{\pi}}$$

3

II-12-30



$d = 0{,}25\,m$

$I = 50\,A$

$$\frac{F}{l} = \frac{\mu_0 I_1 I_2}{2\pi d}$$

a) Attraction for parallel currents (check energy density..)

$$\frac{F}{l} = \frac{4\pi\cdot 10^{-7}\,(50)^2}{2\cdot\pi\cdot 0{,}25} \approx 2\cdot 10^{-3}\,N/m$$

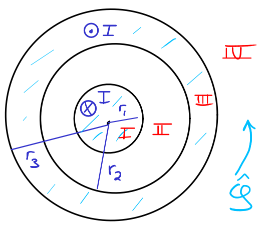
b) Attraction

c) For antiparallel currents there is a repulsion between the currents (best understood from the energy density of the system, and how it changes as d is varied..)

4

II-12-48

Find B caused by the homogeneous currents



a) I, $r < r_1$

b) II, $r_1 < r < r_2$

c) III, $r_2 < r < r_3$

d) IV, $r > r_3$

$$\oint \vec{B}\cdot d\vec{l} = \mu_0 I_{enc}$$

I: $I_{enc}(r) = I\left(\frac{r}{r_1}\right)^2$

$$\longrightarrow 2\pi r B = \mu_0 I \left(\frac{r}{r_1}\right)^2 \longrightarrow B = \frac{\mu_0 I}{2\pi r_1^2}\,r$$

and

$$\boxed{\vec{B} = -\frac{\mu_0 I}{2\pi r_1^2}\,r\,\hat{\varphi}}$$

Linear in r

5

II : $2\pi r B = \mu_0 I \rightarrow \boxed{\bar{B} = -\frac{\mu_0 I}{2\pi r}\hat{\varphi}}$

IV : $\bar{B} = 0$ as $I_{enc} = 0$

III : $\bar{B} = \bar{B}_1 + \bar{B}_2$

$$\bar{B}_1 = -\frac{\mu_0 I}{2\pi r}\hat{\varphi}$$

For $\bar{B}_2$:

$$2\pi r B_2 = \mu_0 I_{enc}, \quad I_{enc} = I\frac{(r^2-r_2^2)}{(r_3^2-r_2^2)}$$

$$\rightarrow B_2 = \frac{\mu_0 I}{2\pi r}\frac{(r^2-r_2^2)}{(r_3^2-r_2^2)}$$

and the total in III

$$\boxed{\bar{B} = \frac{\mu_0 I}{2\pi r}\left\{-1 + \frac{(r^2-r_2^2)}{(r_3^2-r_2^2)}\right\}\hat{\varphi}},$$

and

$B(r_3) = 0$