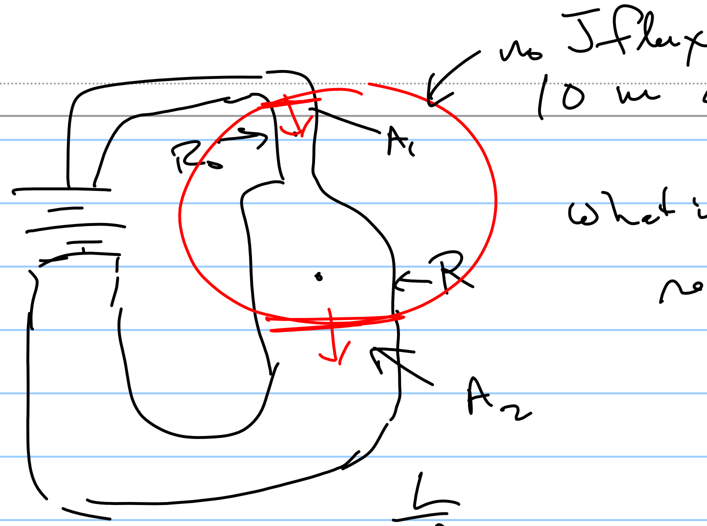
Note Title 4/15/2009

10 m copper wire

what is the current density in each region?



$\frac{L}{\sigma A}$

Princip: $V = IR$ $J = \sigma E$

charge is conserved

$$\vec{\nabla} \cdot \vec{J} = -\frac{\partial \rho}{\partial t} = 0$$

ρ is constant

method: $\vec{\nabla} \cdot \vec{J} = 0 \rightarrow \oint J \cdot d\vec{a} = 0$

$$J_1 A_1 - J_2 A_2 = 0 \qquad J = \rho v_d$$

$$J_1 = J_2 \frac{A_2}{A_1}$$

check:

areas → together ⇒ same J or v_d

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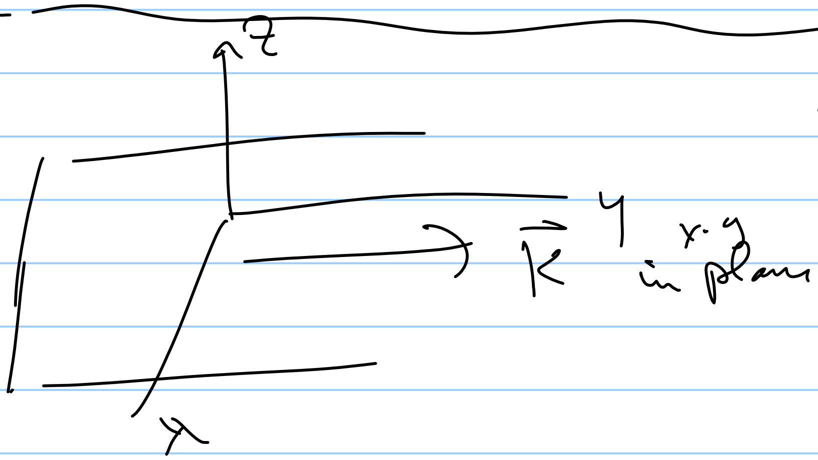
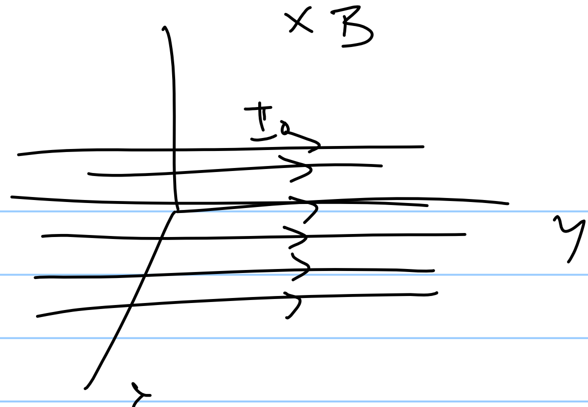
find B



Prin.

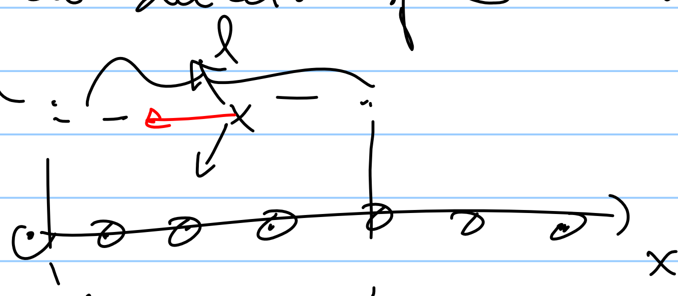


Biot S. & Amps law

Method: solve Amps law for B

Better Amp ⇒ $\oint \vec{B} \cdot dl = \mu_0 I_{enc}$

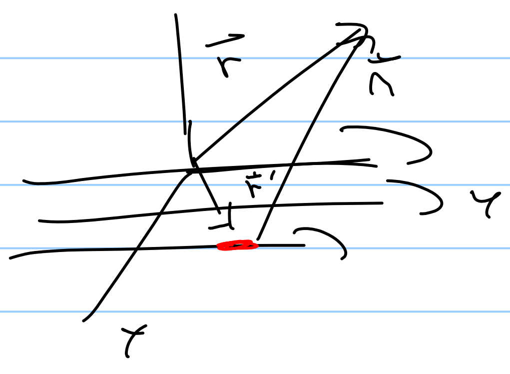
need to know direction of B to draw amp path:



Amp path has to be a rectangle

integrate $\oint \vec{B} \cdot d\vec{l} = \mu_0 I_{en} = \mu_0 \#\text{ wires } I_0$

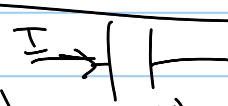
Method Biot & Savart $B = \frac{\mu_0}{4\pi} \int \frac{I\, d\vec{l} \times \hat{r}}{r^2}$



$d\vec{l} = y\,\hat{y}$

Check: I or $K \to 0$ $\quad B \to 0$

$r \to \infty$ $\quad B$? infinite current



$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I_{enc} = \mu_0 \left(I_{enc}^{charge} + I_{enc}^{\int \epsilon_0 \partial E / \partial t \, da} \right)$$

I_{enc}^{charge}: 0 in cap

$$E^{(0)} = \frac{\sigma}{\epsilon_0}$$

$B(t)$