

PHYS 5C:

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Date May 5, 2017

I. Magnetism

- Positive current direction is given by Right Hand Rule of the integration path
- $\int \mathbf{B} \cdot d\mathbf{L}$, for a circular path, then $\mathbf{B} \parallel d\mathbf{L}$
- Ampere's law is always true and sometimes useful for finding \mathbf{B}
- To extract \mathbf{B} : pick a path where:

\mathbf{B} is constant and $\mathbf{B} \parallel d\mathbf{L}$

where \mathbf{B} changing, make $\mathbf{B} \perp d\mathbf{L}$ ($\mathbf{B} \cdot d\mathbf{L} = 0$)

Examples: long straight out of board. $B = \frac{\mu I}{2\pi r}$

Because \mathbf{B} is constant $\int \mathbf{B} \cdot d\mathbf{L} \Rightarrow B \int dL \Rightarrow 2\pi r B = \mu I$

- Long straight wire with cross section radius R

1. $r < R$

Current density $J = \frac{I}{\pi R^2}$

$$\int \mathbf{B} \cdot d\mathbf{L} = B 2\pi r = \mu I_{\text{enc}} \Rightarrow \mu \frac{I r^2 \pi}{R^2 \pi} \Rightarrow I \mu \frac{r^2}{R^2}$$

$$B = \frac{\mu I}{2\pi R^2} r$$

2. $r > R$

$$\int \mathbf{B} \cdot d\mathbf{L} = \mu I_{\text{enc}} \Rightarrow B 2\pi r = \mu I \Rightarrow B = \frac{\mu I}{2\pi r}$$

II. Solenoid

- Infinitely long closed-packed solenoid