

How To Find the Magnetic Field due to a Current-Carrying Wire Using the Biot-Savart Law

1. First, draw a picture.
2. Break the wire into segments (either straight-line segments or simple curves), and label the currents in each.
3. For each segment:
 - Blacken a piece of wire $d\vec{l}$ (your line element).
 - Draw the vector \vec{r} from the line element to the point P where you are finding the magnetic field due to the wire.
 - Using the Biot-Savart Law $d\vec{B} = \frac{\mu_0}{4\pi} I \frac{d\vec{l} \times \hat{r}}{r^2}$, write down the contribution to the \vec{B} field $d\vec{B}$ for that little piece $d\vec{l}$. The direction of $d\vec{B}$ is given by the RHR.
 - Sum all of the contributions from all the pieces $d\vec{l}$ of the wire, $B_{\text{tot}} = \int d\vec{B} = \int \frac{\mu_0}{4\pi} I \frac{d\vec{l} \times \hat{r}}{r^2}$, for each vector component. This is usually the hardest step and often needs a change of variables to get a tractable integral.

Note that sometimes you can just use an expression for the B field due to a segment that you already know or are given.

4. Add (vectorially) contributions to \vec{B} from each of the segments.