**Magnetic field near a straight wire**

**Problem:** Find the magnetic field at a point *P* which is a distance *y* away from the midpoint of a thin wire of length *L*, carrying current .

*I*

*x*

*P*

*y*

**Solution:** We’ll divide the wire into a bunch of short lengths , and calculate the field at *P* using the Biot-Savart law:

**Step 1:**

Let’s make the *x*-axis along the wire, with just below *P*. What is the distance in the Biot-Savart law, in terms of *x* and *y* on the drawing?

**Step 2:**

What is the direction of the vectors and ?

**Step 3:**

What is the direction of ? Is the direction the same for all along the wire?

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**Step 4**

You know that . Which is the one you want, or ?

**Step 5**

In fact, which is bigger: , , or are they the same?

**Step 6**

Combine your answers from steps 1 through 5 to rewrite the Biot-Savart law so that the cross product is gone and all geometric variables are in terms of *x* and *y*. (What variable are you integrating over, anyway?)

**Step 7**

Evaluate the integral, remembering your limits of integration.

**Step 8**

Just out of curiosity, what does your answer reduce to in the limit ?

*Note: one of the following might be helpful:*





