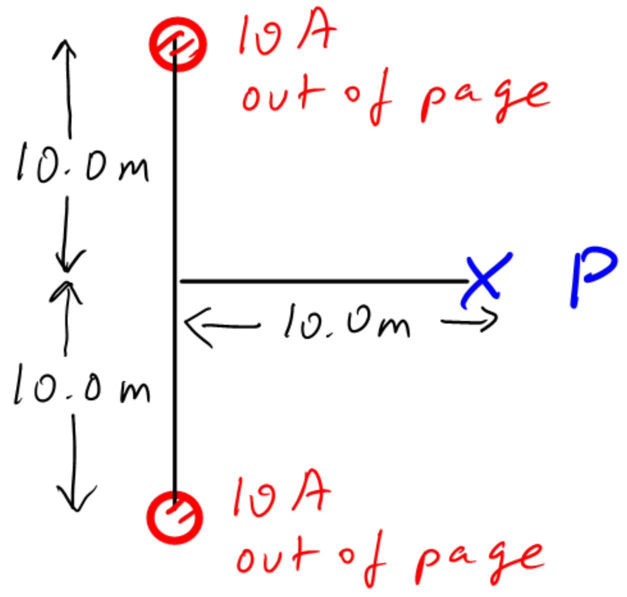
PhysicsTutor

Magnetic field

Giambattista 19.99

Problem:

- Two conducting wires perpendicular to the page are shown in cross section as red dots in the figure. They each carry 10.0 A out of the page. What is the magnetic field at point *P*?



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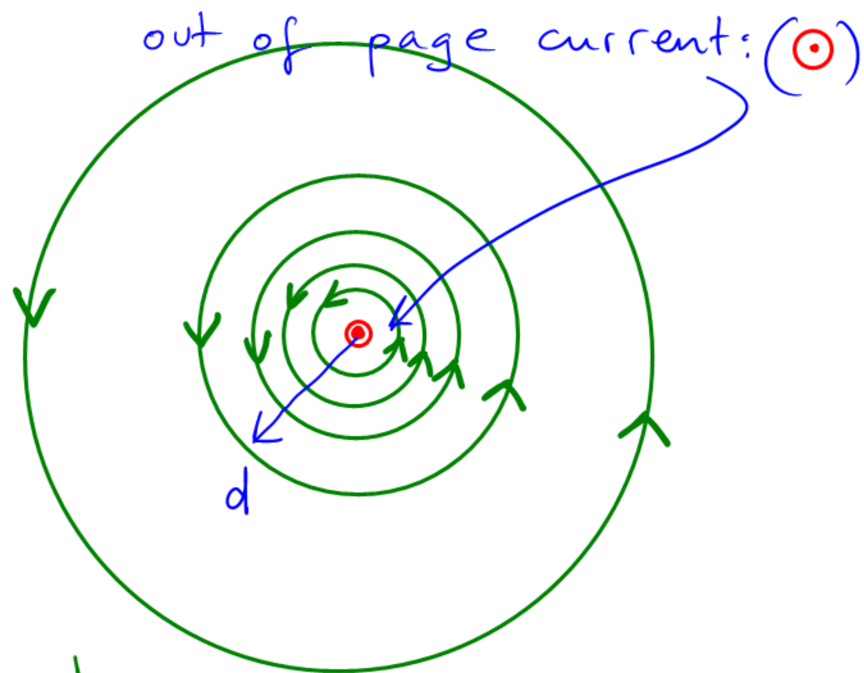
- A long current-carrying wire is surrounded by a magnetic field whose strength drops as 1/d.

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

strength of B falls off with distance d



Spacing of field lines grows with d.

Relevant ideas:

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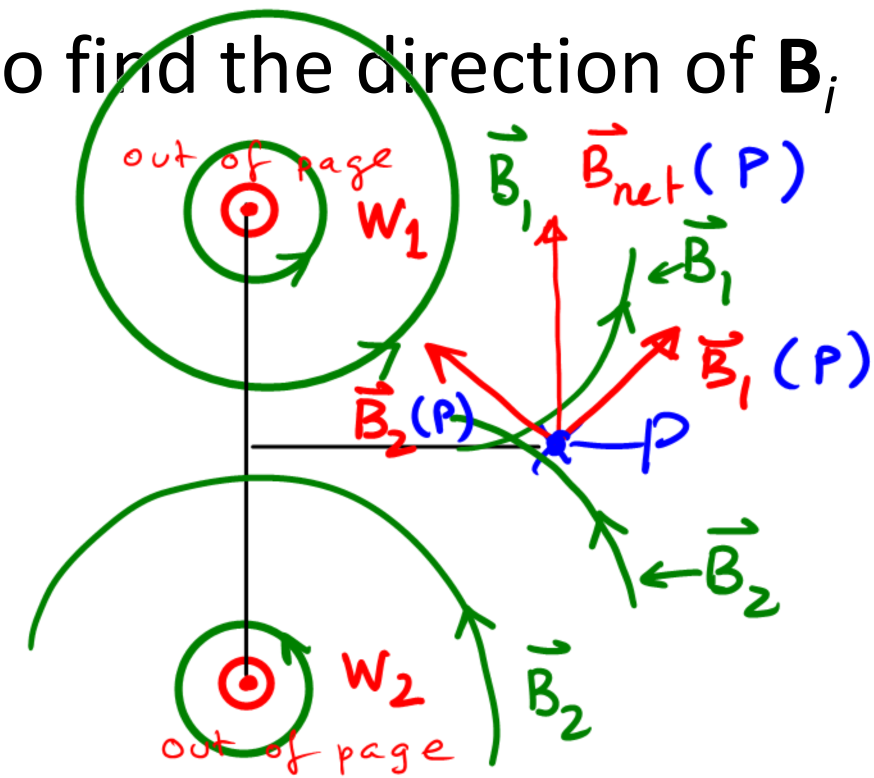
- The field lines are circles about the wire. Use the Right-Hand rule to find the direction of $\mathbf{B}_i$ at *P* for wires i = 1, 2.



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- A long current-carrying wire is surrounded by a magnetic field whose strength drops as 1/d.
- The field lines are circles about the wire. Use the Right-Hand rule to find the direction of $\mathbf{B}_i$ at P for wires i = 1, 2.
- The net magnetic field adds all contributions.

vector addition required!

Do <u>not</u> add: $B_1 = \frac{\mu_0 I}{2\pi d_1}$ and $B_2 = \ldots$

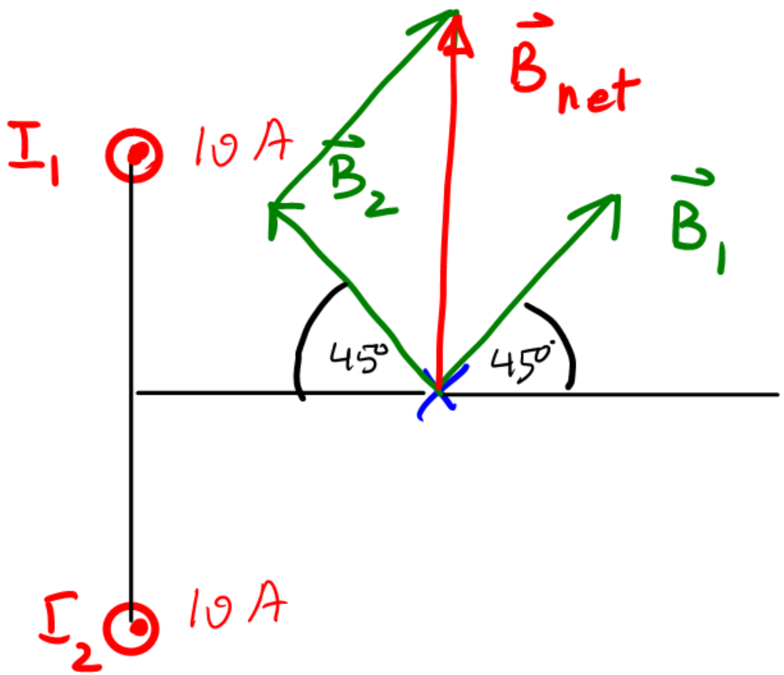
Equations associated with ideas:

$$B = \frac{\mu_0 I}{2\pi d} \qquad B_i = \frac{\mu_0 I_i}{2\pi d_i}$$

$I_1 = I_2 = I$

$i = 1, 2$

$d_1 = d_2$



$B_{net}^2 = 2 B_1^2$

since $\vec{B}_1$, $\vec{B}_2$

form a square

Strategy

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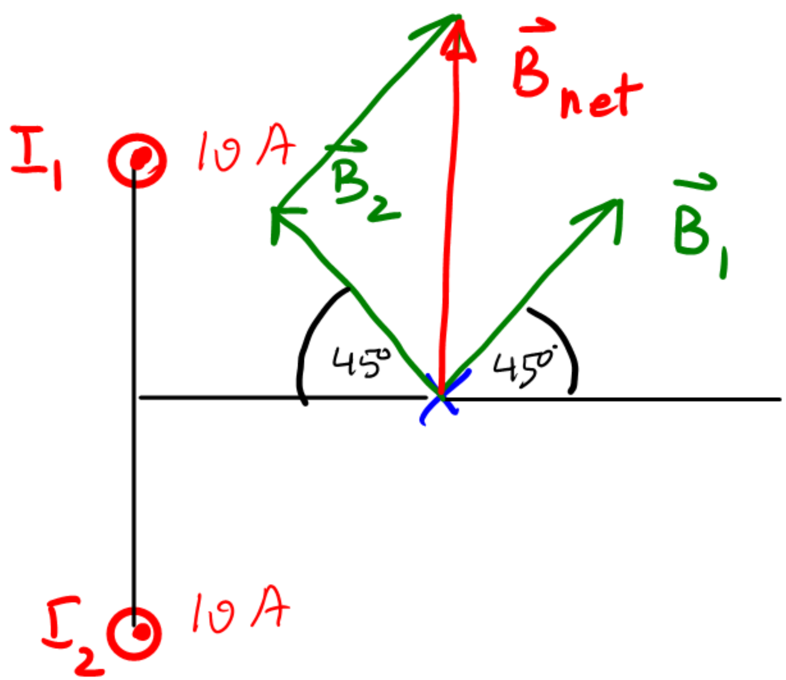

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- The net magnetic field at *P* is pointing up: the horizontal components cancel.
- Use vector addition: the magnetic field strength formula yields the magnitudes of $\mathbf{B}_1$ and $\mathbf{B}_2$. The components are obtained from trigonometry (or geometry).

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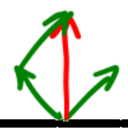
- vector addition  $B_{net} = \sqrt{2 B_1^2} = 2.0 \times 10^{-7}\ \text{T}$
- $\vec{B}_{net} = 2.0 \times 10^{-7}\ \text{T}\ \hat{j}$; upward direction