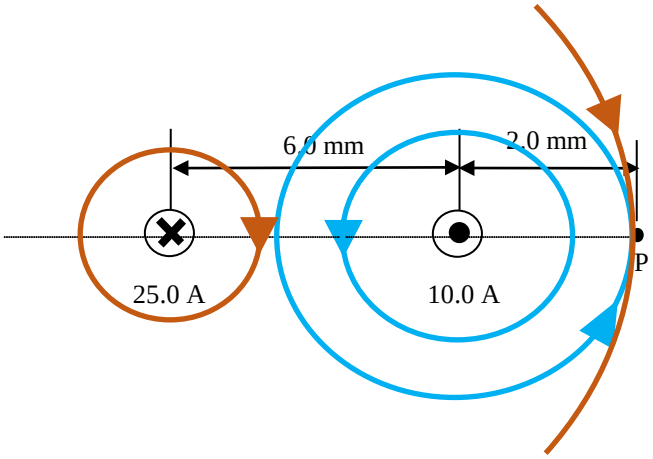
Physics Quiz #4 Name_____



$\mu_0 = 4\ \pi \times 10^{-7}\ T{\cdot}m/A$

As illustrated above, the wire on the left has 25.0 A of current flowing through it and the wire on the right has 10.0 A of current flowing through it. With regards to the point of interest, P, answer the following questions. (Notice the '·' and the 'x' to indicate the direction of current flow.)

A) What is the magnetic field at point P due only to the wire on the left?

From Ampere's Law

$$\oint \vec{B} \cdot d\vec{s} = \mu_0 I$$

The magnetic field at point P due to the wire on the left is upward and extends around a circle centered on the wire. If this circle is chosen as the path for integrating the left side of the equation for Ampere's Law, the B field is parallel to the path and its magnitude is a constant. Therefore, the equation becomes

$$B \oint d\vec{s} = \mu_0 I$$

The distance around a circle is a circumference so

$$B\, 2\pi\, r = \mu_0 I$$

The distance between the wire and the point of interest is 8.0 mm. Therefore, the magnetic field is

$$B = \frac{\mu_0 I}{2\pi\, r} = \frac{\left(4\pi \times 10^{-7}\, T \cdot m / A\right)\left(25.0 A\right)}{2\pi\, \left(8.0 \times 10^{-3} \mathrm{m}\right)} = 6.25 \times 10^{-4} T$$

*in the **downward** direction (by the right-hand rule).*

B) What is the magnetic field at point P due only to the wire on the right?

The distance from this wire and the point of interest is 2.0 mm. The equation generated for part A is the same for this wire and, therefore, the magnetic field is

$$B = \frac{\mu_0 I}{2\pi r} = \frac{\left(4\pi \times 10^{-7} T \cdot m / A\right)\left(10.0A\right)}{2\pi \left(2.0 \times 10^{-3} \text{m}\right)} = 1.00 \times 10^{-3} T$$

*in the **upward** direction (by the right-hand rule).*

C) What is the magnetic field at point P due to both wires?
Since magnetic field is a vector and the magnetic fields are in opposite direction, they combine to give a field of

$$B = -6.25 \times 10^{-4} T + 1.00 \times 10^{-3} T = 3.75 \times 10^{-4} T$$

*in the **upward** direction.*

D) 1 tesla = 10,000 gauss. What is your answer in terms of gauss?

$$B = 3.75 \times 10^{-4} T \left(\frac{10,000\ G}{1.00\ T} \right) = 3.75\ G$$

The earth's magnetic field is around 0.5 G, this field is 7.5x that of the earth's.