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MFF 6A: STRAIGHT CURRENT-CARRYING WIRE

MFF6A-WBT1: STRAIGHT CURRENT-CARRYING WIRE

Draw and describe a physical arrangement to which the equation below could apply.

$$1 \times 10^{-5} T = \frac{(4\pi \times 10^{-7} \text{ m} \cdot \text{T/A})(2.50 \text{ A})}{2\pi(0.05 \text{ m})}$$

MFF6A-WBT2: STRAIGHT CURRENT-CARRYING WIRE

Draw and describe a physical arrangement to which the equation below could apply.

$$0.133m = \frac{(4\pi \times 10^{-7} m \cdot T / A)(10A)}{2\pi(1.50 \cdot 10^{-5} T)}$$

MFF6A-WBT3: STRAIGHT CURRENT-CARRYING WIRE

Draw and describe a physical arrangement to which the equation below could apply.

$$7.50A = \frac{2\pi(.05m)(3.00 \times 10^{-5}T)}{4\pi \times 10^{-7} m \cdot T/A}$$

MFF6A-CCT1: STRAIGHT CURRENT-CARRYING WIRE

Consider the following statements made by three students.

Student I: “For a long, straight wire to create a magnetic field, it only needs to have current flowing in the wire.”

Student II: “For a long, straight wire to create a magnetic field, it will create a magnetic field if it has a net charge.”

Student III: “A long, straight wire cannot create a magnetic field by itself.”

Which, if any, of these three students do you believe is correct? Explain fully why you chose as you did.

MFF6A-CCT2: STRAIGHT CURRENT-CARRYING WIRE

Consider the following statements made by three students.

Student I: “For a current-carrying long, straight wire, the magnetic field generated looks like the magnetic field generated around a bar magnet.”

Student II: “For a current-carrying long, straight wire, the magnetic field generated looks like circular loops around the wire with the wire as the center of the loops.”

Student III: “For a current-carrying long, straight wire, the magnetic field generated looks like straight lines sticking out of the wire.”

Which, if any, of these three students do you believe is correct? Explain fully why you chose as you did.

MFF6A-WWT1: STRAIGHT CURRENT-CARRYING WIRE

“A long, straight wire is conducting current whose direction is pointing out of the paper towards you. The magnetic field generated by this wire may be represented by concentric circular loops (with the wire being the center of the circle) evenly separated from the wire.”

What, if anything, is wrong with the above statement about this situation? If something is wrong, explain the error and how to correct it. If the statement is legitimate as it stands explain why it is valid.

MFF6A-WWT2: STRAIGHT CURRENT-CARRYING WIRE

“A long, straight wire is conducting current whose direction is pointing out of the paper towards you. The magnetic field generated by this wire may be represented by concentric circular loops (with the wire being the center of the circle) in the clockwise direction.”

What, if anything, is wrong with the above statement about this situation? If something is wrong, explain the error and how to correct it. If the statement is legitimate as it stands explain why it is valid.

MFF6A-WWT3: STRAIGHT CURRENT-CARRYING WIRE

What, if anything, is wrong with the following statement? If something is wrong, explain the error and how to correct it. If the statement is legitimate as it stands, explain why it is valid.

“A long, straight wire is conducting current whose direction is pointed out of the paper towards you. The magnetic field generated by this wire is into the paper to the right of the wire and out of the paper to the left of the wire.”

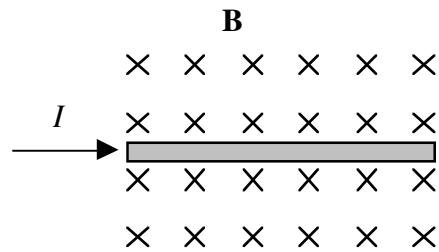
MFF6A-TT1: STRAIGHT CURRENT-CARRYING WIRE

There is at least one error in the statement below. Identify the error(s) and explain how to correct it (them).

“A current-carrying long, straight wire is conducting current in the + x-direction. The direction of the magnetic field generated must be out of the x-y plane everywhere in the region of the wire.”

MFF6A-TT2: STRAIGHT CURRENT-CARRYING WIRE

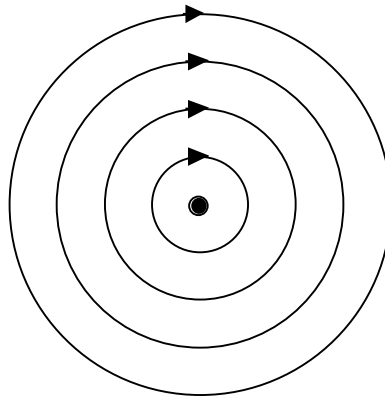
As shown in the figure below, a current-carrying long, straight wire is conducting current to the right. The magnetic field generated by the current in the wire is uniform and into the paper.



There is at least one error in the diagram and/or statement above. Identify the error(s) and explain how to correct it (them).

MFF6A-TT3: STRAIGHT CURRENT-CARRYING WIRE

As shown in the figure below, a current-carrying long straight wire is conducting current out of the paper (indicated by the •). Concentric circles in the clockwise direction indicate the magnetic field generated by this current-carrying wire.



There is at least one error in the diagram and/or statement above. Identify the error(s) and explain how to correct it (them).

MFF6A-LMCT1: STRAIGHT CURRENT-CARRYING WIRE

As shown in the figure below, a current-carrying long, straight wire is conducting current to the right. Point P is located above the wire as shown.



A number of changes in this situation will be described below. For each change, you are to identify how the change will affect, if it will, the magnetic field generated by the current-carrying wire at point P.

The possible answers are:

- A. this change will only alter the direction of the magnetic field generated by the wire.
- B. this change will only increase the magnitude of the magnetic field generated by the wire.
- C. this change will only decrease the magnitude of the magnetic field generated by the wire.
- D. this change will alter both the magnitude and direction of the magnetic field generated by the wire.
- E. this change will not affect the magnetic field generated by the wire.

Each change below refers to the original situation stated above:

- The current in the wire is replaced by a larger current.** _____
- The direction of the current in the wire is reversed.** _____
- The current in the wire is reduced to zero.** _____
- The current in the wire is replaced by a smaller current.** _____
- Point P is moved closer to the current-carrying wire.** _____
- Point P is moved further away from the current-carrying wire.** _____
- Point P is moved the same distance below the wire.** _____

MFF6A-PET1: STRAIGHT CURRENT-CARRYING WIRE

A current-carrying long, straight wire is initially conducting current towards the east. The current is reversed.

What will happen to the magnetic field generated by the current-carrying wire? Explain fully.

MFF6A-PET2: STRAIGHT CURRENT-CARRYING WIRE

A current-carrying long, straight wire is conducting current out of the paper. The current direction is reversed.

What will happen to the magnetic field generated by the current-carrying wire? Explain fully.

MFF6A-M/MCT1: STRAIGHT CURRENT-CARRYING WIRE

The figure below shows a long, straight wire conducting a 10 A current. Point P is 0.05 m from the wire.



Given below is a student's calculation for the magnetic field generated by the current-carrying, long straight wire.

$$\vec{B} = \frac{(4\pi \cdot 10^{-7} \text{ m} \cdot \text{T} / \text{A})(10\text{A})}{2\pi(.05\text{m})} \hat{k}$$

Is this calculation meaningful (i.e., it tells us something legitimate about this situation) or is it meaningless (i.e., the value calculated is either nonsense, or it tells us nothing legitimate about this situation)?

MFF6A-QRT1: STRAIGHT CURRENT-CARRYING WIRE

The figure below shows a point P near a current-carrying long, straight wire. Point P and the wire lie in the plane of the paper.



What is the direction of the magnetic field due to the current-carrying wire at point P?

What would happen to the direction of the magnetic field at point P if the current in the wire was reversed?

What would happen to the magnetic field at point P if the current in the wire was increased?

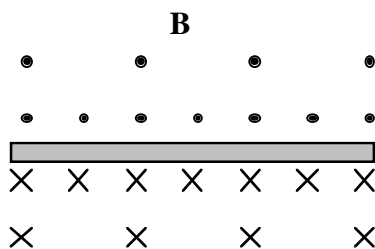
What would happen to the magnetic field at point P if the current in the wire was decreased?

What would happen to the magnetic field at P if point P was moved farther away from the wire?

What would happen to the magnetic field at P if point P was moved closer to the wire?

MFF6A-QRT2: STRAIGHT CURRENT-CARRYING WIRE

The figure below shows the magnetic field due to a current-carrying long, straight wire.



What is the direction of the current in the wire?

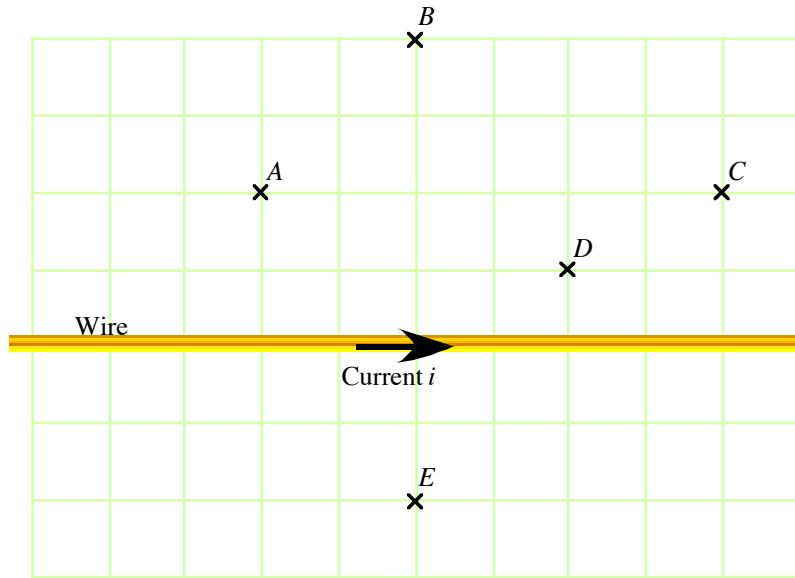
If we reversed the direction of the current, what would happen to the direction of the magnetic field generated by the wire?

If we increase the current flowing in the wire, what will happen to the strength of the generated magnetic field?

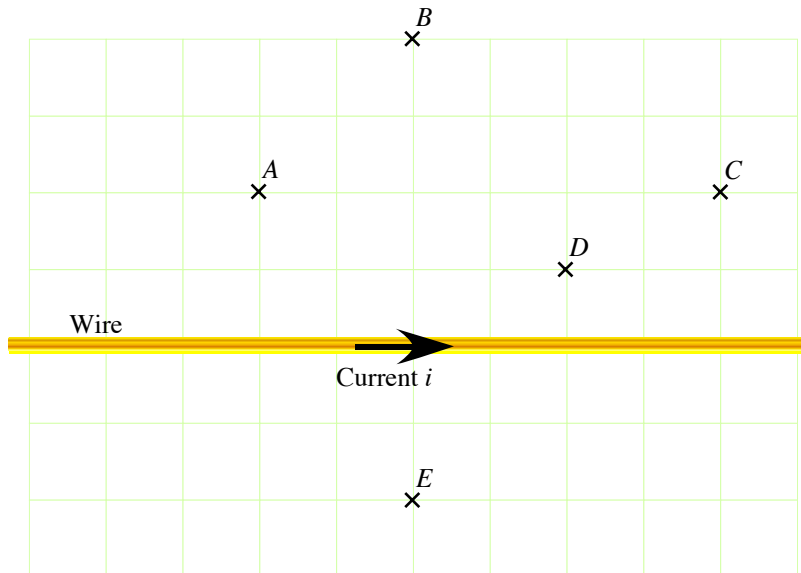
Describe the strength of the magnetic field as a function of the distance from the wire.

MFF6A-BCT1: STRAIGHT CURRENT-CARRYING WIRE

The figure below shows a current-carrying long, straight wire conducting current in the $+x$ -direction.



Represent on the bar chart below, the magnitude of the magnetic field at the various points shown in the diagram above given the magnitude at point A.



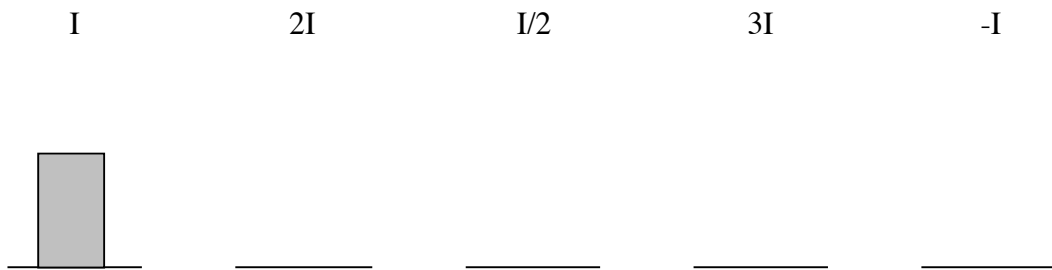
Explain the reasoning behind your bar charts:

MFF6A-BCT2: STRAIGHT CURRENT-CARRYING WIRE

The figure below shows a current-carrying long, straight wire conducting current in the $+x$ -direction. Point P is located a distance r away from the wire.



Represent on the bar chart below the magnitude of the magnetic field at point P if the current in the wire can change. The current in the wire is indicated above each bar chart, and the bar chart for P in the figure is given.



Explain the reasoning behind your bar charts:

MFF6A-CRT1: STRAIGHT CURRENT-CARRYING WIRE

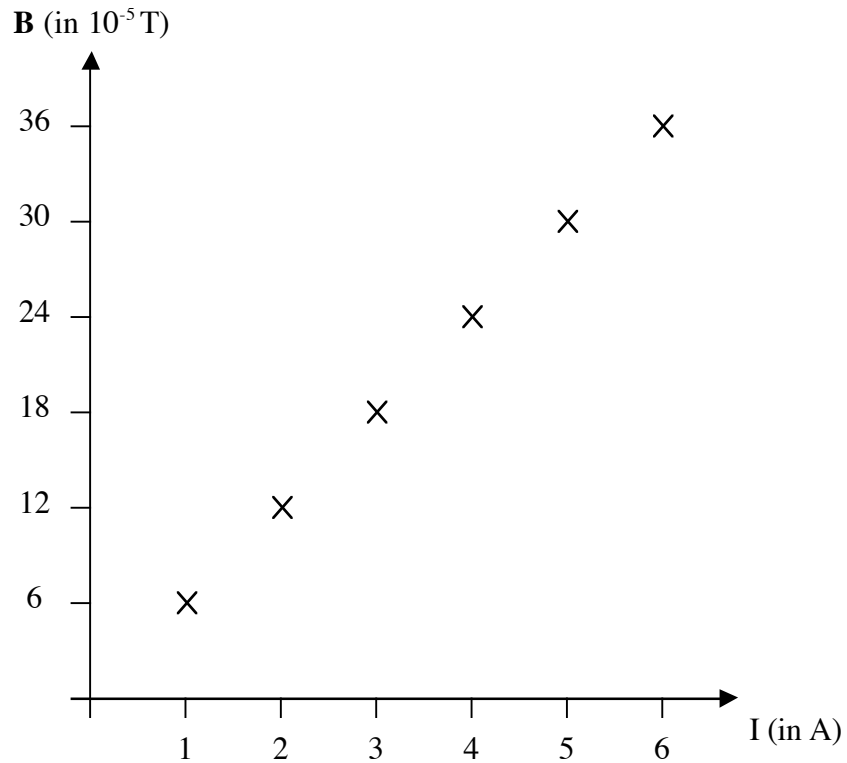
The equation below represents the magnetic field at a particular point due to a current-carrying long, straight wire.

$$1 \times 10^{-5} T = \frac{(4\pi \times 10^{-7} \text{ m} \cdot \text{T/A})(2.50 \text{ A})}{2\pi(0.05 \text{ m})}$$

Draw an appropriate diagram of the current-carrying wire and magnetic field represented by this equation.

MFF6A-CRT2: STRAIGHT CURRENT-CARRYING WIRE

Shown below is the graph of the magnetic field due to a current in a long straight wire. The magnetic field is measured at some point P.



Setup an appropriate equation that would give the distance r that point P is from the current-carrying straight wire.