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MFF 4A: STRAIGHT CURRENT-CARRYING WIRE IN A UNIFORM MAGNETIC FIELD

MFF4A-WBT1: STRAIGHT CURRENT-CARRYING WIRE IN A UNIFORM MAGNETIC FIELD

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

$$6.48\text{N} = (1.60\text{A})(2.50\text{m})(1.62\text{T})$$

MFF4A-WBT2: STRAIGHT CURRENT-CARRYING WIRE IN A UNIFORM MAGNETIC FIELD

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

$$-6.48\hat{i}\text{N} = (-1.60\text{A})(2.50\hat{j}\text{m})\times(1.62\hat{k}\text{T})$$

MFF4A-WBT3: STRAIGHT CURRENT-CARRYING WIRE IN A UNIFORM MAGNETIC FIELD

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

$$7.20\text{N} = (3.20\text{A})(1.50\text{m})(3.00\text{T})\sin 30^\circ$$

MFF4A-WBT4: STRAIGHT CURRENT-CARRYING WIRE IN A UNIFORM MAGNETIC FIELD

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

$$0\text{N} = (1.60\text{A})(2.50\text{m})(1.62\text{T})\sin 0^\circ$$

MFF4A-CCT1: STRAIGHT CURRENT-CARRYING WIRE IN A UNIFORM MAGNETIC FIELD

Consider the following statements made by three students.

Student I: “For a straight wire to feel a magnetic force, it only needs to be within a magnetic field.”

Student II: “For a straight wire to feel a magnetic force, it only needs to be conducting current and within a magnetic field.”

Student III: “For a straight wire to feel a magnetic force, the wire must be conducting current within a magnetic field and cutting across the magnetic field.”

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

MFF4A-CCT2: STRAIGHT CURRENT-CARRYING WIRE IN A UNIFORM MAGNETIC FIELD

Consider the following statements made by three students.

Student I: "For a straight wire to feel a magnetic force, it only needs to be within a magnetic field."

Student II: "For a straight wire to feel a magnetic force, the wire must be conducting current, within a magnetic field and cutting across that magnetic field."

Student III: "For a current-carrying wire to feel a magnetic force, the wire must be within a magnetic field and has to be perpendicular to the magnetic field."

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

MFF4A-WWT1: STRAIGHT CURRENT-CARRYING WIRE IN A UNIFORM MAGNETIC FIELD

“A straight wire is conducting current whose direction is pointed out of the paper towards you. If this current-carrying wire encounters a magnetic field pointing toward the left, then it feels a magnetic force towards the top of the page.”

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.

MFF4A-WWT2: STRAIGHT CURRENT-CARRYING WIRE IN A UNIFORM MAGNETIC FIELD

“A current-carrying straight wire has current going to the right. It encounters a magnetic field that is into the paper. The direction of the magnetic force felt by the wire must be into the paper.”

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.

MFF4A-WWT3: STRAIGHT CURRENT-CARRYING WIRE IN A UNIFORM MAGNETIC FIELD

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 current-carrying straight wire in a magnetic field always feels a magnetic force.”

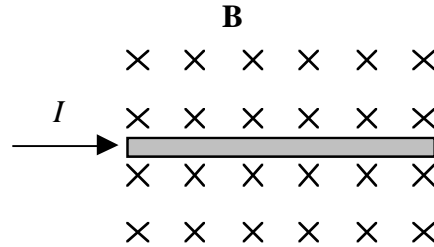
MFF4A-TT1: STRAIGHT CURRENT-CARRYING WIRE IN A UNIFORM MAGNETIC FIELD

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

“A current-carrying straight wire is conducting current in the + x direction. Since the wire feels a magnetic force whose direction is in the + y direction, the direction of the magnetic field is in the + z direction.”

MFF4A-TT2: STRAIGHT CURRENT-CARRYING WIRE IN A UNIFORM MAGNETIC FIELD

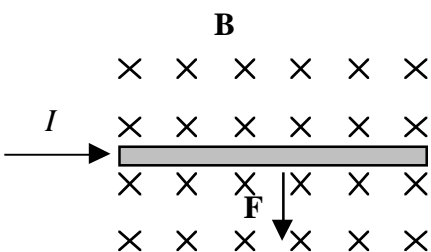
As shown in the figure below, a current-carrying, straight wire is conducting current to the right through a magnetic field. The magnetic field is uniform and into the paper. The current-carrying wire feels no magnetic force due to the magnetic field.



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

MFF4A-TT3: STRAIGHT CURRENT-CARRYING WIRE IN A UNIFORM MAGNETIC FIELD

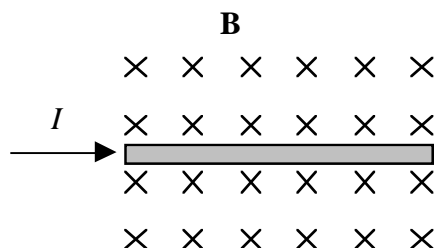
As shown in the figure below, a current-carrying, straight wire is conducting current to the right through a magnetic field. The magnetic field is uniform and into the paper. The current-carrying wire feels a magnetic force due to the magnetic field as shown.



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

MFF4A-LMCT1: STRAIGHT CURRENT-CARRYING WIRE IN A UNIFORM MAGNETIC FIELD

As shown in the figure below, a current-carrying, straight wire is conducting current to the right through a magnetic field. The magnetic field is uniform and into the paper. The current-carrying wire feels a magnetic force due to the magnetic field.



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 force felt by the wire.

The possible answers are:

- A. this change will only alter the direction of the magnetic force felt by the wire.
- B. this change will only increase the magnitude of the magnetic force felt by the wire.
- C. this change will only decrease the magnitude of the magnetic force felt by the wire.
- D. this change will alter both the magnitude and direction of the magnetic force felt by the wire.
- E. this change will not affect the magnetic force felt 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 zero.** _____
- The current in the wire is replaced by a smaller current.** _____
- The length of the wire in the magnetic field is greater.** _____
- The magnetic field is twice its original strength.** _____
- The magnetic field is one-third its original strength.** _____
- The direction of the magnetic field is parallel to the wire.** _____
- The direction of the magnetic field is 45° to the wire.** _____

MFF4A-PET1 : STRAIGHT CURRENT-CARRYING WIRE IN A UNIFORM MAGNETIC FIELD

A current-carrying, straight wire is conducting current towards the right. The wire is in a region in which the magnetic field is uniform and is directed towards the top of the page.

What will happen to the current-carrying wire? Explain fully.

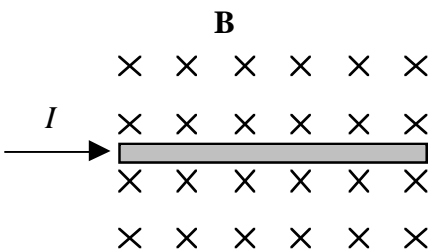
MFF4A-PET2: STRAIGHT CURRENT-CARRYING WIRE IN A UNIFORM MAGNETIC FIELD

A current-carrying, straight wire is conducting current towards the right. The wire is in a region in which the magnetic field is uniform and is also directed towards the right.

What will happen to the current-carrying wire? Explain fully.

MFF4A-M/MCT1: STRAIGHT CURRENT-CARRYING WIRE IN A UNIFORM MAGNETIC FIELD

The figure below shows a straight wire conducting a 10 A current in a uniform magnetic field of 200 mT. The wire is 5 m long.



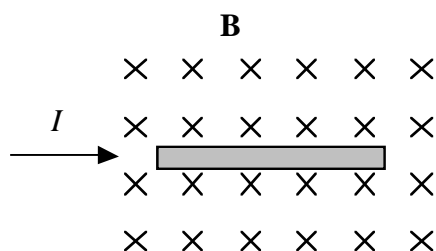
Given below is a student's calculation for the magnetic force on the current-carrying wire due to the magnetic field

$$F_B = (10A)(5.00m)(.200T)$$

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)?

MFF4A-QRT1: STRAIGHT CURRENT-CARRYING WIRE IN A UNIFORM MAGNETIC FIELD

The figure below shows a current-carrying straight wire segment (with connecting wires up out of the paper that are not shown) in a uniform magnetic field directed into the paper.



What is the direction of the magnetic force acting on the wire segment due to the magnetic field?

What would the direction of the magnetic force be if the direction of the magnetic field was out of the paper?

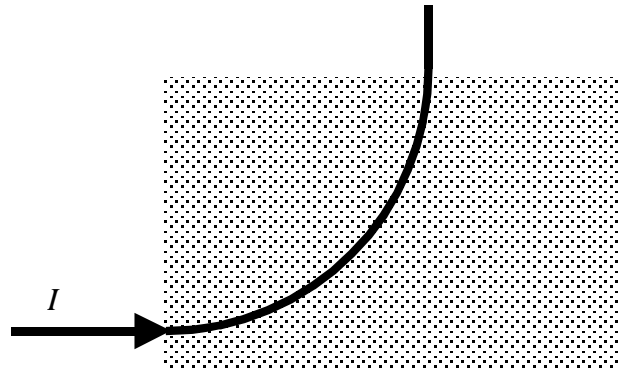
What would happen to the magnitude of the magnetic force acting on the wire segment if the wire segment was longer but still completely within the magnetic field?

What would happen to the direction of the magnetic force if we reverse the direction of current in the wire segment?

What would happen to the magnitude of the magnetic force acting on the wire segment if the wire segment is moved without changing its orientation so that its length is half-in and half-out of the magnetic field region?

MFF4A-QRT2: CURRENT-CARRYING WIRE IN A UNIFORM MAGNETIC FIELD

The figure below shows the effect on a thin, flexible current-carrying wire with one end fixed, in a region of uniform magnetic field strength.



What is the direction of the magnetic field acting on the wire?

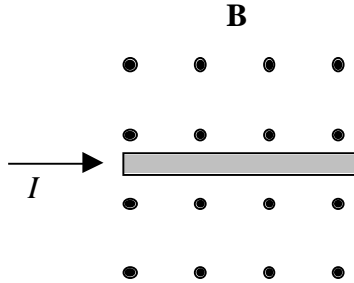
If we reversed the direction of the magnetic field, what would happen to the “bend” of the wire in the uniform magnetic field?

If we increase the current flowing in the wire, what will happen to the “bend” of the wire in the uniform magnetic field?

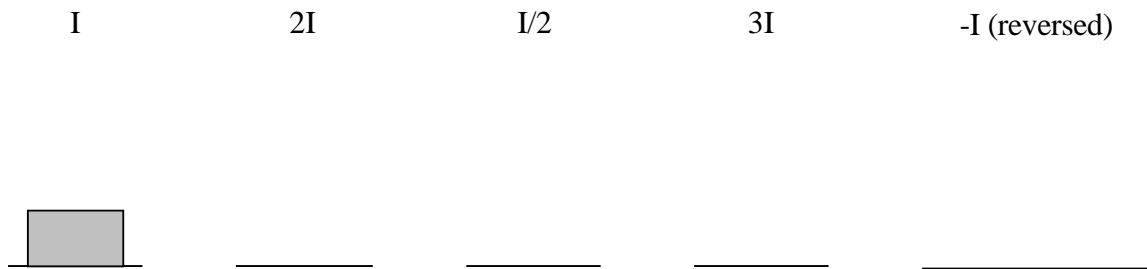
If we double the magnitude of the uniform magnetic field, what will happen to the “bend” of the wire in the uniform magnetic field?

MFF4A-BCT1: STRAIGHT CURRENT-CARRYING WIRE IN A UNIFORM MAGNETIC FIELD

The figure below shows a current-carrying straight wire segment conducting a current in a region where there is a uniform magnetic field directed out of the plane of the paper.



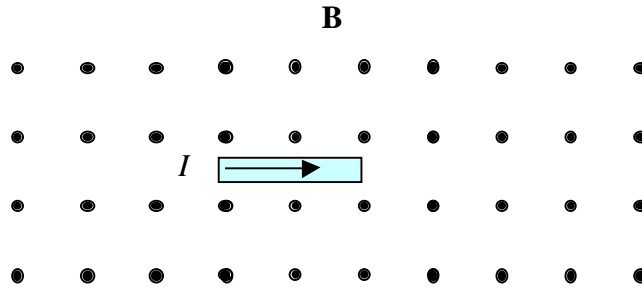
Represent this situation with a bar chart of the magnitude of the magnetic force that the wire feels due to the magnetic field if the current can change. The amount of current is indicated on the bar chart.



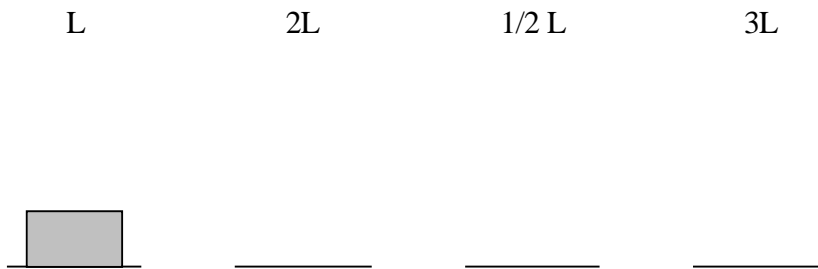
Explain the reasoning behind your bar chart:

MFF4A-BCT2: STRAIGHT CURRENT-CARRYING WIRE IN A UNIFORM MAGNETIC FIELD

The figure below shows a current-carrying straight wire segment conducting a current in a region where there is a uniform magnetic field directed out of the plane of the paper.



Represent this situation with a bar chart of the magnitude of the magnetic force that the wire feels due to the magnetic field if the length of the wire can change. The length of the wire inside the magnetic field is indicated on the bar chart



Explain the reasoning behind your bar chart:

MFF4A-CRT1: STRAIGHT CURRENT-CARRYING WIRE IN A UNIFORM MAGNETIC FIELD

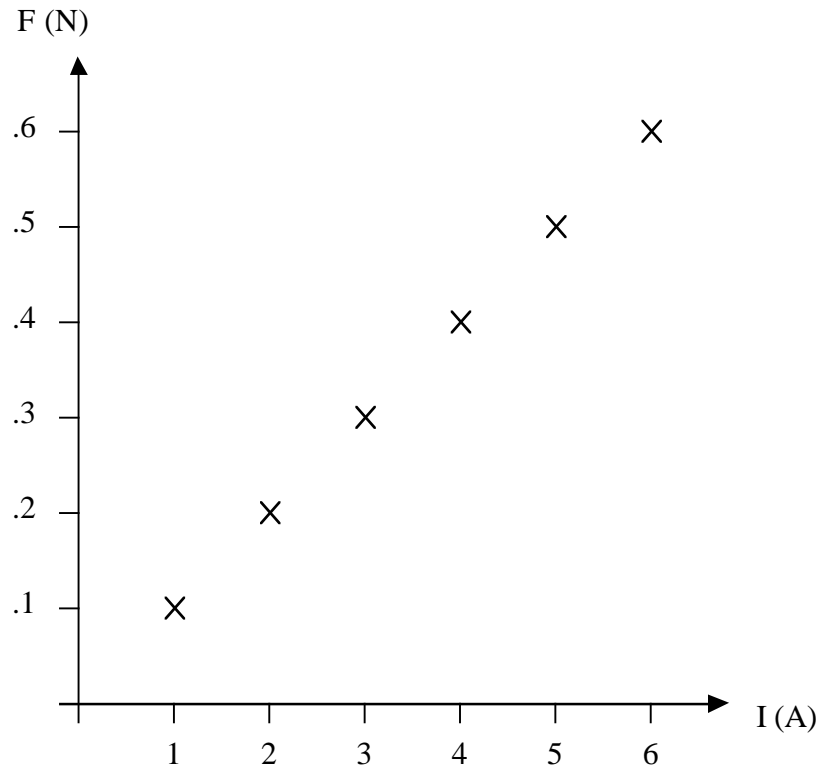
The equation below represents the magnetic force on a current-carrying straight wire segment in a uniform magnetic field.

$$-6.48\hat{j}\text{N} = (1.60\hat{i}\text{A})(2.50\text{m})\times(1.62\hat{k}\text{T})$$

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

MFF4A-CRT2: STRAIGHT CURRENT-CARRYING WIRE IN A UNIFORM MAGNETIC FIELD

Shown below is the graph of the magnetic force on a current-carrying straight wire due to the current in the wire. The wire's length is 2 m and the magnetic field is $7 \mu\text{T}$.



Setup (write) an appropriate equation that would give the strength of the magnetic force felt by the current-carrying straight wire.