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MFF 7A: CURRENT-CARRYING CIRCULAR LOOP

MFF7A-RT1: CURRENT-CARRYING CIRCULAR LOOP

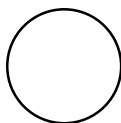
The figures below show current carrying, circular loops. The current in the loop is given and is in the clockwise direction. Also given is the radius of the loop.

Rank these situations from greatest to least on the basis of the strength (magnitude) of the magnetic field at the center of the circular loop.



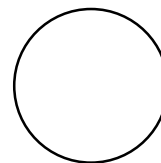
$$I = 3 \text{ A}, r = 2 \text{ cm}$$

A



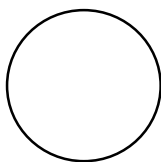
$$I = 2 \text{ A}, r = 3 \text{ cm}$$

B



$$I = 1 \text{ A}, r = 4 \text{ cm}$$

C



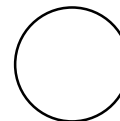
$$I = 3 \text{ A}, r = 4 \text{ cm}$$

D



$$I = 2 \text{ A}, r = 2 \text{ cm}$$

E



$$I = 1 \text{ A}, r = 3 \text{ cm}$$

F

Greatest 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ Least

Or, the field is the same for all six situations. _____

Or, the ranking for the fields cannot be determined. _____

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

Basically Guessed

Sure

Very Sure

1

2

3

4

5

6

7

8

9

10

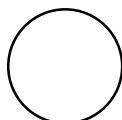
MFF7A-RT2: CURRENT-CARRYING CIRCULAR COIL

The figures below show current carrying, circular coil. The current in the coil is given and is in the clockwise direction. Also given is the radius of the coil and the number of turns of wire making up the circular coil.

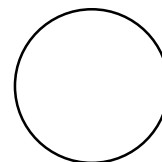
Rank these situations from greatest to least on the basis of the strength (magnitude) of the magnetic field at the center of the circular coil.



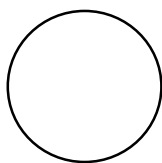
$N = 10$
 $I = 3 \text{ A}$, $r = 2 \text{ cm}$
A



$N = 15$
 $I = 2 \text{ A}$, $r = 3 \text{ cm}$
B



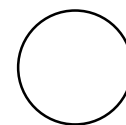
$N = 10$
 $I = 1 \text{ A}$, $r = 4 \text{ cm}$
C



$N = 15$
 $I = 1 \text{ A}$, $r = 4 \text{ cm}$
D



$N = 20$
 $I = 2 \text{ A}$, $r = 2 \text{ cm}$
E



$N = 15$
 $I = 3 \text{ A}$, $r = 3 \text{ cm}$
F

Greatest 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ Least

Or, the field is the same for all six situations. _____

Or, the ranking for the fields cannot be determined. _____

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

Basically Guessed

1

2

3

4

Sure

5

6

7

8

9

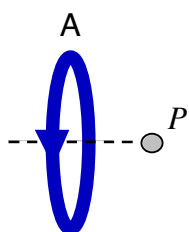
Very Sure

10

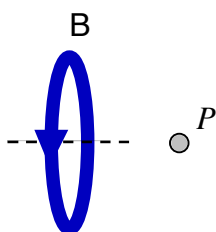
MFF7A-RT3: CURRENT-CARRYING CIRCULAR LOOP

The figures below show current carrying, circular loops, all with the same radius. In each figure, the current flows as shown by the arrow. Also given is a point in space, P, and its distance along the axis from center of loop.

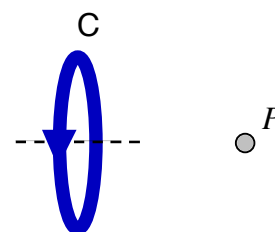
Rank these situations from greatest to least on the basis of the strength (magnitude) of the magnetic field at point P.



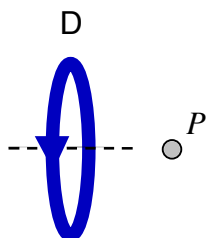
$I = 3\text{A}$ $d = 1\text{cm}$



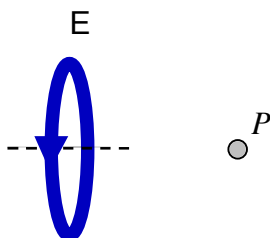
$I = 2\text{A}$ $d = 2\text{cm}$



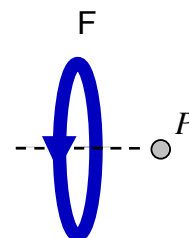
$I = 1\text{A}$ $d = 3\text{cm}$



$I = 1\text{A}$ $d = 2\text{cm}$



$I = 3\text{A}$ $d = 3\text{cm}$



$I = 2\text{A}$ $d = 1\text{cm}$

Greatest 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ Least

Or, the field is the same for all six situations. _____

Or, the ranking for the fields cannot be determined. _____

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

Basically Guessed

Sure

Very Sure

1

2

3

4

5

6

7

8

9

10

MFF7A-WBT1: CURRENT-CARRYING CIRCULAR LOOP

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

$$3.14 \cdot 10^{-5} \text{T} = \frac{(4\pi \cdot 10^{-7} \text{T} \cdot \text{m} / \text{A})(2.50 \text{A})}{2(.05 \text{m})}$$

MFF7A-WBT2: CURRENT-CARRYING CIRCULAR LOOP

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

$$6.37\text{A} = \frac{(1.60 \cdot 10^{-5} T)(.025\text{m})}{10(4\pi \cdot 10^{-7} T \cdot \text{m/A})}$$

MFF7A-WBT3: CURRENT-CARRYING CIRCULAR LOOP

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

$$4.83 \times 10^{-2} T = \frac{(4\pi \times 10^{-7} T \cdot m / A)(1.50 A)(0.10 m)^2}{2[(.05 m)^2 + (.10 m)^2]^{3/2}}$$

MFF7A-WWT1: CURRENT-CARRYING CIRCULAR LOOP

“A circular loop lying flat in a plane is conducting current counter-clockwise around the loop as viewed from above. The magnetic field at the center of the loop points into the plane.”

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.

MFF7A-WWT2: CURRENT-CARRYING CIRCULAR COIL

“A circular coil is conducting current in the clockwise direction as viewed from above. Since the coil is made of several turns of wire, the magnetic field is larger than for a single loop. If the coil is lying flat in a plane, the direction of the magnetic field through the center of the loop is out of the plane.”

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.

MFF7A-WWT3: CURRENT-CARRYING CIRCULAR LOOP

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 circular loop is conducting current clockwise around the loop. The strength of the magnetic field varies inversely with the distance from the loop on the central axis perpendicular to the plane of the loop.”

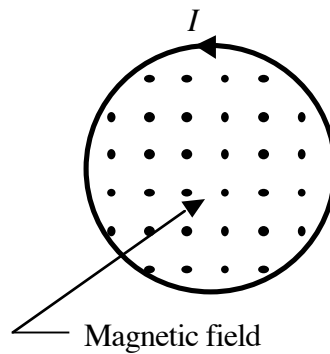
MFF7A-TT1: CURRENT-CARRYING CIRCULAR LOOP

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

“A circular loop is lying on a table. The direction of the magnetic field at the center of the loop is into the table. The current must be in the counter-clockwise direction around the loop when viewed from above table.”

MFF7A-TT2: CURRENT-CARRYING CIRCULAR LOOP

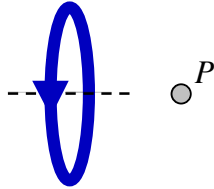
As shown in the figure below, a current carrying, circular loop is conducting current in the counter-clockwise direction. The magnetic field generated by the current is uniform inside the loop and directed out of the paper as shown.



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

MFF7A-TT3: CURRENT-CARRYING CIRCULAR LOOP

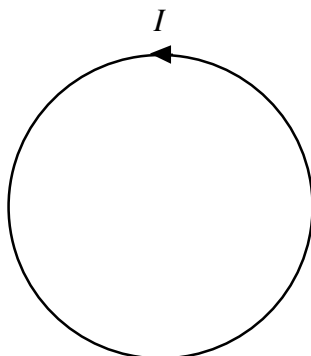
As shown in the figure below, a circular loop is conducting current in the direction indicated by the arrow. The direction of the magnetic field at point P is to the left. Point P is on the central axis to the plane of the circular loop.



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

MFF7A-LMCT1: CURRENT-CARRYING CIRCULAR LOOP

As shown in the figure below, a circular loop is conducting current counter-clockwise around the loop. The magnetic field at the center of the loop is directed out of the paper.



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 circular loop at its center.

The possible answers are:

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

Each change below refers to the original situation stated above:

The current in the loop is replaced by a larger current. _____

The direction of the current in the loop is reversed. _____

The current in the loop is reduced to zero. _____

The current in the loop is replaced by a smaller current. _____

The radius of the loop is increased. _____

The radius of the loop is decreased. _____

The loop is replaced by a coil with several turns that has the same size and current. _____

MFF7A-PET1: CURRENT-CARRYING CIRCULAR LOOP

A circular loop is initially conducting current in a counter-clockwise direction. The current is reversed.

**What will happen to the magnetic field generated by the current carrying circular loop?
Explain fully.**

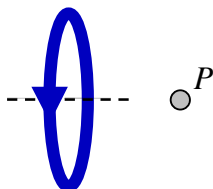
MFF7A-PET2: CURRENT-CARRYING CIRCULAR LOOP

A current-carrying, circular loop lying in the plane of this page produces magnetic field at the center of the loop that is out of the page. The magnetic field is made larger than before.

**What could have occurred to the circular coil to cause the magnetic field to increase?
Explain fully.**

MFF7A-M/MCT2: CURRENT-CARRYING CIRCULAR LOOP

The figure below shows a circular loop, of radius 10cm, with current flowing in the direction indicated by the arrow. The current is 1.5 A and point P is located 5 cm along the central axis perpendicular to the plane of the loop from the center of the loop.



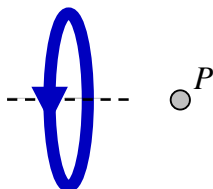
Given below is a student's calculation for the magnetic field generated by the current carrying loop.

$$B = \frac{\mu_0 I}{2r} = \frac{(4\pi \times 10^{-7} \text{ T} \cdot \text{m/A})(1.50 \text{ A})}{2[.10\text{m}]}$$

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)?

MFF7A-M/MCT1: CURRENT-CARRYING CIRCULAR LOOP

The figure below shows a circular loop, of radius 10cm, with current flowing in the direction indicated by the arrow. The current is 1.5 A and point P is located 5 cm along the central axis perpendicular to the plane of the loop from the center of the loop.



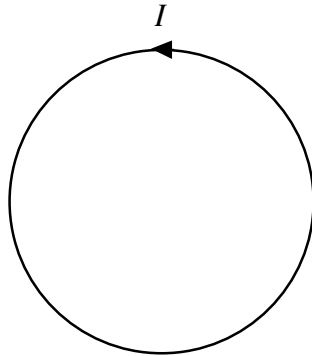
Given below is a student's calculation for the magnetic field generated by the current carrying loop.

$$6.74 \times 10^{-6} \text{ T} = \frac{(4\pi \times 10^{-7} \text{ T} \cdot \text{m/A})(1.50 \text{ A})(.10\text{m})^2}{2[(.05\text{m})^2 + (.10\text{m})^2]^{3/2}}$$

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)?

MFF7A-QRT1: CURRENT-CARRYING CIRCULAR LOOP

The figure below shows a current carrying circular loop.



What is the direction of the magnetic field at the center of the loop due to the current carrying loop?

What would happen to the direction of the magnetic field at the center of the loop if the current was reversed?

What would happen to the magnitude of the magnetic field at the center of the loop if the current in the loop is increased?

What would happen to the magnitude of the magnetic field at the center of the loop if the current in the loop is decreased?

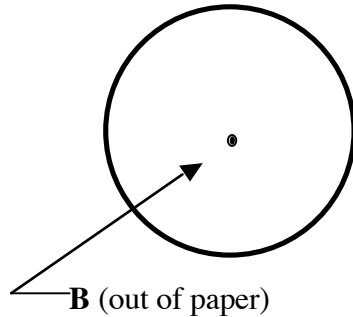
What would happen to the magnitude of the magnetic field at the center of the loop if the radius of the loop is increased?

What would happen to the magnitude of the magnetic field at the center of the loop if the radius of the loop is decreased?

What would happen to the magnitude of the magnetic field at the center of the loop if the number of turns of wire making up the loop is increased?

MFF7A-QRT2: CURRENT-CARRYING CIRCULAR LOOP

The figure below shows the magnetic field due to a current carrying, circular loop at the center of the loop.



What is the direction of the current in the loop?

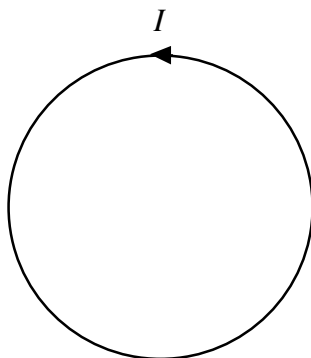
If we reversed the direction of the current, what would be the direction of the magnetic field generated by the loop at the center of the loop?

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

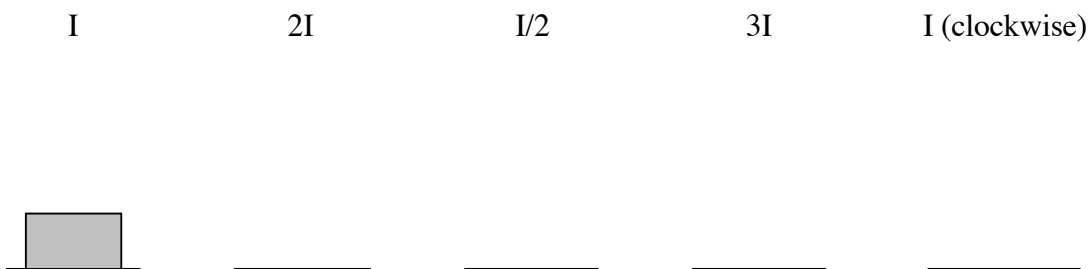
If we increase the loops of wire that make up the circular coil, what will happen to the strength of the generated magnetic field?

MFF7A-BCT1: CURRENT-CARRYING CIRCULAR LOOP

The figure below shows a current carrying circular loop conducting current in a counter-clockwise direction.



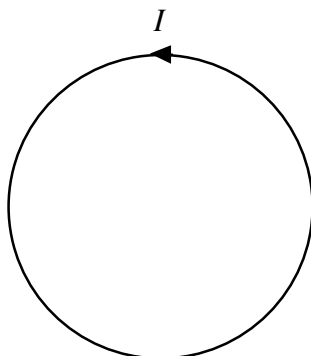
Represent this situation with a bar chart of the magnitude of the magnetic field at the center of the loop if the current can change. The amount of current is indicated on the bar chart.



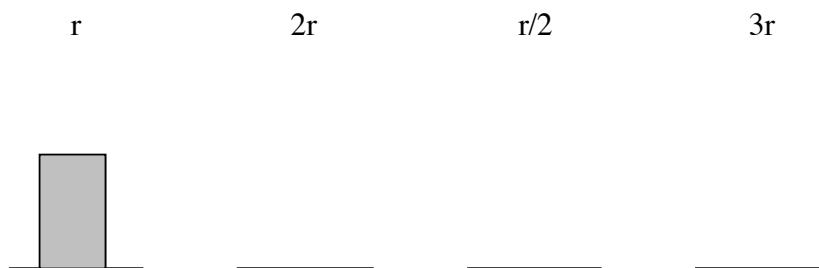
Explain the reasoning behind your bar chart:

MFF7A-BCT2: CURRENT-CARRYING CIRCULAR LOOP

The figure below shows a current carrying circular loop conducting current in a counter-clockwise direction.



Represent this situation with a bar chart of the magnitude of the magnetic field at the center of the loop if the radius can change. The radius value is indicated on the bar chart.



Explain the reasoning behind your bar chart:

MFF7A-CRT1: CURRENT-CARRYING CIRCULAR LOOP

The equation below represents the magnetic field due to a current carrying circular loop.

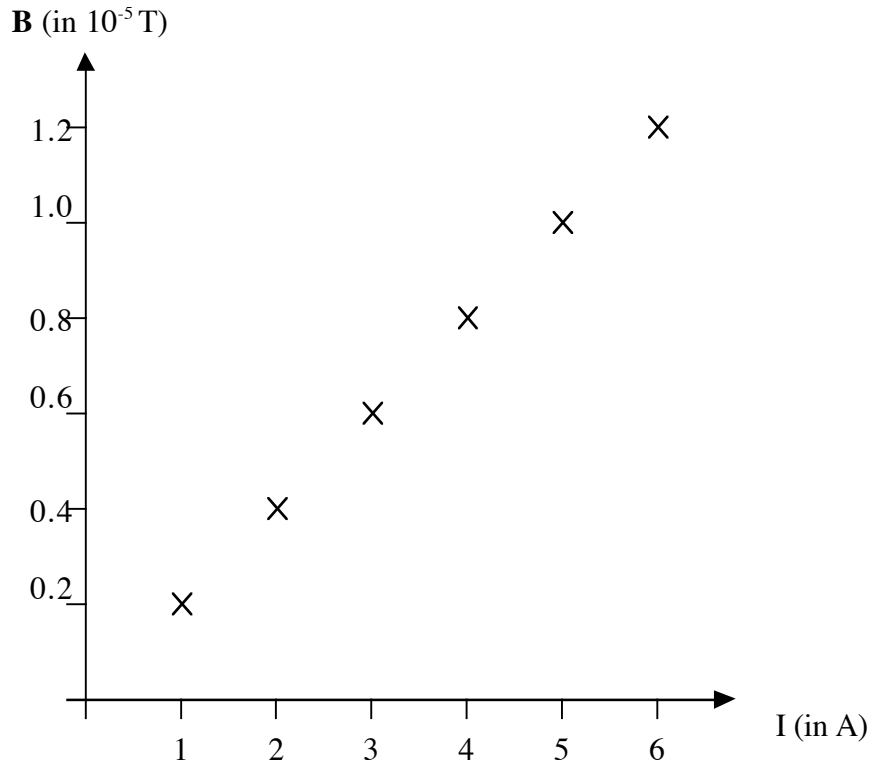
$$3.14 \times 10^{-5} T = \frac{(4\pi \times 10^{-7} T \cdot m / A)(2.50 A)}{2(.05 m)}$$

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

If the current in this circular loop varies, draw an appropriate graph to represent the magnetic field strength versus current for the changing current.

MFF7A-CRT2: CURRENT-CARRYING CIRCULAR LOOP

Shown below is the graph of the magnetic field generated by a current in a circular loop. The magnetic field is measured at the center of the circular loop.



Setup (write) an appropriate equation that would give the radius r of the circular loop based on this graph.