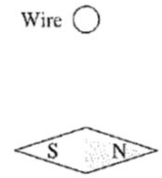
1.

The figure shows a wire directed into the page and a nearby compass needle. Is the wire's current going into the page or coming out of the page? Explain.

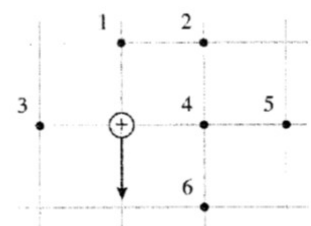



2.

A positively charged particle moves toward the bottom of the page.

a. At each of the six number points, show the direction of the magnetic field or, if appropriate, write $\vec{B} = \vec{0}$.

b. Rank in order, from strongest to weakest, the magnetic field strengths $B_1$ to $B_6$ at these points.




Order:

Explanation:

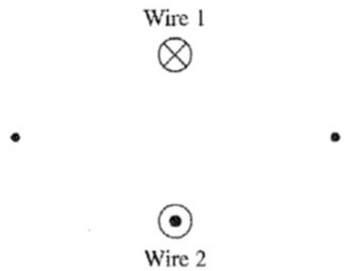
3.

The negative charge is moving out of the page, coming toward you. Draw the magnetic field lines in the plane of the page.

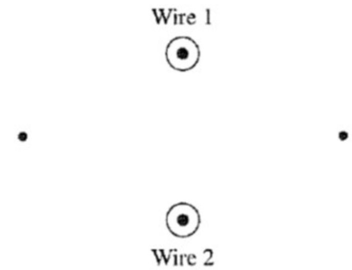
4.

Each figure below shows two long straight wires carrying equal currents into or out of the page. At each of the dots, use a **black** pen or pencil to show and label the magnetic fields $\vec{B}_1$ and $\vec{B}_2$ due to each wire. Then use a **red** pen or pencil to show the net magnetic field.

a.




b.

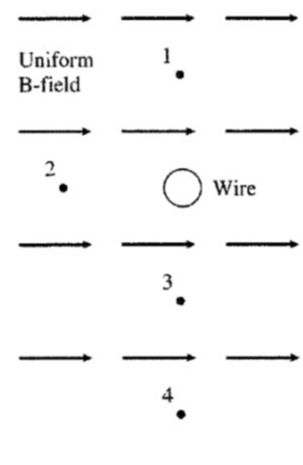



5.

A long straight wire, perpendicular to the page, passes through a uniform magnetic field. The *net* magnetic field at point 3 is zero.

a. On the figure, show the direction of the current in the wire.

b. Points 1 and 2 are the same distance from the wire as point 3, and point 4 is twice as distant. Construct vector diagrams at points 1, 2, and 4 to determine the net magnetic field at each point.

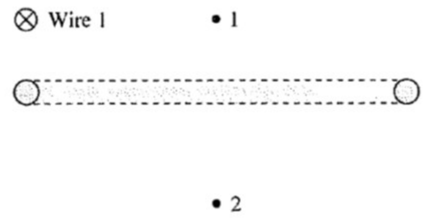


6.

A long straight wire passes above one edge of a current loop. Both are perpendicular to the page. $\vec{B}_1 = \vec{0}$ at point 1.

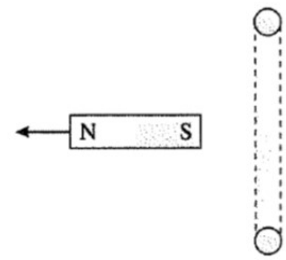
a. On the figure, show the direction of the current in the loop.

b. Use a vector diagram to determine the net magnetic field at point 2.

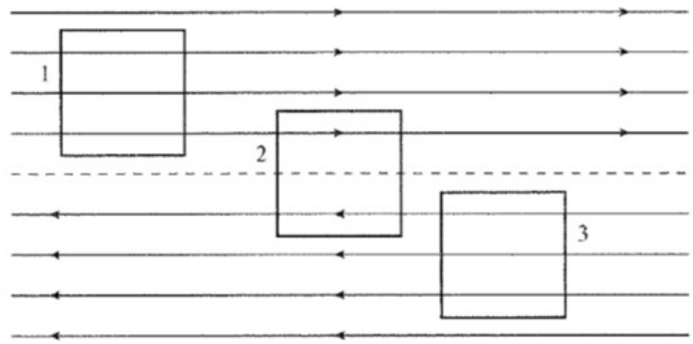



7.

The current loop exerts a repulsive force on the bar magnet. On the figure, show the direction of the current in the loop. Explain.



8. The magnetic field above the dotted line is $\vec{B} = (2\text{ T, right})$. Below the dotted line the field is $\vec{B} = (2\text{ T, left})$. Each closed loop is $1\text{ m} \times 1\text{ m}$. Let's evaluate the line integral of $\vec{B}$ around each of these closed loops by breaking the integration into four steps. We'll go around the loop in a *clockwise* direction. Pay careful attention to signs.



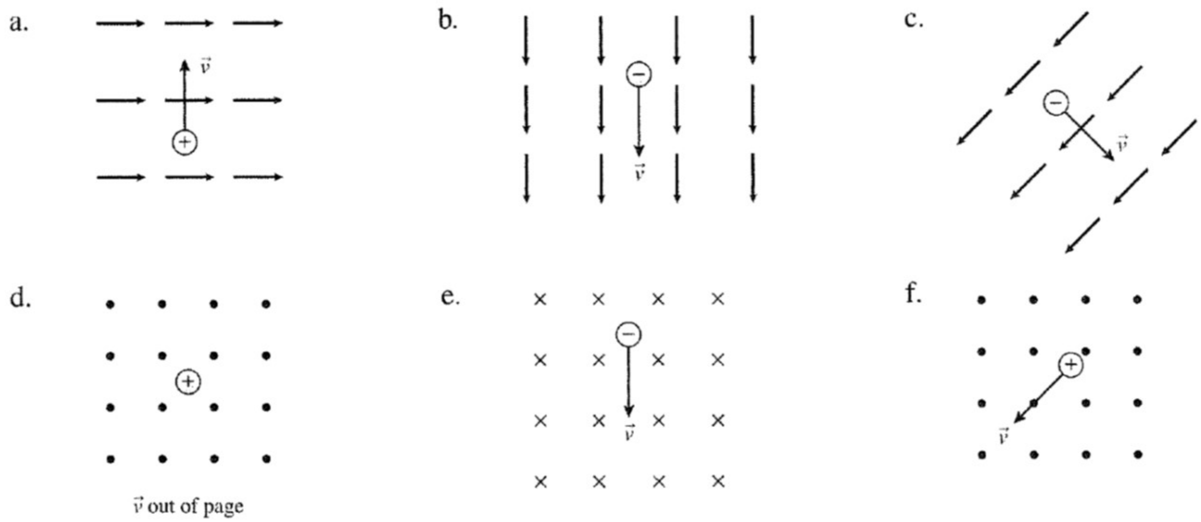

| | Loop 1 | Loop 2 | Loop 3 |
|---|---|---|---|
| $\int \vec{B} \cdot d\vec{s}$ along left edge | | | |
| $\int \vec{B} \cdot d\vec{s}$ along top | | | |
| $\int \vec{B} \cdot d\vec{s}$ along right edge | | | |
| $\int \vec{B} \cdot d\vec{s}$ along bottom | | | |

The line integral *around* the loop is simply the sum of these four separate integrals:

| | Loop 1 | Loop 2 | Loop 3 |
|---|---|---|---|
| $\oint \vec{B} \cdot d\vec{s}$ around the loop | | | |

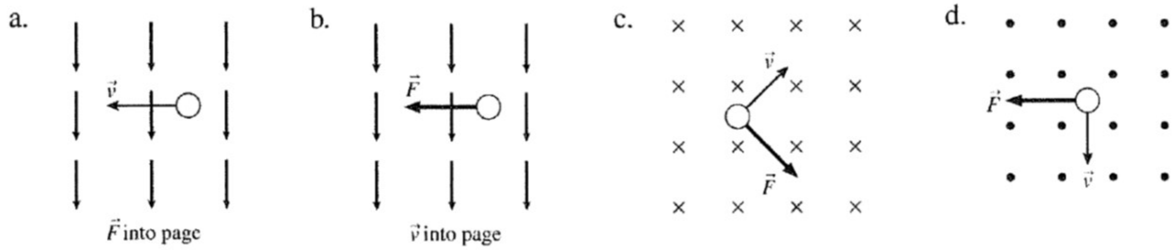
9.
A solenoid with one layer of turns produces the magnetic field strength you need for an experiment when the current in the coil is 3 A. Unfortunately, this amount of current overheats the coil. You've determined that a current of 1 A would be more appropriate. How many additional layers of turns must you add to the solenoid to maintain the magnetic field strength? Explain.

10.
For each of the following, draw the magnetic force vector on the charge or, if appropriate, write "$\vec{F}$ into page," "$\vec{F}$ out of page," or "$\vec{F} = \vec{0}$."



11.

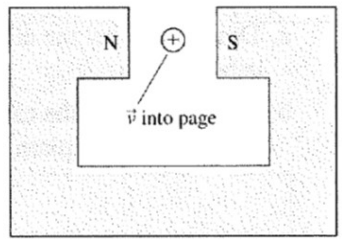
For each of the following, determine the sign of the charge (+ or −).




$q =$ ______ $q =$ ______ $q =$ ______ $q =$ ______

12.

A positive ion, initially traveling into the page, is shot through the gap in a horseshoe magnet. Is the ion deflected up, down, left, or right? Explain.

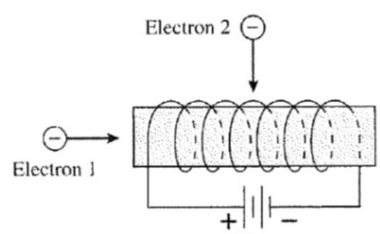



13.

A hollow solenoid is wound as shown and attached to a battery. Two electrons are fired into the solenoid, one from the end and one through a very small hole in the side.

a. In what direction does the magnetic field inside the solenoid point? Show it on the figure.

b. Is electron 1 deflected as it moves through the solenoid? If so, in which direction? If not, why not?



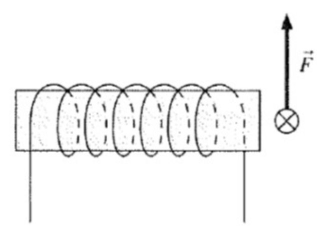

c. Is electron 2 deflected as it moves through the solenoid? If so, in which direction? If not, why not?

14.

Three current-carrying wires are perpendicular to the page. Construct a force vector diagram on the figure to find the net force on the upper wire due to the two lower wires.

15.

A current-carrying wire passes in front of a solenoid that is wound as shown. The wire experiences an upward force. Use arrows to show the direction in which the current enters and leaves the solenoid. Explain your choice.




16.

The south pole of a bar magnet is brought toward the current loop. Does the bar magnet attract the loop, repel the loop, or have no effect on the loop? Explain.