Magnetic Fields -- Conceptual Questions

1.) What is the symbol for a magnetic field? What are its units? Also, what are magnetic fields, really?

2.) What are magnetic forces? That is, how do magnetic forces act; what do they act on; what, in general, do they do?

3.) Give two ways you can tell if a magnetic field exists in a region of space.

4.) The direction of an electric field line is defined as the direction a positive test charge would accelerate if put in the field at the point of interest. How are magnetic field lines defined?

5.) What does the magnitude of a magnetic field tell you?

6.) What kind of forces do magnetic fields produce?

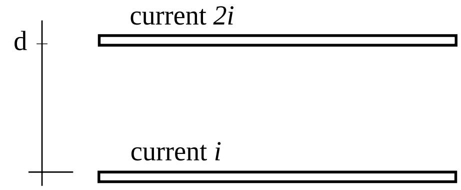
7.) You put a stationary positive charge in a magnetic field whose direction is upwards toward the top of the page. Ignoring gravity:

- a.) What will the charge do when released?
- b.) How would the answer to *Part 4a* change if the charge had been negative?
- c.) In what direction would the charge have to move to feel a magnetically produced force *into the page*? If allowed to move freely, would the charge continue to feel that force into the page?
- d.) How would the answer to *Part 4c* change if the charge had been negative?
- e.) The positive charge is given an initial velocity of 2 m/s directed upward toward the top of the page. How will its velocity change with time?

8.) In what direction is the magnetic field associated with a wire whose current is coming *out of the page*?

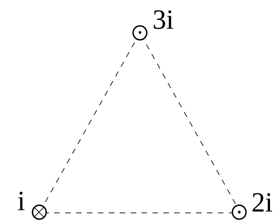
9.) You have two current-carrying wires, one on the left and one on the right, positioned perpendicularly to the page. The magnitude of the current in each is the same. You are told that the current flow in the wire on the left is *into* the page. If you are additionally told that there is *no place* between the wires where the magnetic field is zero, in what direction is the current in the wire on the right?

10.) You have two current-carrying wires in the plane of the page. The magnitude of the current in the upper wire is twice the magnitude of the current in the lower wire. Do a quick sketch of the magnetic field between the wires if:

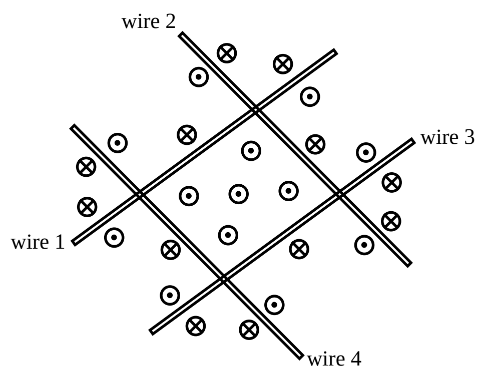


a.) Both currents are to the right.
b.) The top current is to the right while the bottom current is to the left.

11.) Three wires with different currents as shown are perpendicular to the page as depicted in the sketch. In what direction is the magnetic field at the center of the triangle?



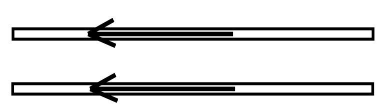
12.) A group of current-carrying wires is shown to the right. The current is the same in each wire and the direction of the magnetic field is shown at various places in the configuration. From what you have been told, identify the direction of each wire's current.



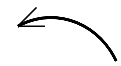
13.) A coil sits so that its central axis is perpendicular to the plane of the page. From that perspective, current passes clockwise through the coil.

a.) Is there much of a magnetic field out far from the coil (i.e., at *Point P*)?
b.) In general, *where* and *in what direction* is the coil's actual magnetic field?

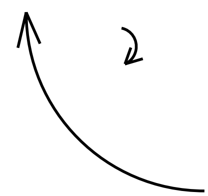
14.) Two parallel wires have equal currents passing through them. The currents are toward the left. The top wire's current produces a magnetic field which, impinging upon the current-carrying bottom wire, produces a force on the bottom wire. The bottom wire produces a similar force on the top wire.



a.) Draw on the sketch the direction of both forces.
b.) Are the two forces alluded to in *Part 14a* N.T.L. force couples? Explain.
c.) If you doubled the distance between the wires, how would the



15.) A negative charge passes through a magnetic field. It follows the path shown in the sketch.
a.) In what direction is the field?
b.) In what direction would a positive charge take in the field?
c.) If the size of the magnetic field had been doubled, how would the radius of the motion have been changed?
d.) If the magnitude of the velocity had been double, how would the radius of the motion have been changed?



16.) Two charges move through a given magnetic field as shown.
a.) If we assume the velocities and masses are the same, which charge must be larger?
b.) If we assume the charges and masses are the same, which charge must have the larger velocity?
c.) If the magnetic field is oriented out of the page, what is the sign of each charge (i.e., positive or negative)?

17.) An electric field E is oriented toward the bottom of the page. In the same space is a magnetic field B. A negative charge passes straight through the region moving in the *+x direction*. As a consequence of both fields, the negative charge moves through the region *without changing its direction of motion*. Ignoring gravity:
a.) What is the direction of the magnetic force in this case?
b.) What is the direction of the magnetic field in this case?

18.) Is there a Gauss's Law counterpart to magnetic fields? If so, how do the two approaches compare?

19.) What can you say about the magnetic circulation around a closed path in a magnetic field?

20.) When using Ampere's Law, you are looking for a path that has one of two characteristics. What are those characteristics?

21.) Galvanometers are based on what principle?

22.) An ammeter can be built using a galvanometer and what kind of circuit? How do you determine the value for any extra resistors used in the circuit (i.e., extra beyond the resistance of the galvanometer)?

23.) A voltmeter can be built using a galvanometer and what kind of circuit? How do you determine the value for any extra resistor(s) used in the circuit (i.e., extra beyond the resistance of the galvanometer)?

24.) You are given two 200 meter strands of identical copper wire. With one strand you create a coil whose radius is 2 cm. With the second strand you create a 4 cm coil. Assuming the current is the same in both, which coil will have the greater *B field* down its axis?

25.) A straight, isolated wire of length *L* is hooked up to a 1 volt battery. A second situation differs only in that its wire is twice as thick. If you test the magnetic fields one meter from each wire, which wire will produce the larger *B field*?

26.) Why would you not expect the existence of a magnetic monopole?

27.) How can one piece of iron be magnetized while a second piece is not?

28.) What does the earth's magnetic field really look like, and why?

29.) *Magnet A* is a light, weak, bar magnet. *Magnet C* is a heavy, strong, bar magnet. You place *magnet A* on a table so that it can move freely.

a.) If you pick up *magnet C* and approach *magnet A* so that C's north pole comes close to A's south pole, what will happen and why?

b.) If you pick up *magnet C* and approach *magnet A* so that C's south pole comes close to A's south pole, what would you expect to happen and why?

c.) If you said the magnets would repulse one another for *Part 29b*, you could be wrong. In fact, there is a good chance that if you actually tried this, the two magnets would attract. THIS <u>DOESN'T</u> MEANS *LIKE POLES ATTRACT*! What does it mean?