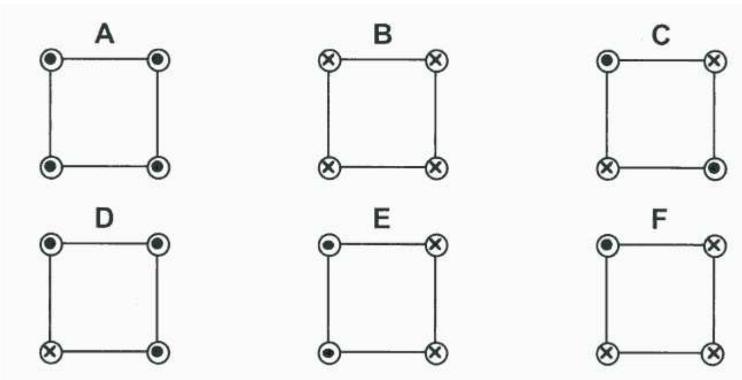
REVIEW: POTENTIAL EXAM QUESTIONS

The following questions are not part of your lab grade, ***you won't be graded on the answers****. Questions like these – but not identical – may appear on the exam. You are welcome to discuss the questions and your answers with your fellow students or the instructors during your recitation/lab section.*

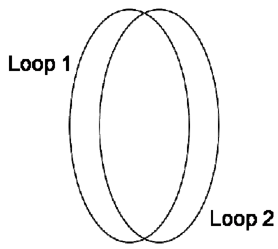
1. Which of the following statements is true?
   a) Two wires carrying parallel current are repelled from each other because the electrons in each wire repel the electrons in the other wire.
   b) Two wires carrying parallel current are attracted to each other because the magnetic field produced by each wire causes an attractive force on the current in the other wire.
   c) Two wires carrying anti-parallel current are attracted to each other because the magnetic field produced by each wire causes an attractive force on the current in the other wire.
   d) Two wires carrying anti-parallel current exert no force on each other because their magnetic fields cancel.
   e) Two wires carrying parallel current exert no force on each other because their magnetic fields cancel.

2. Shown below are six configurations of four current-carrying wires viewed "end on". Each circle with a dot represents current coming out of the page, and each circle with a cross represents current flowing into the page. Each wire carries the same amount of current. What is the order of **net magnetic field magnitude** at the center of each square?

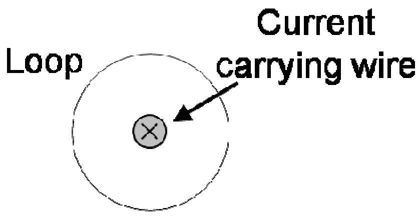


   a) A > D > C = E > F > B
   b) A = B > D = F > C = E
   c) D > F > E > C > A = B
   d) E > D = F > A = B = C
   e) C = E > D = F > A = B

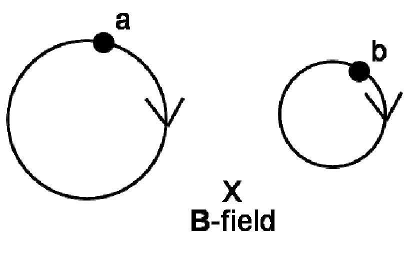
3. Consider two loops, placed next to each other as shown in the diagram. Which of the following statements is true?
   a) Any current in loop 1 will induce a current in loop 2.
   b) A current in loop 1 has no effect on loop 2.
   c) Any increasing or decreasing current in loop 1 will induce a current in loop 2.
   d) An alternating current in loop 1 will induce a steady current in loop 2.
   e) A steady current in loop 1 will induce an alternating current in loop 2.



4. A long straight wire carrying a current passes through the center of a circular wire loop. The wire loop is in the plane of the page, and the straight wire is perpendicular to the page. The current is going **into** the page and is **decreasing**. Which of the following describes the current induced in the loop?
   a) Clockwise, increasing
   b) Clockwise, steady
   c) Counterclockwise, increasing
   d) Counterclockwise, decreasing
   e) None of the above

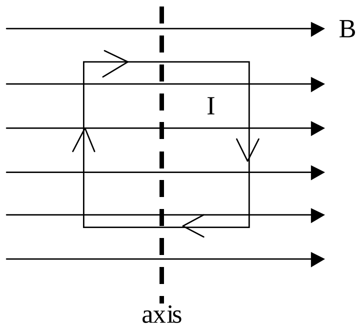


5. Two charged particle (a and b) are orbiting in a uniform magnetic field (which is pointing into the page) in the sense shown. The magnitudes of the charges are the same and the velocities of the particles are the same too. Which of the following statement is true?
   a) Both particles are positive and the mass of particle b is larger than the mass of particle a.
   b) Both particles are negative and the mass of particle b is larger than the mass of particle a.
   c) Both particles are positive and the mass of particle a is larger than the mass of particle b.
   d) Both particles are negative and the mass of particle a is larger than the mass of particle b.
   e) None of the above or impossible to tell

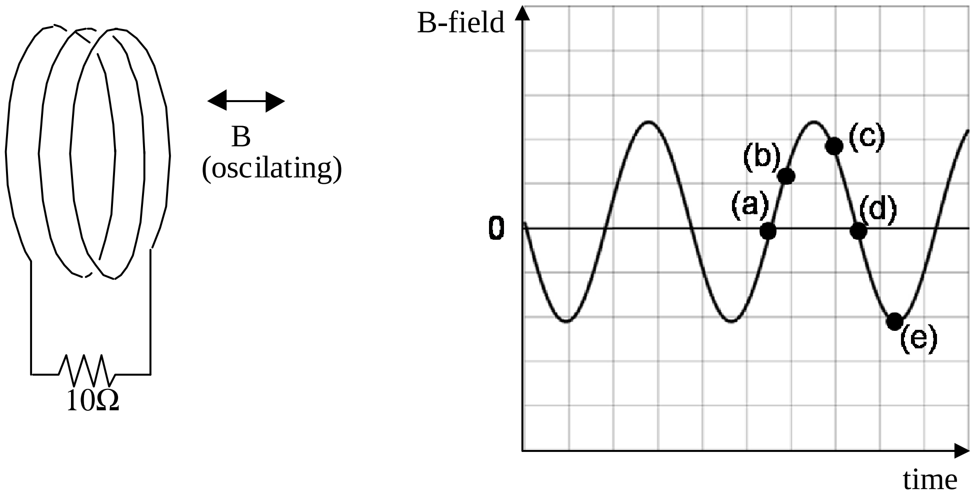


6. A coil of wire carrying a current I can freely move or rotate about an axis in a magnetic field. If the coil is released from the position shown, what will happen?

   a) The coil will oscillate from left to the right and back.
   b) The coil will rotate, the right side will move out of the page.
   c) The coil will rotate, the left side will move out of the page.
   d) The coil will move up.
   e) The coil will move down.

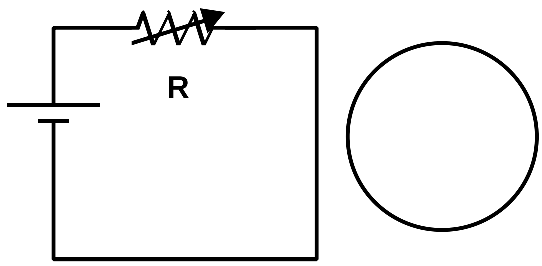


7. A coil of wire attached to a resistor is in an oscillating magnetic field. The B-field as a function of time is shown. At what point in time is the current through the resistor zero.



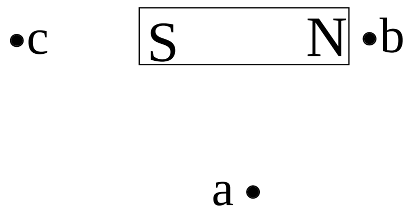
8. A circuit with a battery is shown and a variable resistor is near a loop of wire as shown. When the resistance R is decreased, the induced current in the loop is …

   a) CW.
   b) oscillating.
   c) CCW.
   d) zero.
   e) impossible to tell.

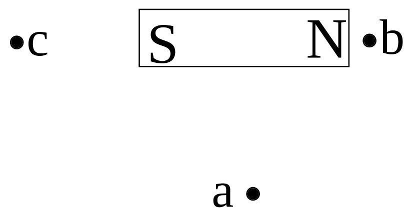


Problem A: You have a regular bar magnet (shown). The labeled points "a-c" are just empty points in space.

1) Draw an arrow at each of the points a-c, showing the magnetic field at each of them. (Make the relative lengths of these arrows correspond at least roughly to the relative strength of the field at the points, and the directions should be correct too.)

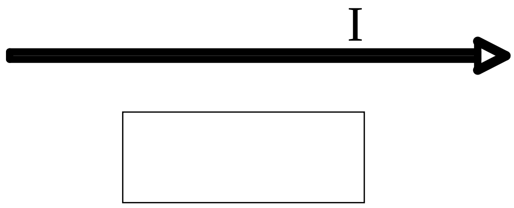


2) If you were given a second bar magnet *identical* to the one above, add it into the picture (draw it in!) in a position and orientation such that the B-field at point "a" would now vanish. Briefly, justify in words (or with arrows) your choice.



3) Given your choice in part 2 above (i.e. given BOTH bar magnets: the original one in the position shown and the new one you added), indicate in the picture (using arrows) what the NEW total magnetic field vector would now look like at points b and c. No need for computations, just make the length and direction reasonable. Explain your reasoning with words/arrows (whatever you need).

Problem B: A square conducting loop is placed below a very long wire with current I as shown.



1) If the current I in the long wire is steady, describe the induced current (if any) in the loop. What principle(s) of physics are you using?

2) Describe 3 completely different ways (which might involve moving the wire, or changing the current in the wire, or moving the square loop, or squeezing or stretching or rotating the square loop, ... or something else!) that would make a current flow in a CLOCKWISE fashion around the square loop. Very briefly explain why you think this would work in each case.

i.

ii.

iii.

3) In the previous question, taking just your first way (labeled i), would this "induced" clockwise current in the square loop persist for a long time, or would it stop flowing? Why?

4) Again back to question 2, take just your first way (labeled i) and explain whether there would be any new net FORCE on the square loop due solely to the magnetic interaction of the current I with the (clockwise) current induced in the loop. If there is a net force, which direction would it point in? As usual, give a brief explanation.