

Pretest 14 – Review of Ampere’s Law through Magnetization

An airplane flies from Denver to Washington D.C. through the earth’s magnetic field. At a certain point on the journey the airplane is headed due east, and the magnetic field of the earth points north and down at about 40 degrees from horizontal.

Which wing of the airplane will accumulate positive charge? Please choose one.

- a) Right (south)
- b) Left (north)
- c) Neither
- d) Not enough information

On which part of the wing will the positive charge accumulate? Please select ALL that apply.

- a) Top
- b) Bottom
- c) Front
- d) Rear
- e) Other
- f) Not enough information

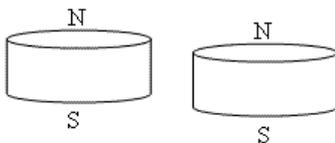
Please explain your answers to the previous two questions briefly but clearly:

The following statements about  $V$ , the electric potential, and  $\mathbf{A}$ , the magnetic vector potential maybe be true or false. Please select ALL that are true.

- a)  $V$  and  $\mathbf{A}$  are physical quantities that can be directly and absolutely measured.
- b) There can be a non-zero  $\mathbf{A}$ -field throughout a region with zero  $\mathbf{B}$ -field.
- c) There can be a non-zero  $V$ -field throughout a regions with zero  $\mathbf{E}$ -field.
- d)  $V$  and  $\mathbf{A}$  re both relate to potential energy.

Please explain your answer to the previous question. Choose two of the above statements and explain why you thought they were either true or false:

Imagine two identical disk-shaped refrigerator magnets with uniform magnetization pointing upwards:



You stack them on top of each other so that they stick together.

Where, if anywhere, are there bound currents on the two magnets stuck together? Please select ALL that apply.

- a) Top surface
- b) Bottom surface
- c) Outer cylindrical surface
- d) Inside the magnets
- e) There are no bound currents

Please explain your answer to the previous question:

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Suppose you had a long needle-like material with a strong B-field running up it, but  $\mathbf{B}=0$  outside the

needle (i.e.  $\vec{B} = C\delta^2(s)\hat{z}$ , where  $s$  is the usual cylindrical coordinate and  $C$  is a constant). Which of the following could describe the vector potential outside the needle (and not near the ends of the needle)? Please choose one.

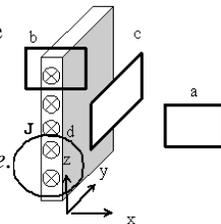
- a) Pointing in z-hat and depends on  $s$
- b) Pointing in z-hat and doesn’t depend on  $s$
- c) Pointing in s-hat and depends on  $s$
- d) Pointing in s-hat and doesn’t depend on  $s$
- e) Pointing in phi-hat and depends on  $s$
- f) Pointing in phi-hat and doesn’t depend on  $s$
- g) Zero

Please explain your answer to the previous question:

We have a large (infinite) *sheet* with a uniform current density  $\mathbf{J}$  flowing down it. The current runs in the +y direction, as shown. (The sheet is infinite in the y and z directions)

Now, consider several small Amperian loop choices, labeled a-d. Circle ALL of these which might prove useful in learning something quantitative about  $\mathbf{B}(x,y,z)$  somewhere.

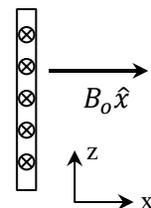
- a) a
- b) b
- c) c
- d) d
- e) None of these



You have a large (infinite) sheet with a uniform surface current density  $\vec{K} = K_0\hat{y}$  flowing down it in the +y direction. On the right side of the sheet the magnetic field is given by  $\vec{B} = B_0\hat{x}$ .

Which direction should the magnetic field point on the left side of the sheet?

- a) purely in the - x direction
- b) purely in the + x direction
- c) purely in the - z direction
- d) purely in the + z direction
- e) in the - x and - z directions
- e) in the + x and + z directions
- f) in the - x and + z directions
- f) in the + x and - z directions



Please explain your answer to the previous question:

You are performing an experiment to determine some properties of an object. You hang this object on a string, and when you bring a strong bar magnet close to the object, the object is weakly attracted to the magnet. However, when you bring another object (identical to the one that is hanging on the string) very close, the objects are neither attracted nor repelled from each other. The object you are testing could be: Please select ALL that apply.

- a) Diamagnetic
- b) Paramagnetic
- c) Ferromagnetic
- d) None of the se

Please explain your answer to the previous question:

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Given a loop of wire carrying a current  $I$  (shown to the right), which of the following methods could, in principle, be used to solve for the magnetic field at point  $P$ ?

Select all that apply.

- a) Ampere’s Law
- b) Biot-Savart Law
- c) Boundary conditions
- d) Multipole Expansion
- e) None of these

Please explain your answer to the previous question:

