Physics 52 **Exam 2** **October 25, 1996**

Name _____

Which recitation section? Wed. ____ , Thur. ____

Work directly on these pages and show your work clearly. Properly labeled figures are important and will figure into the grading.

1. [*4 pts*] The curled fingers *right hand rule* says
   (a) if the fingers are in the direction of a circular magnetic field, the thumb will be in the direction of the current.
   (b) if the fingers are in the direction of a current going in a circle, the thumb will be in the direction of the magnet field inside the circle.
   (c) both of the above
   (d) neither of the above

2. [*4 pts*] If a particle with charge +q moves in the $\hat{\mathbf{x}}$ direction through a magnetic field in the $\hat{\mathbf{z}}$ direction, it will experience
   (a) a force in the $-\hat{\mathbf{x}}$ direction.
   (b) a force in the $-\hat{\mathbf{y}}$ direction.
   (c) a force in the $\hat{\mathbf{z}}$ direction.
   (d) none of the above forces.

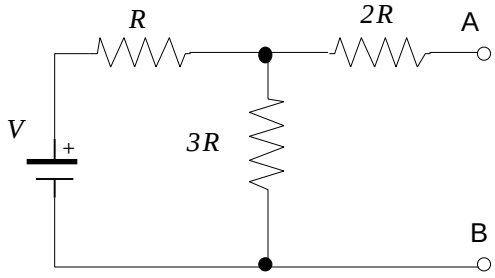
1-5.
6.
7.
8.
9.
Total

3. [*4 pts*] For a fixed and rigid loop in an applied field **B**, Lenz's law says that the induced current will be in a direction to produce a magnetic field
   (a) in the same direction as **B**.
   (b) opposite to the direction of **B**.
   (c) in the direction of d**B**/dt.
   (d) opposite to the direction of d**B**/dt.

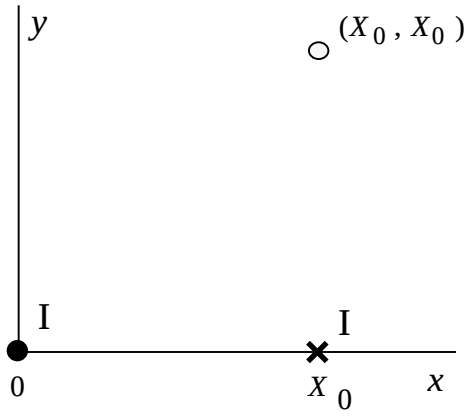
4. [*4 pts*] When moving around a circuit with more than one EMF, the potential will
   (a) *increase* when you cross an EMF in the direction of the current.
   (b) *decrease* when you cross an EMF in the direction of the current.
   (c) could be either one.

5. [*4 pts*] Indicate **all** of the items in the following list that must be described by vectors.
   (a) Magnetic field
   (b) Magnetic flux
   (c) Area
   (d) Element along a path

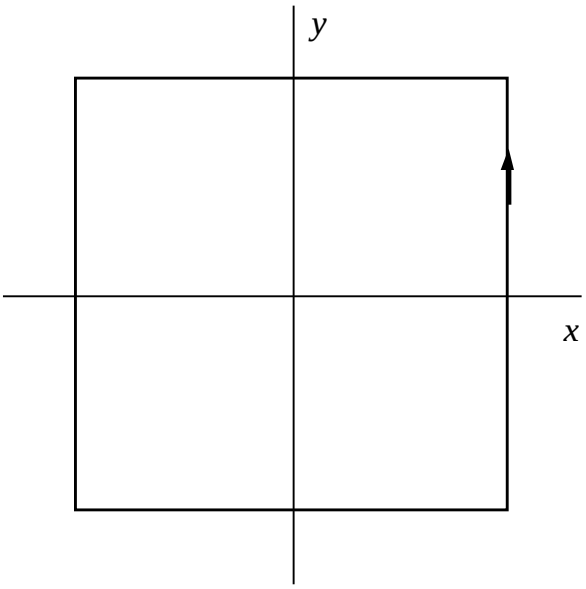
6. [*20 pts*] In terms of the element values shown on the picture, determine an expression for the potential difference $V_A - V_B$.



7. [*20 pts*] If the current at the origin is in the $+\hat{\mathbf{z}}$ direction along an infinite wire and the similar one at X_0 is in the $-\hat{\mathbf{z}}$ direction, find a vector expression (in cartesian coordinates) for the magnetic field at the point (X_0, X_0). The magnitude of the **B** field next to a long wire is $B = \frac{\mu_0 I}{2\pi r}$.



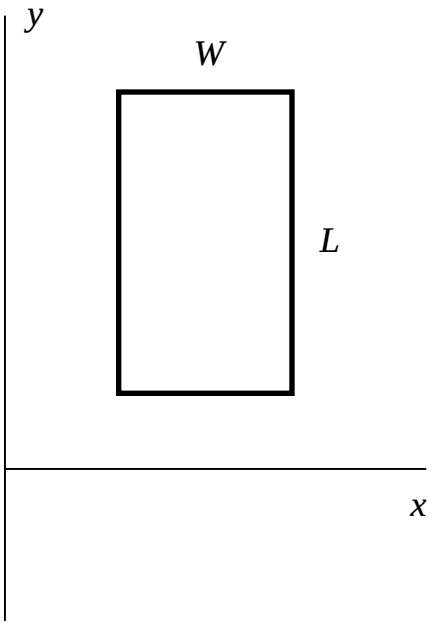
8. [*20 pts*] A square wire frame with sides of length L is centered at the origin as shown.



a. Assuming there is a counter-clockwise current I flowing in the loop, write an expression for the d**B** at the origin that corresponds to the d**l** shown in the first quadrant.

b. Now write an integral expression (complete with limits) for the **B** field at the origin resulting from the current in the full length of the right hand wire. I **don't want** you to perform the integration, but I **do want** you to reduce the integral as much as possible by simplifying the vectors and moving **all** constants outside the integral sign.

9. [20 pts] A rigid wire frame in the shape of a rectangle of width W and height L is being pulled to the right with velocity $\mathbf{V}$ through a nonuniform applied magnetic field of the form $\mathbf{B} = \frac{B_0}{x_0} x\hat{\mathbf{z}}$, where B_0 and x_0 are positive constants. *Note that this field is not realistic, but it makes the problem easier.*



a. Write an expression for the magnetic flux through the wire frame when it is at some arbitrary position in the first quadrant.

b. Use this result to find an expression for the electromotive force induced in the frame when it is moving to the right with velocity $\mathbf{V}$.

c. Indicate the direction of the current induced in the wire frame.