Exam 3 – white version

Physics 2760

Fall 2012

Please identify your Lab section
Lab Section #
Name of TA:

Last Name_____KEY_____

First Name

ID # _____

This is a closed book exam. I understand, pursuant to University Regulations on academic honesty, that I am not to use any notes or consult with peers during the examination.

Signature_____

For multiple choice questions, please make sure that you circle the letter for the answer which you believe to be correct and only that answer. If more than one answer is circled for the same problem or there are any ambiguities, you will not receive credit for it. Don't get hung up on questions. They should take only one or two minutes each. If you find yourself spending more than a few minutes on a multiple choice question you are probably looking at it the wrong way. You should skip it for now and come back to it later.

For full credit show your work for solutions to questions that require calculations. Explain from where you start to solve the problem and show your math flowing from it for full credit. **No shown work, no credit!**

Relax, read carefully, think – and then read everything again.

During the exam, if you have questions please raise your hand and the TA or the instructor will come to you and provide help.

1. (5 points) A sphere of radius *R* is placed near a long, straight wire that carries a steady current *I*. The magnetic field generated by the current is *B*. The total magnetic flux passing through the sphere is

a) $\mu_0 I$

b) $\mu_0 I/(4\pi R^2)$

c) zero

d) $4\pi R^2 \mu_0 I$

2. (5 points) A circular loop of area 2.0 m^2 carries a current of 3.0 A and has a unit normal vector to its surface of $2\hat{i}+3\hat{k}$. What is the z component of the torque (in N-m) on this loop when it is placed in a uniform magnetic field $\vec{B}=2\hat{i}+\hat{j}$ (in T)?

a) 42

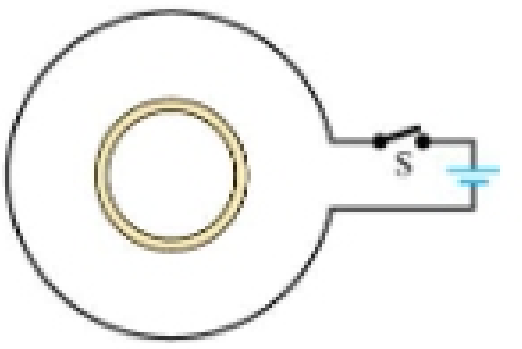
b) 18

c) 23

d) 4

e) 12

3. (5 points) Using Lenz's law find the direction of the current induced in the small ring just after switch *S* is closed.

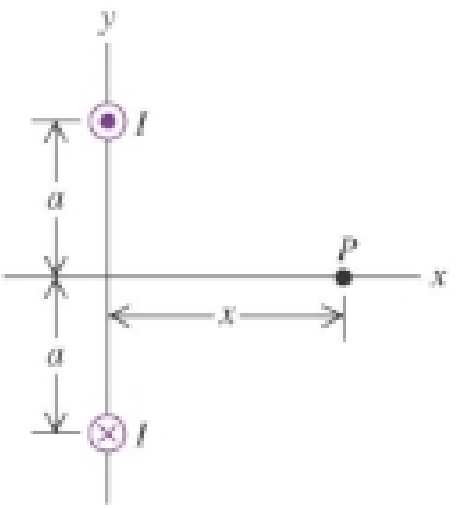


a) clockwise

b) counterclockwise

c) there is no induced current

4. (5 points) Two long, straight wires are oriented perpendicular to the *xy*–plane. They carry currents of equal magnitude *I* in opposite directions as shown. At point *P*, the magnetic field due to these currents is in



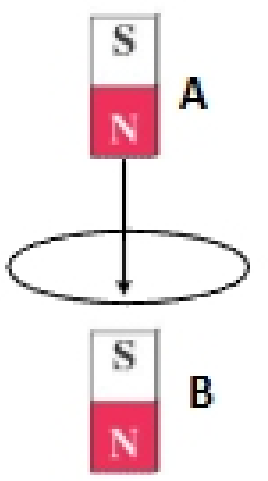
a) the positive *x*–direction

b) the negative *x*–direction

c) the positive *y*–direction

d) the negative *y*–direction

5. (5 points) A bar magnet is dropped through the center of a circular coil, its north pole pointing downward. Consider the situation at A, just before the magnet reaches the coil, and at B, just after it has fallen through it. As viewed from above, the induced current in the coil will be



a) clockwise when the magnet is at A, counterclockwise when it is at B

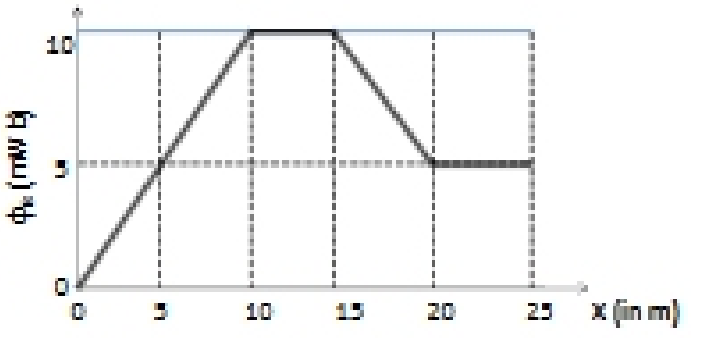
b) counterclockwise when the magnet is at A, clockwise when it is at B

c) clockwise as the magnet passes through both locations

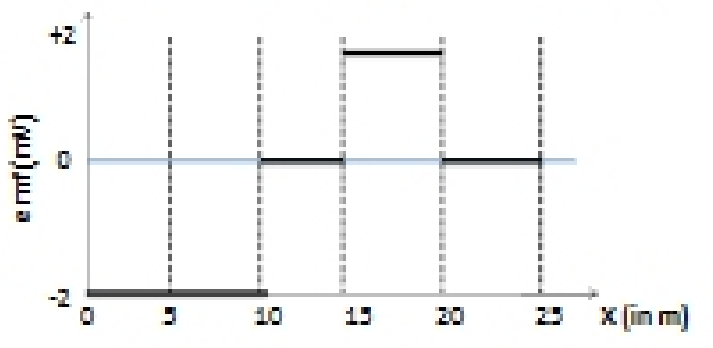
d) counterclockwise as the magnet passes through both locations

Problem 6

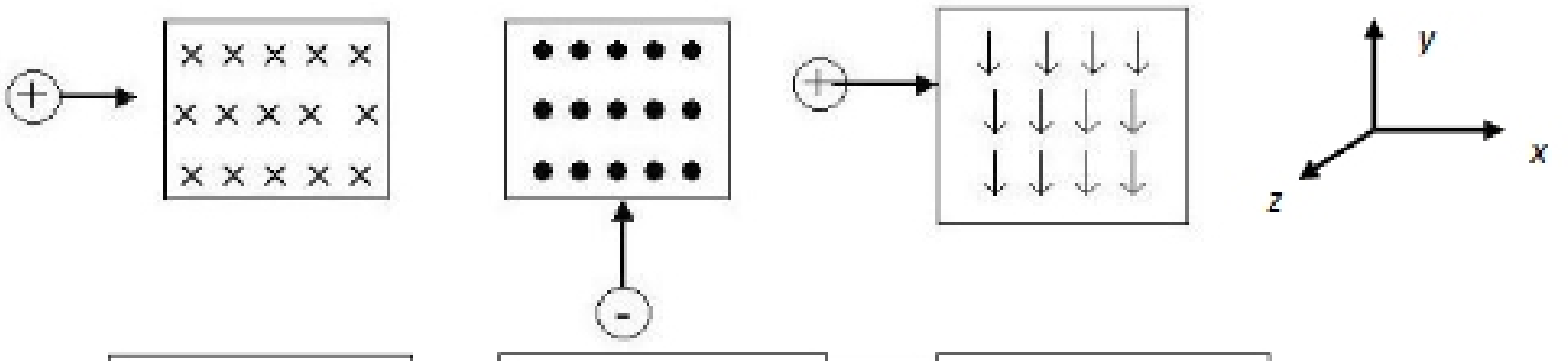
8 points **(a)** A rectangular loop is pulled at a constant speed *v* through a region of magnetic field B. (The field may not be uniform throughout.) The flux (in mWb) through the loop as a function of position x (m) is shown in the figure. Plot the induced emf of the loop as a function of x in the figure. Assume that the speed v=2 m/s. Mark the appropriate values of emf on the y axis.



$$\varepsilon = -\frac{d\emptyset}{dt} \Rightarrow -\frac{d\emptyset}{dx}\frac{dx}{dt} = -\frac{d\emptyset}{dx}\,v$$



9 points **(b)** Determine the initial direction of deflection for the charged particles entering each of the magnetic fields shown in the figures below. (The B-field is directed inward (- z) in the left figure, outward (+z) in the middle figure and downward (-y) in the right figure).

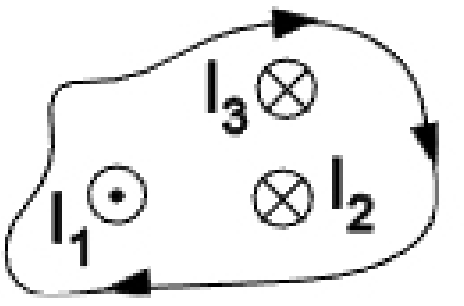


Upward force (+y direction)

Force is to the left (-x direction)

Force is into the page (-z direction)

8 points **(c)** The value of the line integral of the magnetic field B around the closed path in the direction indicated in the figure is $\oint \vec{B}\cdot d\vec{s} = 2\pi\times10^{-6}$ Tm. If current I_3 = 7 A and I_2= 3 A, what is the value of I_1?



$\oint \vec{B}.d\vec{s} = \mu_0 I_{enclosed}$; $\quad \oint \vec{B}.d\vec{s} = \mu_0[-I_1 + I_2 + I_3]$

$2\pi \times 10^{-6} = 4\pi \times 10^{-7}[-I_1 + 7 + 3]$;

$5 = [-I_1 + 7 + 3]$;

$I_1 = 5\,A$