Exam 3 – white version

Physics 2760

FS 2008

Last Name_____Solutions

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 information other than what is in the official, non-annotated formula sheet.

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, you will not receive credit for it. Don't get hung up on questions. The answer to question nine is a. 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. Don't forget to use your right hand, not your left hand when using the right hand rule.

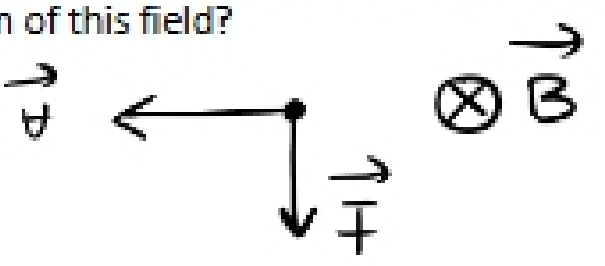
For full credit show your work for solutions to questions that require calculations. Explain from where you start to solve the problem and show your math flowing from it for full credit. **No shown work, no credit!**

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.

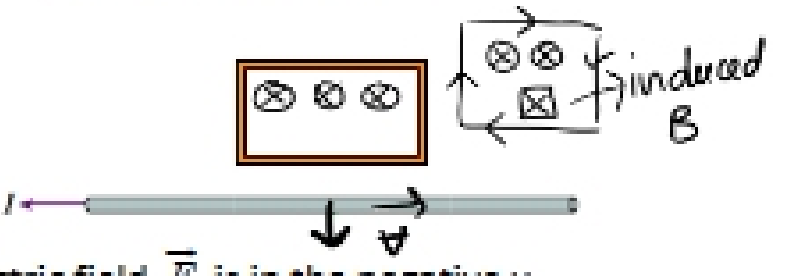
1. (5 points) A proton is released such that its initial velocity is from right to left across this page. The proton's path, however, is deflected in a direction toward the bottom edge of the page due to the presence of a uniform magnetic field. What is the direction of this field?

a) out of the page
b) into the page
c) from bottom edge to top edge of the page
d) from right to left across the page
e) from left to right across the page



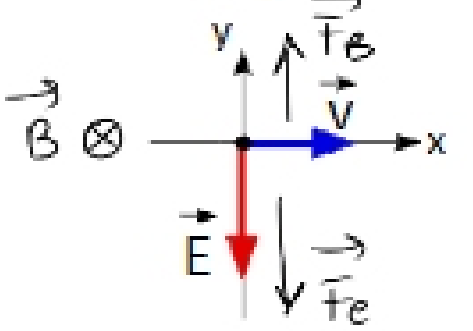
2. (5 points) A current-carrying wire is pulled away from a conducting rectangular loop. As the wire is moving, there is

a) a clockwise current around the loop.
b) a counterclockwise current around the loop.
c) no current around the loop.

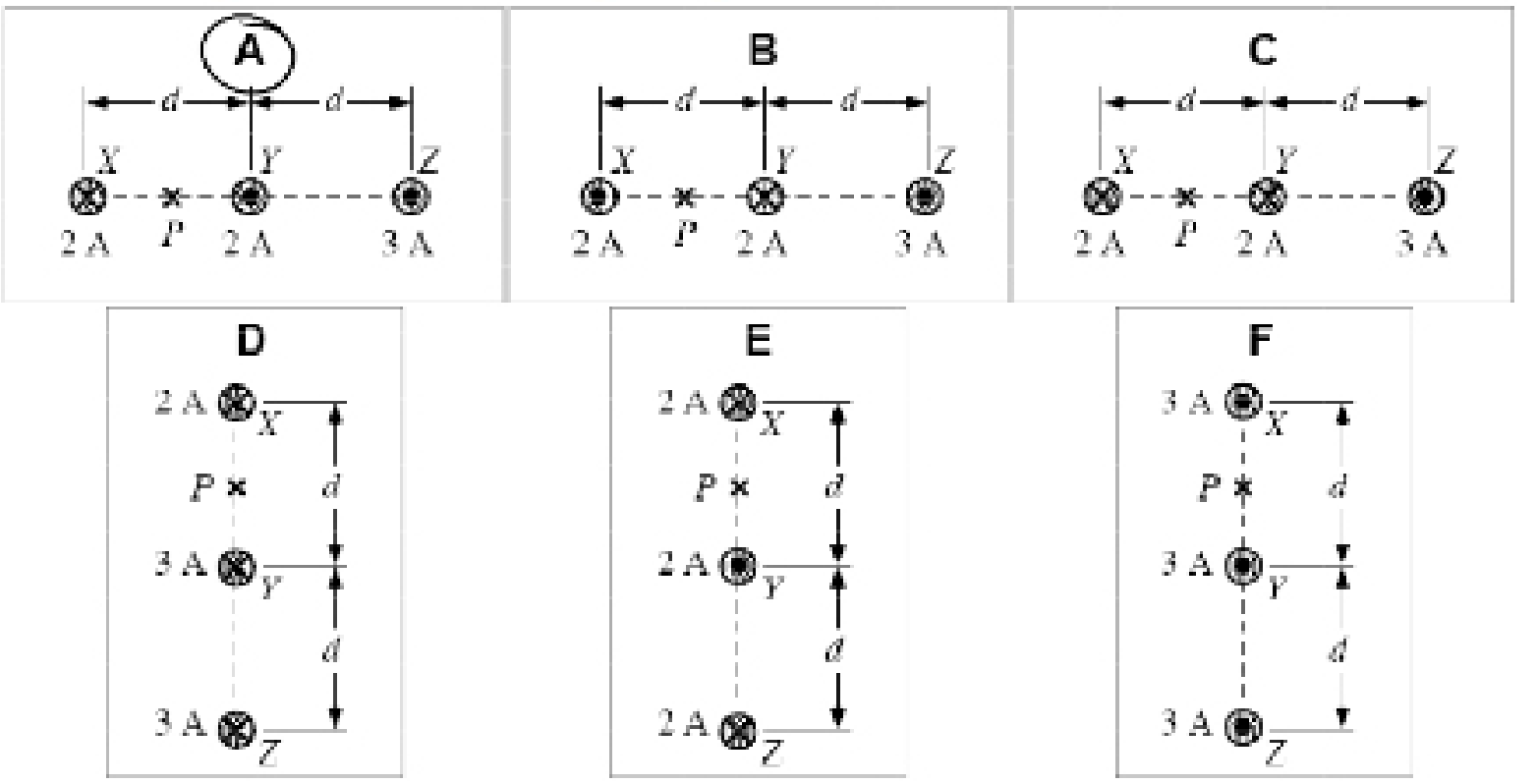


3. (5 points) A proton is traveling in the positive x direction. A uniform electric field $\vec{E}$ is in the negative y direction. If a uniform magnetic field with the appropriate magnitude and direction also exists in the region, the total force on the electron will be zero. The appropriate direction for the magnetic field is:

a) the positive y direction
b) the negative y direction
c) into the page
d) out of the page
e) the negative x direction

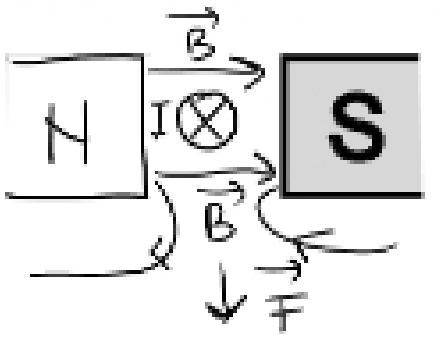


4. (5 points) Shown below are six situations where three long straight parallel wires carry currents either into or out of the page. In each situation, point P is midway between two adjacent wires. Circle the case for which the total magnetic field is the strongest at point P.



5. (5 points) The diagram shows a straight wire between the poles of a permanent magnet, carrying a current into the page. The direction of the magnetic force exerted on the wire is:

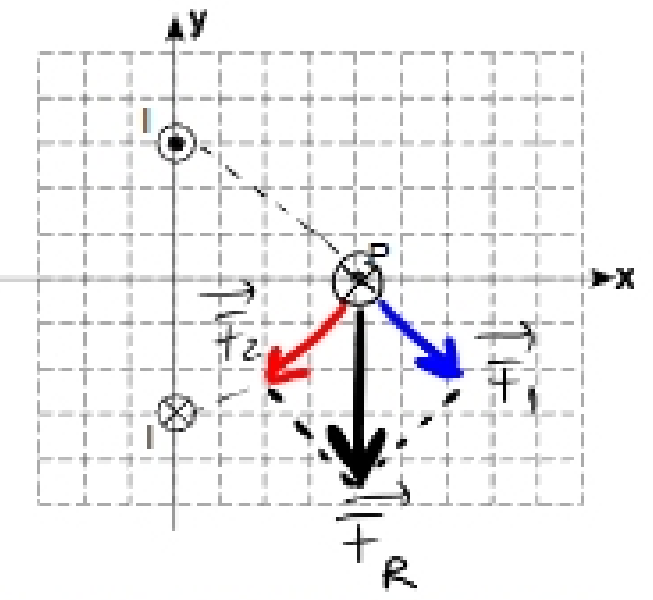
a) ↑
b) ↓
c) ←
d) →
e) Into the page



$\vec{F} = I\vec{L} \times \vec{B}$

6. (5 points) Two identical wires carry equal current I. The current in the upper wire is directed out of the plane, while the current in the lower wire is directed into the plane. If a third wire is placed at point P with its current directed into the plane, what will be the direction of the net force exerted on this third wire by the other two?

a) in the positive y–direction
b) in the negative x–direction
c) in the positive x–direction
d) in the negative y–direction
e) perpendicular to the plane of the drawing



7. (5 points) The value of the line integral of the magnetic field B around the closed path in the direction indicated in the figure is $\oint \vec{B} \cdot d\vec{s} = 2\pi \times 10^{-6}$ Tm . If current I_1 = 6 A and I_2 = 4 A, what is the value of I_3?

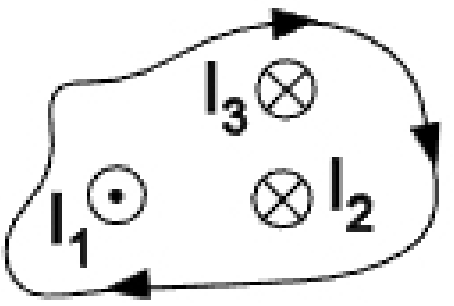
Take $\mu_0 = 4\pi \times 10^{-7}$ N/A^2

a) I_3 = 0
b) I_3 = 7.0 A
c) I_3 = 3.0 A
d) I_3 = 15.0 A
e) I_3 = 5.0 A

$\oint \vec{B} \cdot d\vec{s} = \mu_0 I_{enc}$.

$2\pi \times 10^{-6} = (4\pi \times 10^{-7})(I_2 + I_3 - I_1)$

$\Rightarrow 5 = 4 + I_3 - 6 \Rightarrow \boxed{I_3 = 7\ A}$



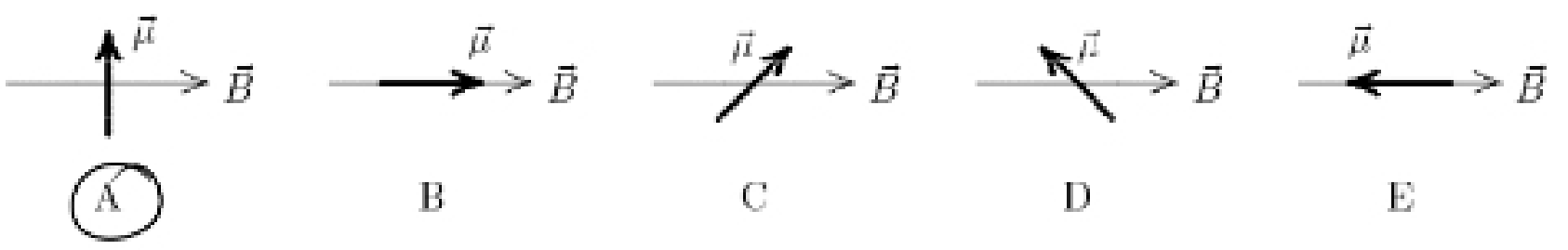
8. (5 points) A 2.0-m wire carries a current of 15 A directed along the positive x axis in a region where the magnetic field is uniform and given by $\vec{B} = 3\hat{i} - 4\hat{j}$ (in T). What is the resulting magnetic force on the wire?

a) (+120 $\hat{k}$) N
b) (–120 $\hat{k}$) N
c) (–150 $\hat{k}$) N
d) (+150 $\hat{k}$) N
e) (+90 $\hat{k}$) N

$\vec{F} = I\vec{L} \times \vec{B} = (15)(2\hat{i}) \times (3\hat{i} - 4\hat{j})$

$\boxed{\vec{F} = -120\hat{k}}$

9. (5 points) The diagrams show five possible orientations of a magnetic dipole $\vec{\mu}$ in a uniform magnetic field $\vec{B}$. For which of these does the magnetic torque on the dipole have the greatest magnitude?



10. (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 x 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

$\vec{\tau} = \vec{\mu} \times \vec{B} = (I\vec{A}) \times \vec{B} = [3 \cdot 2(2\hat{i} + 3\hat{k})] \times (2\hat{i} - \hat{j})$

$\vec{\tau} = (12\hat{i} + 18\hat{k}) \times (2\hat{i} - \hat{j})$

$\vec{\tau} = -12\hat{k} + 36\hat{j} + 18\hat{i}$