Exam 3

Your Name:

Instructions

Solve each of the following problems to the best of your abilities. The exam is worth 100 points total and is calibrated for 120 minutes. Once you have completed the exam, hand it to me, and you can take a break before the second part of class. Class resumes at 7:30PM.

Good luck!

Problem 1

(20 points) A charged particle enters a region of uniform magnetic field. Listed below are some of the properties of the system:

- Particle Mass = 0.05 kg
- Particle Charge = +0.89 mC
- Initial Velocity = 20.0 m/s in the +y direction
- Magnetic Field = 0.75 T in the +z direction

a) (5 points) In which direction is the initial force on the charged particle?
b) (5 points) Suppose I increased the initial speed of the particle. Would the frequency of the revolutions increase, decrease or stay the same? Why?
c) (5 points) Suppose I reversed the direction of the magnetic field (meaning now it is in the –z direction). Would the frequency of the revolutions increase, decrease, or stay the same? Why?
d) (5 points) How much work does the magnetic field do on the particle as it completes one full revolution? Why?

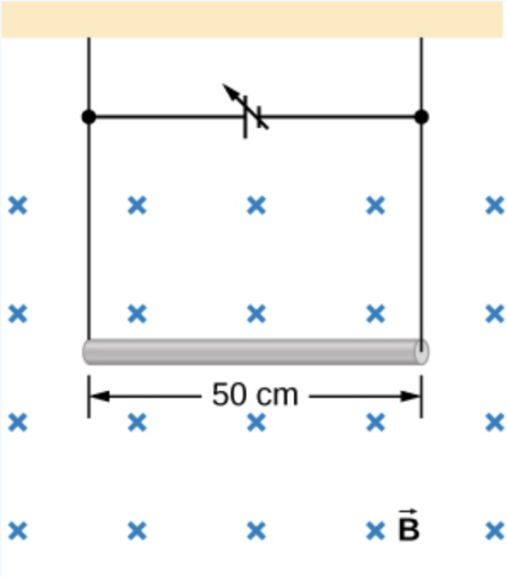
Problem 2

(10 points) A very long wire carrying a current of 1.37 A is oriented along the y-axis and carries the current in the +y direction. Another very long wire carrying a current of 4.22 A is oriented along the x-axis and carries the current in the –x direction. You can assume that the wires are locked into place and that the currents do not affect each other at the origin.

What is the magnitude and direction of the net magnetic field at the point (1.00 m, 2.00 m, 0.00 m)?

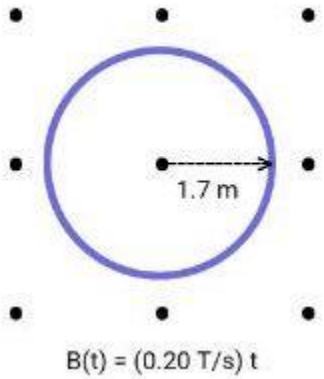
Problem 3

(10 points) A wire of length 50 cm and mass 10 g is suspended in a horizontal plane by a pair of flexible leads. The wire is then subjected to a constant magnetic field of magnitude 0.50 T, which is directed as shown. What are the magnitude and direction of the current in the wire needed to remove the tension in the supporting leads?



Problem 4

(30 points) A loop of wire with a radius of 1.7 m is immersed in a uniform magnetic field as shown in the diagram below. The strength of the magnetic field changes with time according to: B(t) = (0.20 T/s) t



a) (5 points) What is the magnetic flux through the loop at time t = 0.0 seconds?
b) (5 points) What is the magnetic flux through the loop at time t = 5.0 seconds?
c) (5 points) What is the induced EMF through the loop at time t = 0.0 seconds?
d) (5 points) What is the induced EMF through the loop at time t = 5.0 seconds?
e) (5 points) What is the direction of the current in the loop at time t = 0.0 seconds? Your options are “clockwise”, “counterclockwise”, or “there is no current”.
f) (5 points) What is the direction of the current in the loop at time t = 5.0 seconds? Your options are “clockwise”, “counterclockwise”, or “there is no current”

Problem 5

(10 points) What is the difference between diamagnetism, paramagnetism, and ferromagnetism in magnetic materials?

Problem 6

(10 points) What is the difference between the surfaces used for Gauss' law and those used for Ampere's law? Are they interchangeable?

Problem 7

(10 points) Gauss' law for magnetism tells us that the net magnetic flux over a closed surface is equal to zero. Suppose that the net flux was not equal to zero – what would that mean for magnetic fields and magnetic "charges"?