Version

A

Quiz #5 Form #521

Physics 2212 GHJ Fall 2014

Name:____________________

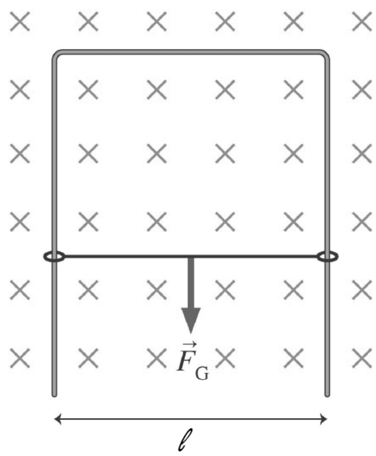
Recitation Section:____________________

- Print your name, quiz form number (3 digits at the top of this form), and student number (9 digit Georgia Tech ID number) in the section of the answer card labeled "Student Identification."
- Bubble the Quiz Form Number in columns 1–3, skip column 4, then bubble your Student Number in columns 5–13.
- Free-response questions are numbered I–III. For each, make no marks and leave no space on your card. Show all your work clearly, including all steps and logic. Box your answer.
- Multiple-choice questions are numbered 1–8. For each, select the answer most nearly correct, circle this answer on your quiz, and bubble it on your answer card. Do not put any extra marks on the card.
- Turn in your quiz and answer card as you leave. Your score will be posted when your quiz has been graded. Quiz grades become final when the next quiz is given.
- You may *not* use any aids, including a calculator or other electronic device.

e	Fundamental charge	m_e	Mass of an electron
μ_0	Permeability constant	c	Speed of light
K	Coulomb constant $= 1/4\pi\epsilon_0$	g	Magnitude of Free Fall Acceleration

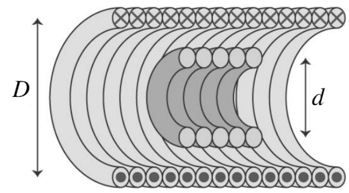
Unless otherwise directed, drag should be neglected, and all circuit elements are ideal.
Any integrals in free-response problems must be evaluated. Questions about magnitudes will state so explicitly.

I. (16 points) A U-shaped conducting rail is oriented vertically in a uniform, horizontal, magnetic field with magnitude B directed into the page. The rail has no electric resistance and does not move. A slide wire with mass m, length ℓ, and resistance R can slide up and down without friction while maintaining electrical contact with the rail. The slide wire is released from the rest. Find the expression for the terminal speed v of the slide wire in terms of other parameters defined in the problem and physical or mathematical constants. (*On Earth.*)



II. (16 points) A five-turn coil with diameter d and resistance R is inside a solenoid with diameter D, as shown. The solenoid has N_{sol} turns, a length ℓ much greater than D, and carries a time-varying current

$$I_{\text{sol}} = at^2 + bt + c$$

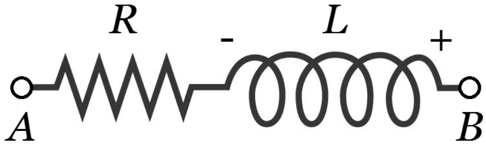


where a, b and c are positive constants. Determine the magnitude of the current in the coil. Express your answer in terms of parameters defined in the problem and physical or mathematical constants.

1. (6 points) In the problem above, what is the direction of the induced magnetic field and induced current in the coil?

   (a) Induced field is to the right, and induced current flows in the bottom and out the top of each coil.
   (b) Induced field is to the right, and induced current flows in the top and out the bottom of each coil.
   (c) Induced field is to the left, and induced current flows in the bottom and out the top of each coil.
   (d) Induced field is to the left, and induced current flows in the top and out the bottom of each coil.
   (e) Induced field is down the page, and induced current flows in the top and out the bottom of each coil.

III. (16 points) In the circuit segment shown, the inductance is 1.0 H and the resistance is 5.0 Ω. The potential difference is $\Delta V_{AB} = V_B - V_A = -20\,\mathrm{V}$ at an instant when the rate of current change in the circuit has a **magnitude** of 10 A/s. The polarity of the inductor at this moment is indicated. Is the inductor supplying or storing energy? At what rate?



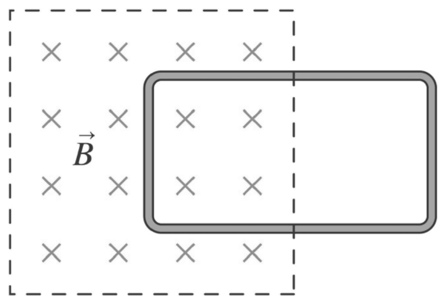
2. (6 points) Considering, if necessary, the direction of current flow you found above, and the polarity of the inductor indicated in the figure, is the magnitude of the current through the circuit increasing or decreasing?
   (a) I found current flowing to the left, so it must be increasing.
   (b) I found current flowing to the right, so it must be decreasing.
   (c) I found current flowing to the right, so it must be increasing.
   (d) I found current flowing to the left, so it must be decreasing.
   (e) Regardless of the direction of current flow, whether it increases or decreases depends on the inductance L of the inductor.

3. (8 points) Consider two inductors that have the same length and cross section. The second inductor has three times as many coils as the first. The first inductor stores magnetic energy U_1 when a current I_1 flows through it. What energy U_2 is stored in the second inductor when the current through it is $I_2 = I_1/4$?

(a) $U_2 = 3U_1/4$
(b) $U_2 = 3U_1/16$
(c) $U_2 = 4U_1/3$
(d) $U_2 = 9U_1/4$
(e) $U_2 = 9U_1/16$

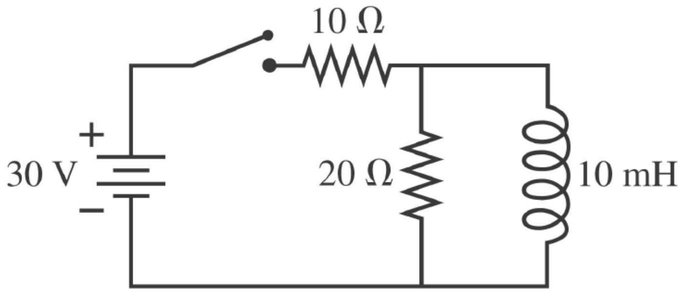
4. (6 points) A conducting loop is halfway into a magnetic field pointing into the page. Suppose the magnetic field begins to decrease rapidly in strength. What happens to the loop? The loop is . . .

(a) pushed to the right, out of the magnetic field.
(b) pushed upward, toward the top of the page.
(c) pulled to the left, into the magnetic field.
(d) not going to move.
(e) pushed downward, toward the bottom of the page.



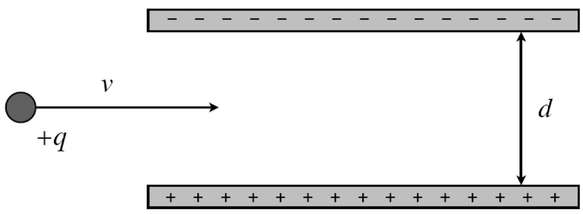
5. (8 points) The switch in the circuit shown on the figure has been open for a long time. It is closed at time $t = 0$. What is the current through the $20\,\Omega$ resistor immediately after the switch is closed and after the switch has been closed for a long time?

(a) The current is 1.0 A immediately after closing the switch, and 0 A after a long time.
(b) The current is 1.0 A immediately after closing the switch, and 1.0 A after a long time.
(c) The current is 3.0 A immediately after closing the switch, and 1.0 A after a long time.
(d) The current is 0 A immediately after closing the switch, and 3.0 A after a long time.
(e) The current is 1.5 A immediately after closing the switch, and 3.0 A after a long time.



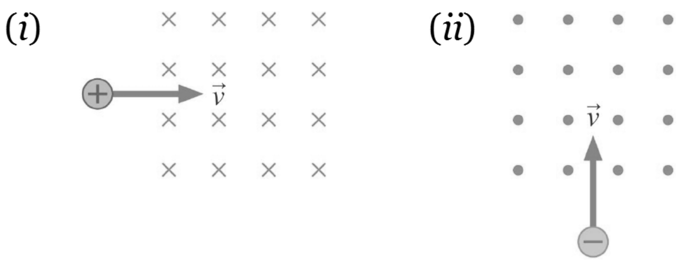
6. (6 points) A positively charged particle with charge q travels with speed v between the two parallel charged plates shown in the figure. The plates are separated by a distance d. What magnetic field strength and direction will allow the charged particle to pass between the plates without being deflected?

(a) $B = E/v$ directed into the page.
(b) $B = vE$ directed down the page.
(c) $B = E/v$ directed out of the page.
(d) $B = qvE$ directed up the page.
(e) $B = vE$ directed out of the page.



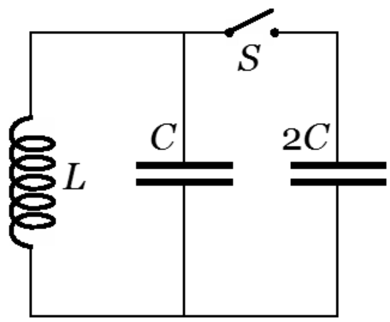
7. (6 points) What is the initial direction of deflection for the charged particles entering the magnetic fields as shown?

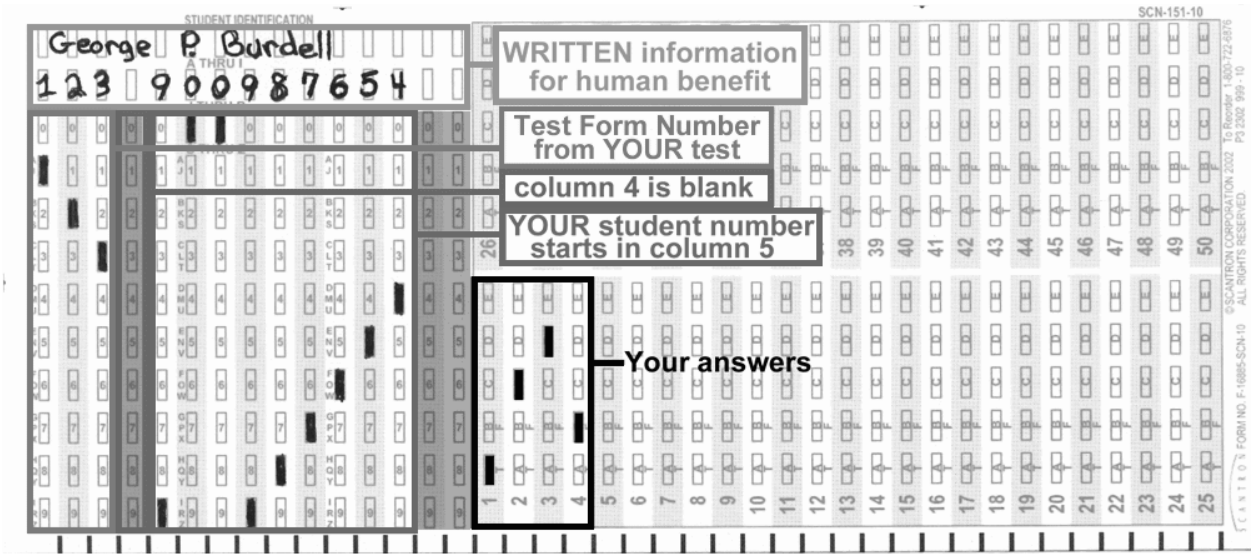
   (a) Particle i is deflected up the page and particle ii is deflected out of the page.
   (b) Particle i is deflected down the page and particle ii is deflected to the left.
   (c) Particle i is deflected down the page and particle ii is deflected into the page.
   (d) Particle i is deflected into the page and particle ii is deflected to the right.
   (e) Particle i is deflected up the page and particle ii is deflected to the left.



8. (6 points) The LC circuit oscillates with a frequency f_0 when the switch S is closed. What will be the frequency of oscillation when the switch is open?

   (a) $f_0\sqrt{3/2}$
   (b) $f_0/3$
   (c) $f_0\sqrt{2/3}$
   (d) $3f_0$
   (e) $f_0\sqrt{3}$





YOUR form number is **521**

Recitation Sections

	Howey S-104	Howey S-106	Howey S-107
Wednesday			
1:05 pm		J01 Barrow, Kirk	
2:05 pm	H05 Barrow, Kirk	G01 Nguyen, Khai	G02 Ma, Wenyao
3:05 pm	J05 White, Meghan	J02 Nguyen, Khai	G06 Ma, Wenyao
4:05 pm		H01 Nguyen, Khai	H06/J06 Doyle, Patrick
5:05 pm		G03 Naegele, James	H02 Kim, Jea Du
Thursday			
12:05 pm		G04 Doyle, Patrick	
1:05 pm		H03 Doyle, Patrick	
2:05 pm	J08 Barrow, Kirk	H04 Doyle, Patrick	J03 Nguyen, Khai
3:05 pm			H07/J07 Naegele, James
4:05 pm		J04 Nguyen, Khai	
5:05 pm		G05 Nguyen, Khai	G07 Kim, Jea Du