Physics 2212G/J Test form **446** Name _____
Fall 2016
Test 4 Recitation Section (see back of test):_____

A

1) Print your name, test form number (above), and nine-digit student number in the section of the answer card labeled "STUDENT IDENTIFICATION".

2) Bubble your test form number (**ABOVE**) in columns 1-3, skip column 4, then bubble in your student number in columns 5-13.

3) For each free-response question, show all relevant work supporting your answer. **Clearly box or underline your final answer.** "Correct" answers which are not supported by adequate calculations and/or reasoning will be counted wrong.

4) For each multiple-choice question, select the answer most nearly correct, **circle this answer on your test**, and bubble it in on your answer card. **Show all relevant work on your quiz.**

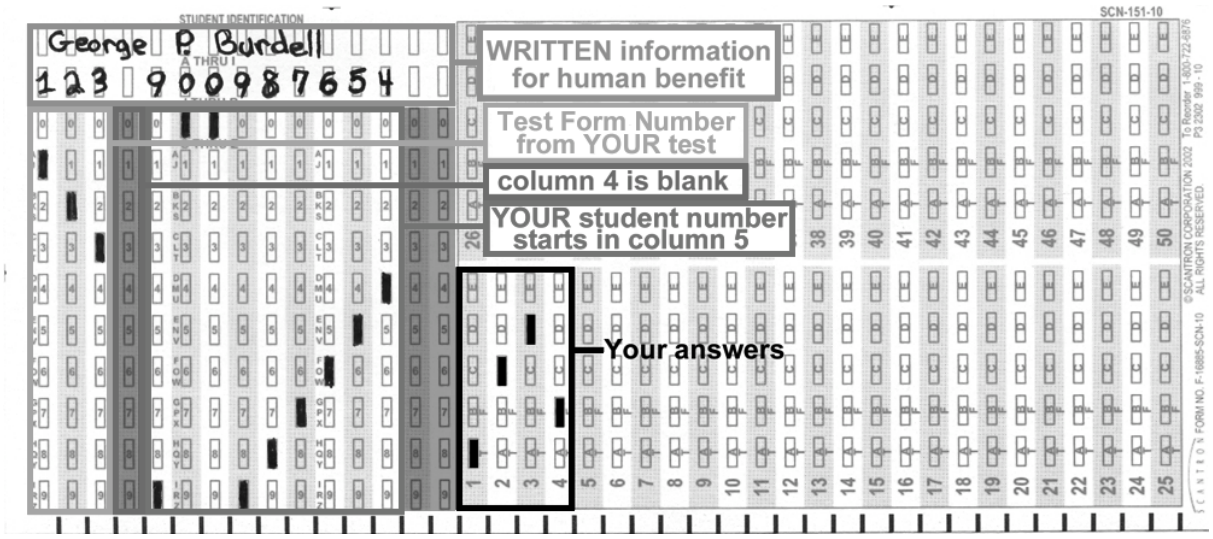
5) Be prepared to present your Buzzcard as you turn in your test. Scores will be posted to WebAssign after they have been been graded. **Quiz grades become final when the next quiz is given.**

6) You may use a simple scientific calculator capable of logarithms, exponentials, and trigonometric functions. **Programmable engineering calculators with text or graphical capabilities are not allowed. Wireless devices are prohibited.**

Numerical Constants:

$k = 8.99\times10^{9}$ N·m^2/C^2	$e = 1.60\times10^{-19}$ C	$m_e = 9.11\times10^{-31}$ kg
$\varepsilon_o = 8.85\times10^{-12}$ C^2/N·m^2	$g = 9.81$ m/s^2	$m_p = 1.67\times10^{-27}$ kg

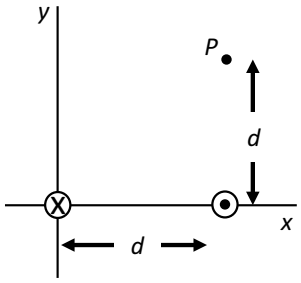
Your test form is: 446



Our Final Exam will be held during Period 19
Monday, December 12 at 6:00 pm

The following problem will be hand-graded. Show all your work for this problem. Make no marks and leave no space on your answer card for it.

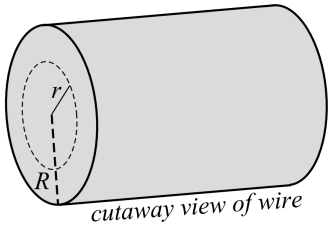
[I] *(20 points)* In the figure at right, two long straight wires carry current perpendicular to the *xy*-plane. The left wire, located at $x = 0$ carries current I into the page; the right wire, located at $x = d$ carries current $2/3\,I$ out of the page.



Calculate the magnetic field at the point P, located at coordinates $(x,y) = (d,d)$. Express your answer as a Cartesian vector (using $\hat{\imath}$ and $\hat{\jmath}$), in terms of the parameters I and d, along with symbols for any necessary physical constants (i.e. do not substitute any numerical values).

The following problem will be hand-graded. <u>*Show all your work for this problem*</u>*. Make no marks and leave no space on your answer card for it.*

[II] *(20 points)* A long straight conducting cylinder of radius R carries a steady, non-uniform current. The current density is given by the expression $J(r) = a\,r$, where r is the distance from the center of the wire and a is a positive constant.



cutaway view of wire

(*i*) Find an expression for the total current flowing in the wire. Express your answer symbolically in terms of R and a, along with any other required mathematical constants.

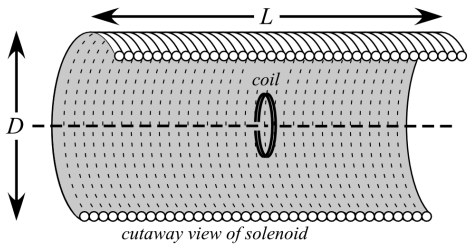
(*ii*) Determine the magnitude of the magnetic field at a distance $d = 3/5\,R$ from the center of the wire.

The following problem will be hand-graded. <u>*Show all your work for this problem*</u>*. Make no marks and leave no space on your answer card for it.*

[III] *(20 points)* A solenoid of diameter D and length L has N_S total windings of wire along its axis. A sinusoidal current is driven through the solenoid, given by the expression:

$$I(t) = I_o \sin(\omega t)$$

Assume that a *positive* value for $I(t)$ corresponds to a <u>clockwise</u> flow of current around the circumference of the solenoid, when viewed from the left. A circular coil of diameter $D/3$ having N_C total windings is placed coaxially within the solenoid.

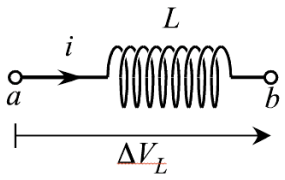


(*i*) Use Faraday's Law to find an expression for the induced emf in the coil as a function of time.

(*ii*) Use Lenz's Law to determine the <u>direction</u> of the induced current in the coil at time $t = 0$.

Question value 8 points

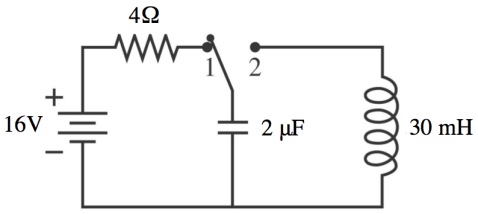
(1) A solenoid having self-inductance L = .48 H has a rightward-directed current flowing through it. At a particular moment in time, the potential difference across the inductor, moving from left to right, is ΔV_L = +24 V. What can be said about the current flowing through the inductor at this moment?



(a) The current is 2.0 A at this moment, but is increasing as time passes.
(b) The current is 50 amps and constant at this moment
(c) The current is decreasing at a rate of 50 amps per second.
(d) The current is increasing at a rate of 50 amps per second.
(e) The current is 0.02 A at this moment, but is decreasing as time passes.

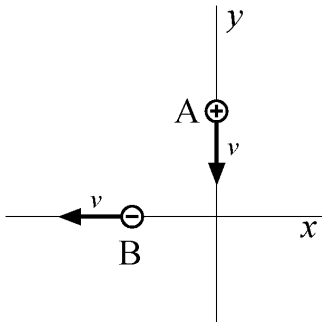
Question value 8 points

(2) The switch has been in position 1 for a long time. It is changed to position 2 at t = 0 s. What is the maximum current through the inductor?



(a) 7.63 mA
(b) 4.00 A
(c) 120 mA
(d) 131 mA
(e) 1.20 A

The next two problems involve the following situation:
Positive point charge A moves with constant velocity along the *y*-axis. Negative point charge B moves with constant velocity along the *x*-axis. Both charges are moving with identical speeds *v*.



Question value 4 points

(3) At the moment when *A* crosses the origin, what direction is the magnetic force (if any) exerted by A on B?

(a) $\vec{F}_{on\,\mathrm{B}}$ is in the negative *x*-direction.
(b) $\vec{F}_{on\,\mathrm{B}}$ is zero.
(c) $\vec{F}_{on\,\mathrm{B}}$ is in the negative *y*-direction.
(d) $\vec{F}_{on\,\mathrm{B}}$ is in the positive *y*-direction.
(e) $\vec{F}_{on\,\mathrm{B}}$ is in the positive *x*-direction.

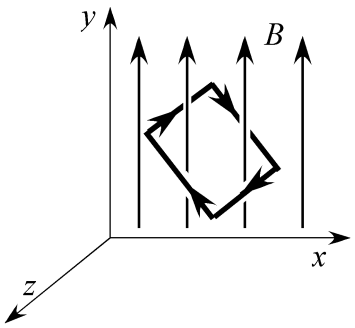
Question value 4 points

(4) At the moment when *A* crosses the origin, what direction is the magnetic force (if any) exerted by B on A?

(a) $\vec{F}_{on\,\mathrm{A}}$ is zero.
(b) $\vec{F}_{on\,\mathrm{A}}$ is in the negative *x*-direction.
(c) $\vec{F}_{on\,\mathrm{A}}$ is in the positive *y*-direction.
(d) $\vec{F}_{on\,\mathrm{A}}$ is in the negative *y*-direction.
(e) $\vec{F}_{on\,\mathrm{A}}$ is in the positive *x*-direction.

Question value 8 points

(5) The loop of wire placed in the uniform magnetic field shown at right will experience



(a) a torque about the negative *x*-axis.

(b) a torque about the negative *z*-axis.

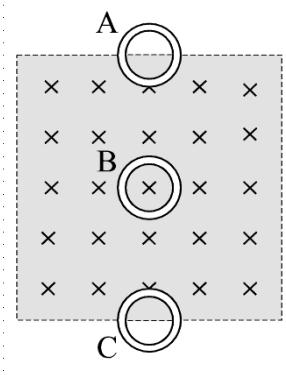
(c) a torque about the positive *x*-axis.

(d) *zero* torque, because the field is uniform.

(e) a torque about the positive *z*-axis.

Question value 8 points

(6) In the figure at right, a copper ring is dropped vertically into a region containing a uniform magnetic field directed into the page. The ring enters the field at A and departs at C. What will be the direction of the magnetic force on the ring (if any) at positions A, B, and C (shown in the diagram)?



(a) $\vec{F}_A$ is up, $\vec{F}_B$ is up, $\vec{F}_C$ is up.

(b) $\vec{F}_A$ is zero, $\vec{F}_B$ is up, $\vec{F}_C$ is zero.

(c) $\vec{F}_A$ is up, $\vec{F}_B$ is zero, $\vec{F}_C$ is up.

(d) $\vec{F}_A$ is down, $\vec{F}_B$ is zero, $\vec{F}_C$ is up.

(e) $\vec{F}_A$ is down, $\vec{F}_B$ is up, $\vec{F}_C$ is down

PHYS 2212 G/J Recitation TA and Room Assignments

	Howey S-104	Howey S-106	Howey S-107
WEDNESDAY			
1:05 pm		J01 Zhou, Boli	
2:05 pm		G01 Zhou, Boli	G02 Daum, Marcus
3:05 pm		G06 Zhou, Boli	J02/J05 Daum, Marcus
4:05 pm		G08 Kim, Sirwoo	
5:05 pm	J09 Daum, Marcus	G03/J06 Kim, Sirwoo	
THURSDAY			
12:05 pm			G04 Daum, Marcus
1:05 pm			J10 Daum, Marcus
2:05 pm		G09 Zhou, Boli	J03/J08 Daum, Marcus
3:05 pm		G10/J07 Zhou, Boli	
4:05 pm		J04 Thoreson, Megan	
5:05 pm		G05 Zhou, Boli	G07 Bernardes, Sarah

Tests will be returned in recitation, in the week *after* the test. In order to ensure that you receive your test back as soon as possible, please enter your recitation section from the table above (G01–G10) on the front of this test.