Instructor(s): *P. Kumar*

PHYSICS DEPARTMENT

PHY 2049 Exam 2 July 10, 2013

Name (print, last first): _____ Signature: _____

*On my honor, I have neither given nor received unauthorized aid on this examination.*

**YOUR TEST NUMBER IS THE 5-DIGIT NUMBER AT THE TOP OF EACH PAGE.**

(1) **Code your test number on your answer sheet (use lines 76–80 on the answer sheet for the 5-digit number)**. Code your name on your answer sheet. **DARKEN CIRCLES COMPLETELY**. Code your UFID number on your answer sheet.
(2) Print your name on this sheet and sign it also.
(3) Do all scratch work anywhere on this exam that you like. **Circle your answers on the test form.** At the end of the test, this exam printout is to be turned in. No credit will be given without both answer sheet and printout.
(4) **Blacken the circle of your intended answer completely, using a #2 pencil or blue or black ink**. Do not make any stray marks or some answers may be counted as incorrect.
(5) **The answers are rounded off. Choose the closest to exact. There is no penalty for guessing. If you believe that no listed answer is correct, leave the form blank.**
(6) Hand in the answer sheet separately.

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Constants: $e = 1.6 \times 10^{-19}$ C $\quad m_p = 1.67 \times 10^{-27}$ kg $\quad m_e = 9.1 \times 10^{-31} kg \quad g = 9.8 m/s^2 \quad$ micro $= 10^{-6}$

$\epsilon_o = 8.85 \times 10^{-12} C^2/N \cdot m^2 \quad k = 1/(4\pi\epsilon_o) = 9 \times 10^9\, N \cdot m^2/C^2 \quad \mu_o = 4\pi \times 10^{-7} T \cdot m/A \quad$ nano $= 10^{-9} \quad$ pico $= 10^{-12}$

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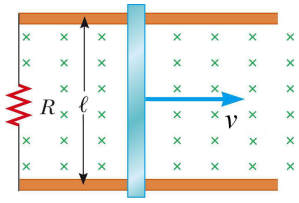
1. People with pacemakers are warned to stay away from magnetic fields stronger than 5 gauss ($5 \times 10^{-4}$T). If a bolt of lightning can reach a current of approximately 30,000 A for a short time, what is the minimum distance that a person wearing a pacemaker can be from the lightning bolt to stay within the B field safety threshold? (Ignore the fact that the magnetic field from a lightning bolt is the least of his concerns.)

   (1) 12 m (2) 20 m (3) 30 m (4) 40 m (5) 250 m

2. A conducting bar can slide with no friction along two conducting rails separated by distance $L = 30$ cm. The rails are interconnected via a resistor $R = 6\Omega$. A uniform 5 Tesla magnetic field points into the page, as indicated by crosses. At what speed should the bar be moved to produce a power dissipation of 1.5 W in the resistor?

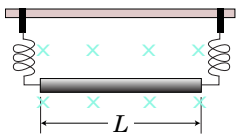



   (1) 2.0 m/s (2) 1.0 m/s (3) 3.0 m/s (4) 1.5 m/s (5) 2.5 m/s

3. Two wires each carry 10 A current in opposite direction and are 3.0 mm apart. What is the magnetic field at a point P, 50 cm away from the nearest wire and in the plane of the wires?

   (1) 24 nT (2) 151 nT (3) 0.0 T (4) 75 nT (5) 96 nT

4. A straight stiff wire of length 1.00 m and mass 50 g is suspended in a magnetic field B = 0.75 T. How much current must flow in the wire so that the wire is suspended with no tension in the springs?

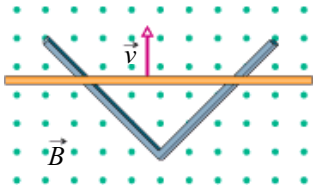



   (1) none of these (2) 0.25 A (3) 330 A (4) 250 A (5) 0.33 A

5. In an oscillating $LC$ circuit, $L = 3.00$ mH and $C = 2.70\mu$F. At $t = 0$ the charge on the capacitor is 3C and the current is zero. What is the maximum current (in mA) that will appear in this circuit?

   (1) 31 (2) 54 (3) 90 (4) 21 (5) none of these

6. Two straight conducting rails meet at a right angle. A conducting bar in contact with the rails starts at the vertex at time $t = 0$ and moves with a constant velocity of v m/s along them. A magnetic field with $B = 0.7$ T is directed out of the page. If the emf generated in the triangular loop at time $t = 6$s is 56.8 V, what is v (in m/s)?

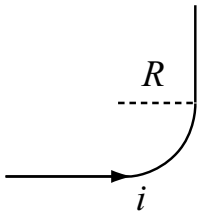



(1) 2.6 (2) 5.2 (3) 1.3 (4) 6.5 (5) None of these

7. A wire of length $L$ carries a current $i$. If the wire is bent into a circular coil of $N$ turns and placed into a uniform magnetic field $B$, what is the magnitude of the maximum possible torque on the loop?

(1) $L^2iB/4\pi N$ (2) $LiB\pi/2N$ (3) $2L^2iB/\pi^2N^2$ (4) $3LiB/\pi N$ (5) $L^2\pi iB/4N^2$

8. A conducting wire is formed into two long, semi-infinite straight sections connected by a quarter circle of radius $R$, as shown in the figure. What is the magnitude and direction of the magnetic field at the center of the quarter circle?

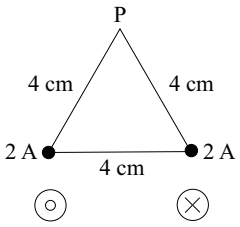



(1) $(\mu_o i/4\pi R)(2 + \pi/2)$, out of the page
(2) $\mu_o i/4\pi R$, out of the page
(3) $\mu_o i/2\pi R$, into the page
(4) $\mu_o i/4R$, into the page
(5) none of these

9. A car radio uses an LC circuit and a variable capacitor to tune to different radio stations. The value of the capacitance to tune to a radio station of 1000 kHz is C. What must its value be to tune to a station at 250 kHz?

(1) 16C (2) 20C (3) 4C (4) 9C (5) 25C

10. Two long straight wires pierce the plane of the paper at vertices of an equilateral triangle as shown. They each carry 2A but in the opposite direction. The wire on the left has the current coming out of the paper while the wire on the right carries the current going into the paper. The magnetic field at the third vertex (P) has the magnitude and direction (Left is west):




(1) 10$\mu$T, north (2) 15$\mu$T, north (3) 20$\mu$T, east (4) 30$\mu$T, south (5) none of these

11. A real inductor has resistance because it is composed of a coil of wire with nonzero resistivity. To measure the inductance of a coil, a student places it across a 12.0-V battery and measures a current of 0.72 A. The student then connects the coil to a 30.0-V (rms) 60 Hz generator and measures an rms current of 0.86 A. What is the inductance of the coil?

(1) 0.081 H (2) 0.51 H (3) 34.9 H (4) 30.6 H (5) None of these

12. A square wire loop of side length 10.0 cm carries a current of 10A. It is placed so that the normal to its plane makes an angle of 30° with respect to the direction of a uniform magnetic field of 4.0T. What is the magnitude of the torque acting on the loop?

(1) 0.20 (2) 0.63 (3) 4.0 (4) 0.35 (5) 10.0

13. Have you filled in your name, UFID and the exam code (top left and right of every page of the exam) in the scantron sheet?

(1) Yes, I have. (2) No, I haven't. (3) Please don't bother, I am taking an exam. (4) Why? (5) Yes, but I lied.