Instructor: *Prof. P. Kumar*

PHYSICS DEPARTMENT

PHY 2049 Exam 2, Summer 2010 July 14, 2010

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.

DIRECTIONS

(1) **Code your test number on your answer sheet (use 76–80 for the 5-digit number)**. Code your name on your answer sheet. **Darken circles completely (errors can occur if too light)**. Code your student number on your answer sheet.
(2) **Blacken the circle of your intended answer completely, using a number 2 pencil**. Do not make any stray marks or the answer sheet may not read properly.
(3) The answers are rounded off. Choose the closest to exact. There is no penalty for guessing.

Table of constants

$k = \frac{1}{4\pi\epsilon_0} = 9 \times 10^9$	$e = 1.6 \times 10^{-19}$C	$m_e = 9.11 \times 10^{-31}$kg	$c = 3 \times 10^8$m/s

1. At a certain position outside Gainesville, the magnetic field of the Earth is 39μT, horizontal to the surface, and directed due North. If the magnitude of the total field is exactly zero 8 cm above a long straight, horizontal wire that carries a constant current i, what is the magnitude and direction of the current?

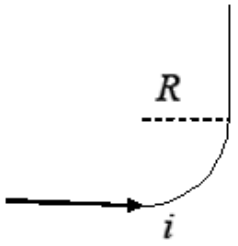
   (1) 16 A, west to east (2) 8 A, north to south (3) 16 A, east to west (4) 4.2 A, west to east (5) 8 A, south to north

2. 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) $L^2\pi iB/4N^2$

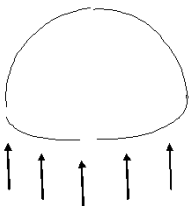
3. A conducting wire is formed into two long, semi-infinite straight sections connected by a quarter circle of radius R, as shown in the figure. What is the magnitude and direction of the magnetic field at the center of the quarter circle?

   (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.

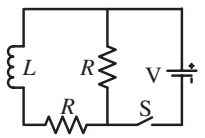


4. A hollow hemispherical "bowl" of radius R is placed in a *uniform* magnetic field of magnitude B which is parallel to its axis. What is the magnetic flux Φ_B through the bowl?

   (1) $\pi R^2 B$
   (2) $2\pi R^2 B$
   (3) $4\pi R^2 B$
   (4) $6\pi R^2 B$
   (5) none of these



5. In the circuit shown, $L = 56$ mH, $R = 4.6\Omega$ and $V = 12.0$ V. The switch S has been open for a long time then is suddenly closed at $t = 0$. At what value of t (in msec) will the current in the inductor reach 1.1 A?



   (1) 6.67 (2) 10.5 (3) 2.88 (4) 19.0 (5) None of these

6. Refer to the previous problem. What is the total energy stored in the inductor a long time after the switch is closed?

   (1) 0.19 J (2) 0.048 J (3) 0.76 J (4) 0.034 J (5) None of these

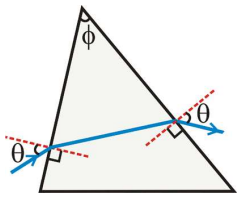
7. A small light bulb is placed 3 cm inside a solid cube of Lucite (n=1.50) and turned on. What is the radius (in cm) of the illuminated circle that would be seen by an observer standing above the Lucite block?

   (1) 2.68 (2) 3.00 (3) 3.35 (4) 4.50 (5) 3.42

8. An arrangement for generating a traveling electromagnetic wave in the shortwave radio region of the spectrum works as follows: an LC oscillator produces a sinusoidal current in the antenna, which generates the wave, traveling outward at the speed of light. What is the wavelength (in meters) of the wave emitted by this system if $L = 0.323\mu$H and $C = 45.0$pF?

   (1) 7.19 m (2) 1.14 m (3) 719 m (4) 114 m (5) None of these

9. A ray is incident on one face of a triangular glass prism in air. The angle of incidence θ is chosen so that the emerging ray also makes the same angle θ with the normal to the other face, as shown. If the apex angle of the prism is $\phi = 68.0°$, and the index of refraction of the prism is n = 1.60, what is θ (in degrees)?



   (1) 64 (2) 52 (3) 34 (4) 68 (5) 88

10. The light from a professor's laser pointer can be considered as an electromagnetic plane wave. If the laser beam has 5 mW of power and illuminates a circular spot 2.5 mm in radius on a screen, what is the maximum electric field amplitude (E_m in N/C) at the screen?

    (1) 440 (2) 311 (3) 622 (4) 550 (5) none of these

11. 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 500 kHz?

    (1) 4C (2) 20C (3) 15C (4) 10C (5) 25C

12. A laser beam with intensity 10^6W/m^2 and wavelength 632.8 nm is aimed vertically upward. What is the maximum radius in nm of a spherical particle of graphite (density 2100 kg/m^3) that can be supported by the laser beam against gravity ($g = 9.80$ m/s^2)? Assume that the particle is totally absorbing.

    (1) 120 (2) 490 (3) 1190 (4) 230 (5) 190

13. Please make sure that you have inserted your exam code in spaces 76-80 on the scantron sheet; also that you have put in your name, UF ID and you have signed the scantron sheet at the back.

    (1) I have already done all.
    (2) Please don't bother me, I am taking an exam.
    (3) What is a scantron sheet.
    (4) What is an exam code.
    (5) None of these

THE FOLLOWING QUESTIONS, NUMBERED IN THE ORDER OF THEIR APPEARANCE ON THE ABOVE LIST, HAVE BEEN FLAGGED AS CONTINUATION QUESTIONS: 6