Instructor(s): *F. Rojas*

PHYSICS DEPARTMENT

PHY 2049 Exam 2 July 11, 2012

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 $= 10^{-6}$

$\epsilon_0 = 8.85 \times 10^{-12} C^2/N \cdot m^2 \quad k = 1/(4\pi\epsilon_o) = 9 \times 10^9 \; N \cdot m^2/C^2 \quad \mu_0 = 4\pi \times 10^{-7} T \cdot m/A \quad$ nano $= 10^{-9} \quad$ pico $= 10^{-12}$

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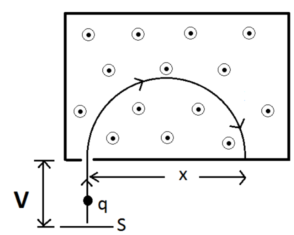
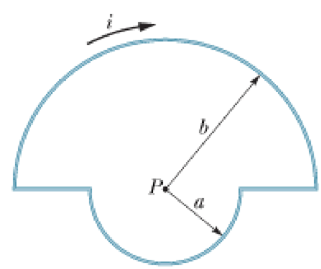
1. A particle of mass $m$ and charge $q$ is emitted from the source $S$ at rest and it is then accelerated through a potential difference $V$ until it enters a region where an uniform magnetic field is directed out of the page. The particle describes a semi-circle until it hits the interior wall at a distance $x$ from the entry point. The mass of the particle in terms of $B$, $q$, $V$, and $x$ is:



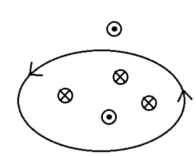

(1) $m = \dfrac{qB^2x^2}{8V}$ (2) $m = \dfrac{qBx}{8V}$ (3) $m = \dfrac{qB^2x^2}{4V}$ (4) $m = \dfrac{qB^2x}{V}$ (5) Not possible to determine with information given

2. In the figure, a current $i$ is set up in a loop having two radial lengths and two semicircles of radii $a$ and $b$ with a common center $P$. The total magnetic field at the center is given by



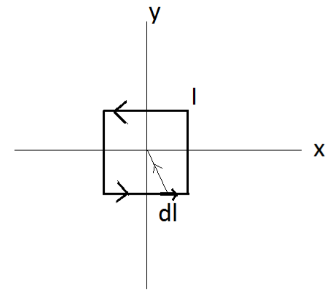

(1) $\dfrac{\mu_0 I}{4}\left(\dfrac{1}{b} + \dfrac{1}{a}\right)$ into the page
(2) $\dfrac{\mu_0 I}{4}\left(\dfrac{1}{b} + \dfrac{1}{a}\right)$ out of the page
(3) $\dfrac{\mu_0 I}{4}\left(\dfrac{1}{b} - \dfrac{1}{a}\right)$ into the page
(4) $\dfrac{\mu_0 I}{4}\left(\dfrac{1}{b} - \dfrac{1}{a}\right)$ out of the page
(5) $\vec{0}$

3. Each of the wires in the figure carries a current of 2 A perpendicular to the page with the direction of current flow indicated. For the path shown, what is $\oint \vec{B} \cdot \vec{ds}$?



(1) $-4\mu_0$ (2) $4\mu_0$ (3) $-2\mu_0$ (4) $2\mu_0$ (5) 0

4. A square loop of side $a$ carries a current $I$ in the counter-clockwise direction as shown in the figure. Which expression gives the total magnetic field at the center of the square loop? ($\hat{k}$ is directed out of the page)




(1) $\vec{B} = \hat{k}\,\dfrac{\mu_0 I a}{2\pi}\displaystyle\int_{-a/2}^{a/2} \dfrac{dx}{(a^2/4+x^2)^{3/2}}$

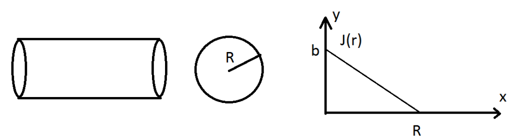
(2) $\vec{B} = \hat{k}\,\dfrac{\mu_0 I a}{2\pi}\displaystyle\int_{-a/2}^{a/2} \dfrac{dx}{a^2/4+x^2}$

(3) $\vec{B} = -\hat{k}\,\dfrac{\mu_0 I a}{2\pi}\displaystyle\int_{-a/2}^{a/2} \dfrac{dx}{(a^2/4+x^2)^{3/2}}$

(4) (2) $\vec{B} = -\hat{k}\,\dfrac{\mu_0 I a}{2\pi}\displaystyle\int_{-a/2}^{a/2} \dfrac{dx}{a^2/4+x^2}$

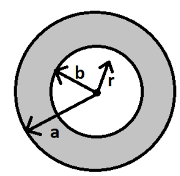
(5) Not possible to determine because the wires are not infinite

5. A cylindrical wire of radius $R$ carries a current for which the current density points along the direction of the wire. As a function of the distance with respect to the central axis of the wire $r$, the magnitude current density $J(r)$ is given by the graph in the figure. The total current through the wire is:



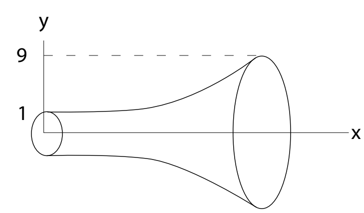

(1) $I = \dfrac{\pi b R^2}{3}$ (2) $I = \pi b R^2$ (3) $I = \dfrac{2\pi b R^2}{3}$ (4) $I = \dfrac{bR}{2}$ (5) $I = bR$

6. The figure shows a cross section of a hollow cylindrical conductor of radii $a$ and $b$, carrying a uniformly distributed current $i$. The magnetic field magnitude $B(r)$ for the radial distance $r$ in the range $r < b$ (i.e. in the hollow part) is:



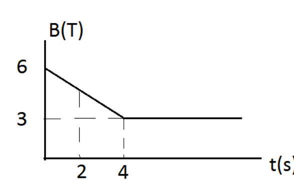

(1) 0 (2) $\dfrac{\mu_0 I}{2\pi r}$ (3) $\dfrac{\mu_0 I}{2\pi r^2}$ (4) $\dfrac{\mu_0 I}{2\pi(a^2-b^2)}\dfrac{r^2-b^2}{r}$ (5) None of these

7. In the figure, a current is set up through a wire with circular cross section and resistivity $\rho$. The wire extends from $x = 0$ to $x = 2$m. The shape of the sides are given by the curve $y = 1 + 2x^2$ as shown. The total resistance of this wire is given by:




(1) $R = \dfrac{\rho}{\pi}\displaystyle\int_0^2 \dfrac{dx}{(1+2x^2)^2}$ (2) $R = \dfrac{\rho}{\pi}$ (3) $R = \dfrac{\rho}{\pi}\displaystyle\int_0^2 \dfrac{dx}{1+2x^2}$ (4) $R = \dfrac{\rho}{\pi}\displaystyle\int_0^2 (1+2x^2)^2 dx$ (5) Not possible to determine

8. A wire loop of radius 2m is located in a uniform magnetic field that changes its magnitude as a function of time as given in the figure. The loop's plane is perpendicular to $\vec{B}$. What is the magnitude of emf is induced in the loop at $t = 2.0$ secs?




(1) 9.4 Volts (2) 75.4 Volts (3) 37.7 Volts (4) 12.6 Volts (5) 0

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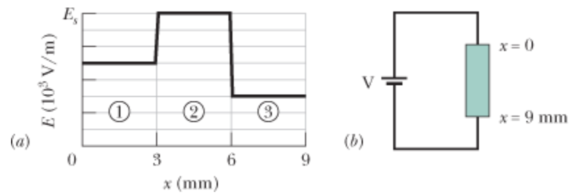
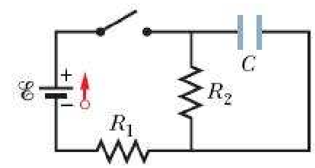
9. Figure ($a$) gives the magnitude $E(x)$ of the electric fields that have been set up by a battery along a resistive rod of length 9.00 mm (figure $b$). The vertical scale is set by $E_s = 8.00 \times 10^3$ V/m. The rod consists of three sections of the same material but with different radii. (The schematic diagram of figure ($b$) does not indicate the different radii.) The radius of section 3 is 3.00 mm. What is the radius of section 1?



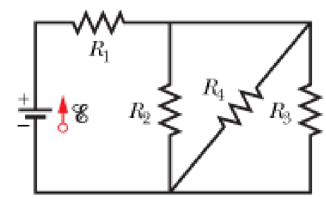

(1) 2.33 mm (2) 1.84 mm (3) 1.27 mm (4) 0.61 mm (5) None of these

10. In the figure, $R_1 = 6k\Omega$, $R_2 = 12k\Omega$, $C = 0.5\mu$F, and the ideal battery has emf $\xi = 12.0$ V. First, the switch is closed a long time so that the steady state is reached. Then the switch is opened at time $t = 0$. What is the charge (in Coulombs) in the capacitor at $t = 3.6$ ms?




(1) $2.2 \times 10^{-6}$ (2) $4.4 \times 10^{-6}$ (3) $8.8 \times 10^{-6}$ (4) zero (5) $17.6 \times 10^{-6}$

11. In the figure $R_1 = 100\Omega$, $R_2 = R_3 = R_4 = 30\Omega$, and the ideal battery has emf = 11 V. What is the current in resistance $R_4$?




(1) 0.03 A
(2) 0.37 A
(3) 1.10 A
(4) 0.7 A
(5) None of these

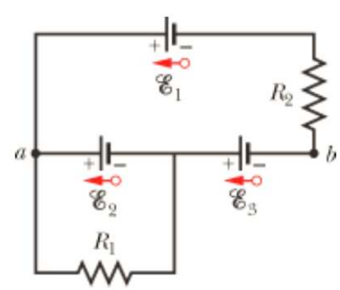
12. A straight wire has current flowing from the point, $(x, y, z) = (1, 2, 0)$, to the point $(x, y, z) = (3, 1, 0)$, where all positions are measured in meters. The current is $i = 2$A. If a magnetic field is pointing in the $z$-direction of magnitude 10 T, i.e. $\vec{B} = 10T\hat{k}$, what is the force on the wire in vector form?

(1) $-20\hat{\imath} - 40\hat{\jmath}$ (2) $20\hat{\imath} - 40\hat{\jmath}$ (3) $-40\hat{\imath} - 20\hat{\jmath}$ (4) $20\hat{\imath} + 40\hat{\jmath}$ (5) $40\hat{\imath} + 20\hat{\jmath}$

13. A circular loop of wire having a radius of 4.0 cm carries a current of 0.10 A. A vector of unit length and parallel to the dipole moment $\vec{\mu}$ of the loop is given by $0.06\hat{\imath} + 0.08\hat{\jmath}$ . (This unit vector, which we normally call $\hat{n}$, gives the orientation of the magnetic dipole moment vector). If the loop is located in a uniform magnetic field given by $\vec{B} = 0.5\hat{\imath} - 0.6\hat{\jmath}$ (in Teslas), find the potential energy stored in this loop:

(1) None of these (2) +0.018 J (3) $5 \times 10^{-4}$ J (4) $-5 \times 10^{-4}$ J (5) $-0.018$ J

14. In the circuit shown, $R_1 = 200\Omega$,$R_2 = 30\Omega$, and the ideal batteries have EMFs of $\xi_1 = 12.0$ V,$\xi_2 = 6.0V$, and $\xi_3 = 3$ V. What is the magnitude of the current flowing through resistor $R_2$?




(1) 0.1 A
(2) 0.4 A
(3) 0.03 A
(4) 0.2 A
(5) None of these