Instructor: *P. Kumar*

PHYSICS DEPARTMENT

PHY 2049 Final Exam August 3, 2009

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

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

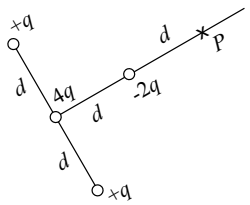
1. A hollow conductor is positively charged. A small uncharged metal ball is lowered by a silk thread through a small opening in the top of the conductor and allowed to touch its inner surface. After the ball is removed, the hollow conductor will have:

   (1) no change in its charge.
   (2) a positive charge
   (3) a negative charge
   (4) a charge whose sign depends on what part of the inner surface it touched
   (5) a charge whose sign depends on where the small hole is located in the conductor

2. A point particle with charge q is at the center of a Gaussian surface in the form of an octahedron (eight faces). The electric flux through any one face of the octahedron is:

   (1) $q/8\epsilon_0$ (2) q/ϵ_0 (3) $q/4\pi\epsilon_0$ (4) $q/4\epsilon_0$ (5) $q/6\epsilon_0$

3. What is the net electric potential at point P due to the four particles, $q = 3.00$ fC, and $d = 2.00$ cm?



   (1) 1.2 mV (2) 2.6 mV (3) 0.8 mV (4) 16.2 mV (5) none of these

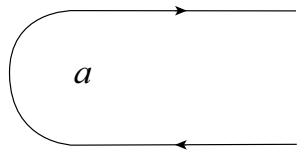
4. In a constant and uniform magnetic field, electrons of energy E move in circular orbits of radius R. If the electron energy is increased by a factor of four (quadrupled), its radius R will increase by a factor of:

   (1) 2 (2) 4 (3) 8 (4) 1.4 (5) none of these

5. Two long straight wires, lined along the z axis (out of the page) and with separation d along the x axis, carry currents i_1 and $i_2 = 3i_1$ out of the page. At what point on the x-axis is the net magnetic field due to the currents equal to zero?

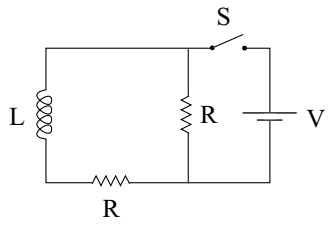
   (1) $d/4$ from wire 1 towards wire 2
   (2) $d/4$ from wire 1 away from wire 2
   (3) $2d$ from wire 2 away from wire 1
   (4) $d/2$ from wire 1 towards wire 2
   (5) none of these.

6. In the figure, a current i = 20 A is set up in a long hairpin conductor formed by bending a wire into a semicircle of radius R = 1.0 mm. What is the magnitude and direction of B at a?



(1) 0.010 T, into the paper
(2) 0.005 T, out of the paper
(3) 0.0129 T, into the paper
(4) 0.0100 T, out of the paper
(5) none of these

7. In the circuit shown, $L = 10$ mH, $R = 5\Omega$ and $V = 12.0$ V. The switch S has been closed for a long time then is suddenly opened at $t = 0$. At what value of t (in msec) will the current in the inductor reach 1.2 A?



(1) 0.69 (2) 8.44 (3) 2.88 (4) 5.36 (5) none of these

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

(1) 0 J (2) 0.048 J (3) 0.76 J (4) 0.2 J (5) 0.15 J

9. How far (in feet) does light travel in water (n = 1.33) in 1 nanosecond?

(1) 0.74 (2) 0.3 (3) 0.23 (4) 1.0 (5) 0.45

10. The average monthly household consumption of electricity comes out as 1000 kWh. The unit kWh corresponds to kilowatt-hour. If that energy were to be obtained from conversion of mass into energy, how much mass would have been converted.

(1) none of these. (2) 12g (3) 20μg (4) 36g (5) 40ng

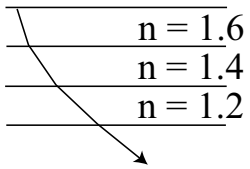
11. A way for making an airplane invisible to radar is to coat the plane with an antireflective polymer. If radar waves have a wavelength of 3 cm and the index of refraction of polymer is n = 1.5, how thick would you make the coating? (You can assume that the metal index of refraction is infinite.)

(1) 0.5 cm (2) 0.75 cm (3) 8 cm (4) 3 cm (5) 12 cm

12. A riverside warehouse has two open doors. A boat on the river sounds its horn. To person A, standing at the far end of the room but equidistant from the two doors, the sound is loud and clear while person B does not hear much. The principal wavelength of sound is 3 m. Estimate the distance between the doors if the warehouse is 150 m long and the two persons A and B are 10 m apart.

(1) 23 m (2) 11.5 m (3) 15 m (4) 46 m (5) none of these

13. A parallel stack of materials with different indices of refraction (starting from top; 1.6, 1.4, 1.2 and 1.0). What is the angle of incidence (in degrees) in the top medium (with n = 1.6) that will lead to total internal reflection at the bottom?



(1) 39 (2) 56 (3) 29 (4) 19 (5) 11

THE FOLLOWING QUESTIONS, NUMBERED IN THE ORDER OF THEIR APPEARANCE ON THE ABOVE LIST, HAVE BEEN FLAGGED AS CONTINUATION QUESTIONS: 8