Instructor: *Prof. P. Kumar*

PHYSICS DEPARTMENT

PHY 2049   Final Exam, Summer 2010   August 5, 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

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

1. A 140 pF capacitor is charged to a potential difference of 60 V, and the charging battery is disconnected. The capacitor is then connected in parallel with a second (initially uncharged) capacitor. If the potential difference across the first capacitor drops to 56 V, what is the capacitance of this second capacitor?

   (1) 10 pF   (2) 20 pF   (3) 35 pF   (4) 15 pF   (5) none of these

2. Two isolated conducting spheres are separated by a large distance. Sphere 1 has a radius of R and an initial charge $3Q$ while sphere 2 has a radius of $3R$ and an initial charge $7Q$. A very thin copper wire is now connected to the spheres. Charge flows between the spheres until they reach the same electrical potential. How much charge will be transferred from sphere 2 to sphere 1? (Note that the charge transferred can be positive, negative or zero .)

   (1) $-Q/2$ (2) $2Q$ (3) $-Q/3$ (4) $3Q$ (5) none of these

3. In the circuit shown, what is the current (in amps) flowing through the 18V battery?
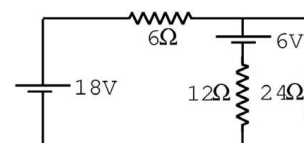
   (1) 1   (2) $\dfrac{1}{2}$ (3) 2   (4) $\dfrac{1}{3}$ (5) $\dfrac{2}{3}$

4. Suppose we have an insulating spherical ball of uniform charge density ρ and radius R. At what radius or radii from the center of the sphere is the electric field strength reduced by a factor of 16 from the electric field strength at the surface?

   (1) $R/16$ and $4R$ (2) $R/4$ and $4R$ (3) $R/16$ and $16R$ (4) $R/4$ and $16R$ (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 $t = 0$. What is the energy stored in the inductor a long time after the switch is closed?
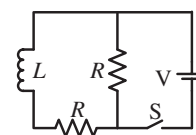
   (1) 0.19 J   (2) 0.048 J   (3) 0.76 J   (4) 0.034 J   (5) None of these

6. 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

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

8. 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

9. A sheet of glass (n = 1.50) is to be coated with a thin film of oil (n = 1.25) so that light with wavelength of 485 nm (in air) is minimally reflected due to destructive interference of the reflections. What is the least thickness of the film?

(1) 97 nm   (2) 102 nm   (3) 85 nm   (4) 204 nm   (5) none of these

10. In the figure shown (not to scale), the focal lengths of the thin converging lenses, L1 and L2, are 20 cm and 10 cm, respectively. When object O is placed 30 cm to the left of L1, its image forms at 6.3 cm to the right of L2. What is the distance between the two lenses in cm?

(1) 43   (2) 53   (3) 37   (4) 60   (5) none of these

11. A thin converging lens has focal length 4 cm. An object of height 8 cm is placed 12 cm away from the lens. What is the height of the resulting image, and is the image inverted or noninverted?

(1) 4 cm, inverted   (2) 6 cm, straight   (3) 6 cm, inverted   (4) 4 cm, straight   (5) none of these

12. The average intensity of light from an incandescent light bulb is 300 mW/m^2 on a particular surface. Assuming that the light is in the form of an electromagnetic plane wave, what is the maximum magnetic field amplitude, B_m?

(1) 5×10^{-8}T   (2) 7×10^{-8}T   (3) 3.5×10^{-8}T   (4) 21 T   (5) 15 T