Instructor: *P. Kumar*

PHYSICS DEPARTMENT

PHY 2049 Exam I May 30, 2008

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 green 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.

>>>>>>>>**WHEN YOU FINISH** <<<<<<<<
Hand in the green answer sheet separately.

1. Two identical conducting spheres A and B carry equal charge. They are separated by a distance much larger than their diameters. A third identical conducting sphere C is uncharged. Sphere C is first touched to A, then to B, and then removed. Finally, spheres A and B are brought into contact and then separated. As a result, the electrostatic force between A and B, which was originally F, becomes:

(1) 25F/64 (2) F/2 (3) F/4 (4) 5F/8 (5) 3F/8

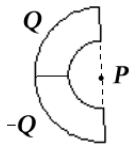
2. A particle with charge 3μC is placed at the origin, an identical particle, with the same charge, is placed 2m from the origin on the x axis, and a third identical particle, with the same charge, is placed 2m from the origin on the y axis. The magnitude of the force on the particle at the origin is:

(1) 2.9×10^{-2} N (2) 1.4×10^{-2} N (3) 2.0×10^{-2} N (4) 4.0×10^{-2} N (5) 8.1×10^{-2} N

3. A charged oil drop with a mass of 2×10^{-4} kg is held suspended by a downward electric field of 300N/C. The charge on the drop is:

(1) -6.5×10^{-6} C (2) -1.5×10^{-6} C (3) $+6.5 \times 10^{-6}$ C (4) $+1.5 \times 10^{-6}$ C (5) 0

4. Positive charge +Q is uniformly distributed on the upper half a semicircular rod (from North to West to South) and negative charge –Q is uniformly distributed on the lower half. What is the direction of the electric field at point P, the center of the semicircle? (North is up)



(1) South (2) North (3) West (4) East (5) North-East

5. Choose the INCORRECT statement:

(1) According to Gauss' law, if a closed surface encloses no charge, then the electric field must vanish everywhere on the surface.
(2) Gauss' law states that the net number of lines crossing any closed surface in an outward direction is proportional to the net charge enclosed within the surface.
(3) Coulomb's law can be derived from Gauss' law and symmetry.
(4) Gauss' law applies to a closed surface of any shape.
(5) Gauss' law can be derived from Coulomb's law.

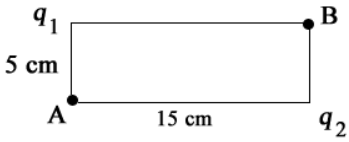
6. Positive charge Q is placed on a conducting spherical shell with inner radius R_1 and outer radius R_2. A particle with charge q is placed at the center of the cavity. The magnitude of the electric field at a point in the cavity, a distance r from the center, is:

   (1) zero (2) kq/r^2 (3) kQ/R_1^2 (4) $k(q+Q)/r^2$ (5) $k(q+Q)/(R_1^2 - r^2)$

7. The electric potential at points in an xy plane is given by $V = (3.0V/m^2)x^2 - (4.0V/m^2)y^2$. What is the electric Field at the point (3.0 m, 3.0 m) (E_x, E_y in V/m)?

   (1) (−18, 24) (2) (18, −24) (3) (27, −36) (4) (−27, 36) (5) none of these

8. In the rectangle shown, the sides have lengths 5 cm and 15 cm, $q_1 = -7.5$C, and $q_2 = +2.5$C. How much work (in joules) is required to move a third charge $q_3 = +2.5$C from A to B along a diagonal of the rectangle?



   (1) -3.0×10^{12} J (2) -1.2×10^{12} J (3) -4.2×10^{12} J (4) 9.0×10^{12} J (5) none of these

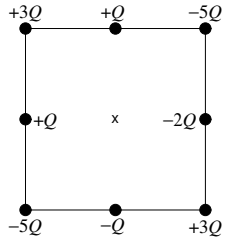
9. An air filled parallel plate capacitor has a capacitance of 4μF. If the separation between the plates is decreased by a factor of 2 and a material with a dielectric constant of 12 (like Silicon) is inserted between the parallel plates, what is the new capacitance, in units of μF?

   (1) 96 (2) 48 (3) 4 (4) 24 (5) 0.67

10. Capacitor C_1 is connected alone to a battery and charged until the magnitude of the charge on each plate is 4.0×10^{-8}C. Then it is removed from the battery and connected to two other capacitors C_2 and C_3, as shown. The charge on the positive plate of C_1 is then 1.0×10^{-8}C. The charges on the positive plates of C_2 and C_3 are:

   (1) $q_2 = 3.0 \times 10^{-8}$C and $q_3 = 3.0 \times 10^{-8}$C
   (2) $q_2 = 2.0 \times 10^{-8}$C and $q_3 = 2.0 \times 10^{-8}$C
   (3) $q_2 = 5.0 \times 10^{-8}$C and $q_3 = 1.0 \times 10^{-8}$C
   (4) $q_2 = 3.0 \times 10^{-8}$C and $q_3 = 1.0 \times 10^{-8}$C
   (5) $q_2 = 1.0 \times 10^{-8}$C and $q_3 = 3.0 \times 10^{-8}$C

11. Charges are arranged on a square of side d as shown in the diagram. In what direction is the electric field at the center of the square?



   (1) Fourth quadrant (2) First quadrant (3) Second quadrant (4) Third quadrant (5) $E = 0$

12. Refer to the previous problem. What is the potential at the center of the square (in units of kQ/d), assuming $V = 0$ at infinity?

   (1) −7.7 (2) +1.3 (3) −9.5 (4) −0.50 (5) +0

THE FOLLOWING QUESTIONS, NUMBERED IN THE ORDER OF THEIR APPEARANCE ON THE ABOVE LIST, HAVE BEEN FLAGGED AS CONTINUATION QUESTIONS: 12