Instructor: *Prof. P. Kumar*

PHYSICS DEPARTMENT

PHY 2049 Exam 1, Summer 2010 June 7, 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

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1. Two charges, $q_1 = -1$ C and $q_2 = -4$ C, are placed along the x-axis a distance L apart with charge q_1 at the origin and q_2 at $x = L$. A third charge, $q_3 = +4/9$ C, is also placed along the x-axis such that there is no net Coulomb force on any of the charges. What is the position of this charge along the x axis in units of L, *i.e.,* what is x/L?

(1) $\frac{1}{3}$ (2) $\frac{1}{2}$ (3) 1 (4) 2 (5) 3

2. Two charges, $q_1 = 1$ C and $q_2 = 9$ C, are placed along the x-axis a distance L apart with charge q_1 at the origin and q_2 at $x = L$. A third charge, $q_3 = -9/16$ C, is also placed along the x-axis such that there is no net Coulomb force on any of the charges. What is the position of this charge along the x axis in units of L, *i.e.,* what is x/L?

(1) $\frac{1}{4}$ (2) $\frac{1}{3}$ (3) 1 (4) 4 (5) 3

3. 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

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 9 from the electric field strength at the surface?

(1) $R/9$ and $3R$ (2) $R/3$ and $3R$ (3) $R/9$ and $9R$ (4) $R/3$ and $9R$ (5) None of these

5. 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

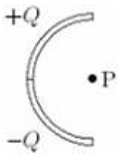
6. Two isolated conducting spheres are separated by a large distance. Sphere 1 has a radius of R and an initial charge $3Q$ while sphere 2 has a radius of $2R$ and an initial charge $6Q$. A very thin copper wire is now connected to the spheres. Charge flows between the spheres until they reach the same 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) zero (2) $2Q$ (3) $-Q/3$ (4) $3Q$ (5) none of these

7. A charged oil drop with a mass of 3×10^{-4} kg is held suspended by a downward electric field of 300N/C. The charge on the drop is: ($g = 9.80$ m/s^2)

   (1) -9.8×10^{-6} C (2) $+1.5 \times 10^{-6}$ C (3) -1.5×10^{-6} C (4) $+9.8 \times 10^{-6}$ C (5) 0

8. Positive charge $+Q$ is uniformly distributed on the upper half of a semi- circular rod 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, in degrees of angle measured from the positive x axis?



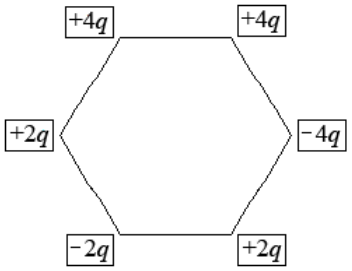
   (1) 270 (2) 90 (3) 0 (4) 180 (5) 45

9. 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

10. What is the electric potential at the origin (center) of the hexagonal array of charged particles. The side length $s = 20$cm and $q = 5 \times 10^{-9}$C.

    (1) 1350 V
    (2) 2250 V
    (3) 3380 V
    (4) -1950 V
    (5) 1130 V



11. A point particle with charge q is at the center of a Gaussian surface in the form of a octahedral prism. The electric flux through any one face of the prism is:

    (1) $q/8\epsilon_0$ (2) $q/6\epsilon_0$ (3) $q/4\epsilon_0$ (4) $q/2\epsilon_0$ (5) none of these

12. A point particle with charge q is at the center of a Gaussian surface in the form of a hexahedral prism. The electric flux through any one face of the prism is:

    (1) $q/6\epsilon_0$ (2) $q/8\epsilon_0$ (3) $q/4\epsilon_0$ (4) $q/2\epsilon_0$ (5) none of these

13. 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 48 V, what is the capacitance of this second capacitor?

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

14. 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 52.5 V, what is the capacitance of this second capacitor?

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

15. 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

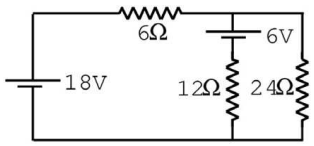
16. Two identical light bulbs A and B are connected in series to a constant voltage source. A wire is then connected across B. What is the brightness of A relative to its former brightness?

(1) 4 (2) 2 (3) $\frac{1}{2}$ (4) 1 (5) none of these

17. Three identical light bulbs A, B and C are connected in series to a constant voltage source. A wire is then connected across B. What is the brightness of A relative to its former brightness?

(1) 2.25 (2) 4 (3) 1.5 (4) $\frac{2}{3}$ (5) none of these

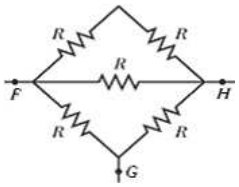
18. In the circuit shown, what is the current (in amps) flowing through the 18V battery?



(1) 1 (2) $\frac{1}{2}$ (3) 2 (4) $\frac{1}{3}$ (5) $\frac{2}{3}$

19. What is the equivalent resistance between points F and H? Each Resistor is 5Ω.

(1) 2.5Ω
(2) 6.25Ω
(3) 2.0Ω
(4) 3.125Ω
(5) none of these



FOLLOWING GROUPS OF QUESTIONS WILL BE SELECTED AS ONE GROUP FROM EACH TYPE
TYPE 1
Q# S 1
Q# S 2
TYPE 2
Q# S 3
Q# S 4
TYPE 3
Q# S 5
Q# S 6
TYPE 4
Q# S 11
Q# S 12
TYPE 5
Q# S 13
Q# S 14
Q# S 15
TYPE 6
Q# S 16
Q# S 17