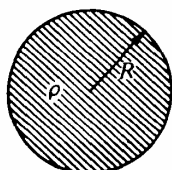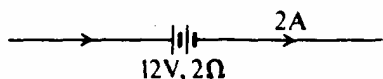# AP Physics C—Electricity & Magnetism—Mid Term Review

1984

37. When lighted, a 100-watt light bulb operating on a 110-volt household circuit has a resistance closest to

    (A) 10^{-2} Ω   (B) 10^{-1} Ω   (C) 1 Ω   (D) 10 Ω   (E) 100 Ω

42. The figure above shows a spherical distribution of charge of radius R and constant charge density ρ. Which of the following graphs best represents the electric field strength E as a function of the distance r from the center of the sphere?
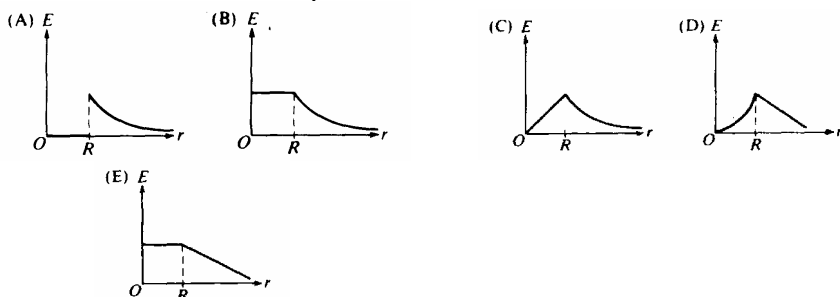
45. A 12-volt storage battery, with an internal resistance of 2Ω, is being charged by a current of 2 amperes as shown in the diagram above. Under these circumstances, a voltmeter connected across the terminals of the battery will read   (A) 4 V   (B) 8 V   (C) 10 V   (D) 12 V   (E) 16 V
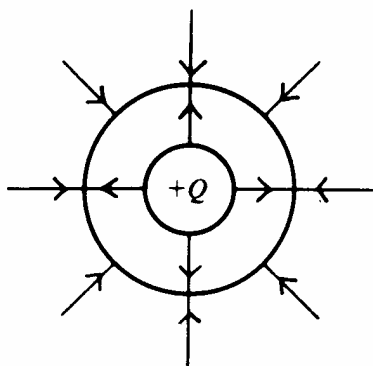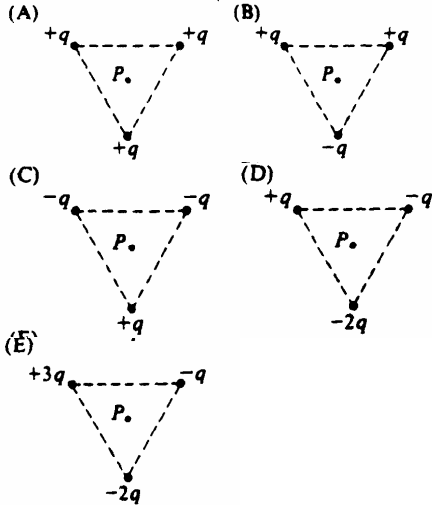

64. The electric field of two long coaxial cylinders is represented by lines of force as shown above. The charge on the inner cylinder is +Q. The charge on the outer cylinder is

    (A) +3Q   (B) +Q   (C) 0   (D) - Q   (E) -3 Q

66. An isolated capacitor with air between its plates has a potential difference V_o and a charge Q_o. After the space between the plates is filled with oil, the difference in potential is V and the charge is Q. Which of the following pairs of relationships is correct?

    (A) $Q=Q_o$ and $V>V_o$ (B) $Q=Q_o$ and $V<V_o$ (C) $Q>Q_o$ and $V=V_o$ (D) $Q< Q_o$ and $V<V_o$
    (E) $Q>Q_o$ and $V>V_o$

1988

40. A positive charge of 3.0 x 10^{-8} coulomb is placed in an upward directed uniform electric field of 4.0 x 10^4N/c. When the charge is moved 0.5 meter upward, the work done by the electric force on the charge is
(A) 6 x 10^{-4} J   (B) 12 x 10^{-4} J   (C) 2 x 10^4 J   (D) 8 x 10^4 J   (E) 12 x 10^4 J

(A)

+q -------- +q
$P_\bullet$
+q

(B)

+q -------- +q
$P_\bullet$
-q

(C)

-q -------- -q
$P_\bullet$
+q

(D)

+q -------- -q
$P_\bullet$
-2q

(E)

+3q -------- -q
$P_\bullet$
-2q

<u>Questions 47-48</u> relate to the following configurations of electric charges located at the vertices of an equilateral triangle. Point P is equidistant from the charges.

47. In which configuration is the electric field at P equal to zero?
   (A)   (B)   (C)   (D)   (E)

48. In which configuration is the electric field at P pointed at the midpoint between two of the charges?
   (A)   (B)   (C)   (D)   (E)

C_1

C_2
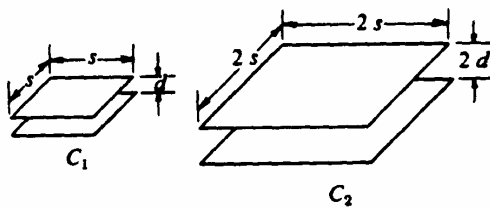
49. Two square parallel-plate capacitors of capacitances C_1 and C_2 have the dimensions shown in the diagrams above. The ratio of C_1 to C_2 is   (A) 1 to 4   (B) 1 to 2   (C) 1 to 1   (D) 2 to 1   (E) 4 to 1

2 A   X   1 A
15 V   10 V   10 V
2Ω
Y
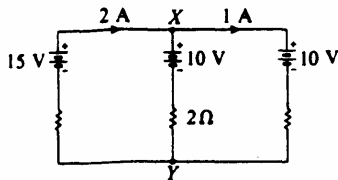
68. In the circuit shown above, the emf's of the batteries are given, as well as the currents in the outside branches and the resistance in the middle branch. What is the magnitude of the potential difference between X and Y ?
(A) 4 V   (B) 8 V   (C) 10 V   (D) 12 V   (E) 16 V

1993

36. From the electric field vector at a point, one can determine which of the following?
    I. The direction of the electrostatic force on a test charge of known sign at that point
    II. The magnitude of the electrostatic force exerted per unit charge on a test charge at that point
    III. The electrostatic charge at that point
   A) I only   B) III only   C) I and II only   D) II and III only   E) I, II, and III
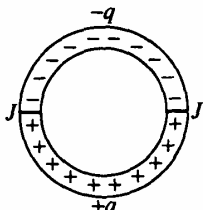
37. A circular ring made of an insulating material is cut in half. One half is given a charge -q uniformly distributed along its arc. The other half is given a charge + q also uniformly distributed along its arc. The two halves are then rejoined with insulation at the junctions J, as shown above. If there is no change in the charge distributions, what is the direction of the net electrostatic force on an electron located at the center of the circle?
   A) Toward the top of the page   B) Toward the bottom of the page   C) To the right
    D) To the left   E) Into the page.

38. The net electric flux through a closed surface is
    A) infinite only if there are no charges enclosed by the surface
    B) infinite only if the net charge enclosed by the surface is zero
    C) zero if only negative charges are enclosed by the surface
    D) zero if only positive charges are enclosed by the surface
    E) zero if the net charge enclosed by the surface is zero

Questions 39-40 refer to the system of six 2-microfarad capacitors shown below.
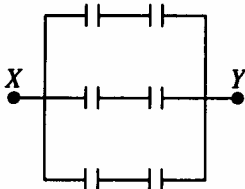
39. The equivalent capacitance of the system of capacitors is
    A) 2/3 μF   B) 4/3 μF   C) 3 μF   D) 6 μF   E) 12 μF

40. What potential difference must be applied between points X and Y so that the charge on each plate of each capacitor will have magnitude 6 microcoulombs?
    A) 1.5 V   B) 3V   C) 6 V   D) 9 V   E) 18 V

48. A conducting sphere of radius R carries a charge Q. Another conducting sphere has a radius R/2, but carries the same charge. The spheres are far apart. The ratio of the electric field near the surface of the smaller sphere to the field near the surface of the larger sphere is most nearly
    A) 1/4   B) 1/2   C) 1   D) 2   E) 4
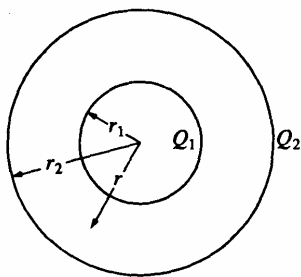
Two concentric, spherical conducting shells have radii r_1 and r_2 and charges Q_1 and Q_2, as shown above. Let r be the distance from the center of the spheres and consider the region $r_1 < r < r_2$.

51. In this region the electric field is proportional to
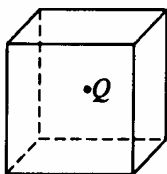   A) Q_1/r^2 B) $(Q_1 + Q_2)/r^2$ C) $(Q_1 + Q_2)/r$ D) $Q_1/r_1 + Q_2/r$ E) $Q_1/r + Q_2/r_2$
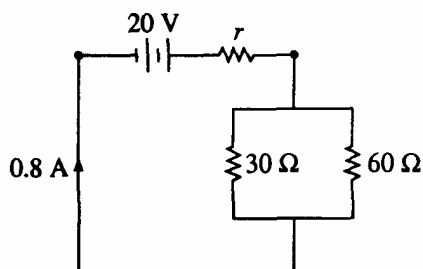
62. A 30-ohm resistor and a 60-ohm resistor are connected as shown above to a battery of emf 20 volts and internal resistance r.   The current in the circuit is 0.8 ampere.   What is the value of r ?
    A) 0.22Ω B) 4.5Ω C) 5Ω D) 16Ω E) 70Ω

64. A solid nonconducting sphere of radius R has a charge Q uniformly distributed throughout its volume. A Gaussian surface of radius r with $r < R$ is used to calculate the magnitude of the electric field E at a distance r from the center of the sphere. Which of the following equations results from a correct application of Gauss's law for this situation?
   A) $E(4\pi R^2) = Q/\varepsilon_o$ B) $E(4\pi r^2) = Q/\varepsilon_o$ C) $E(4\pi r^2) = (Q3r^3)/(\varepsilon_o 4\pi R)$
   D) $E(4\pi r^2) = (Qr^3)/(\varepsilon_o R^3)$ E) $E(4\pi r^2) = 0$

68. The point charge Q shown above is at the center of a metal box that is isolated, ungrounded, and uncharged. Which of the following is true?
    A) The net charge on the outside surface of the box is Q.
    B) The potential inside the box is zero.
    C) The electric field inside the box is constant.
    D) The electric field outside the box is zero everywhere.
    E) The electric field outside the box is the same as if only the point charge (and not the box) were there.

69. Which of the following capacitors, each of which has plates of area A, would store the most charge on the top plate for a given potential difference V ?

(A)

Vacuum d

(B)

Glass d

(C)

Vacuum $\frac{d}{2}$

(D)

Air $\frac{d}{2}$

(E)

Glass $\frac{d}{2}$
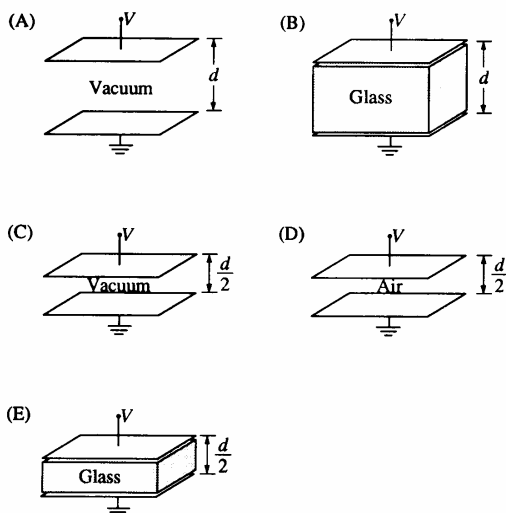
1998
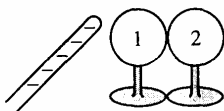
38. Two initially uncharged conductors, 1 and 2, are mounted on insulating stands and are in contact, as shown above. A negatively charged rod is brought near but does not touch them. With the rod held in place, conductor 2 is moved to the right by pushing its stand, so that the conductors are separated. Which of the following is now true of conductor 2 ?
(A) It is uncharged.   (B) It is positively charged.   (C) It is negatively charged.
(D) It is charged, but its sign cannot be predicted.
(E) It is at the same potential that it was before the charged rod was brought near.

Questions 45-46 refer to two charges located on the line shown in the figure below, in which the charge at point I is +3q and the charge at point III is +2q. Point II is halfway between points I and III.

+3q   +2q
I   II   III
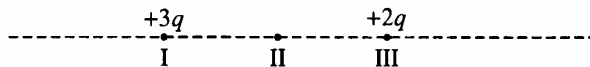
45. Other than at infinity, the electric field strength is zero at a point on the line in which of the following ranges?
(A) To the left of I   (B) Between I and II   (C) Between II and III   (D) To the right of III
(E) None; the field is zero only at infinity.

+q   +q
1   2   3   4   5   6   x
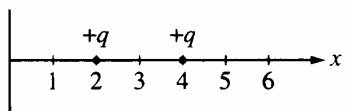
61. Two charged particles, each with a charge of +q, are located along the x-axis at x = 2 and x = 4, as shown above. Which of the following shows the graph of the magnitude of the electric field along the x-axis from the origin to x = 6 ?

(A)

(B)

(C)

(D)

(E)