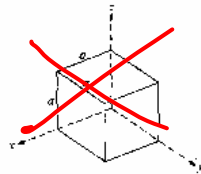


36. A parallel-plate capacitor has a capacitance C_0 . A second parallel-plate capacitor has plates with twice the area and twice the separation. The capacitance of the second capacitor is most nearly
(A) $\frac{1}{4}C_0$ (B) $\frac{1}{2}C_0$ (C) C_0 (D) $2C_0$ (E) $4C_0$
37. When lighted, a 100-watt light bulb operating on a 110-volt household circuit has a resistance closest to
(A) $10^{-2} \Omega$ (B) $10^{-1} \Omega$ (C) 1Ω (D) 10Ω (E) 100Ω

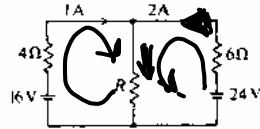
38. If i is current, t is time, E is electric field intensity, and x is distance, the ratio of $\int i dt$ to $\int E dx$ may be expressed in (A) coulombs (B) joules (C) newtons (D) farads (E) henrys

39. The electric field E just outside the surface of a charged conductor is
(A) directed perpendicular to the surface (B) directed parallel to the surface
(C) independent of the surface charge density (D) zero (E) infinite



$$16V - (1A)(4\Omega) - IR = 0$$

$$+24V - 6(2)V - IR = 0$$



$$I_{in} = I_{out}$$

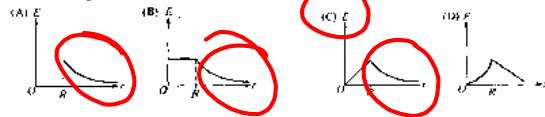
$$1A + 2A = I$$

$$I = 3A$$

41. In the circuit shown above, what is the resistance R ?
(A) 3Ω (B) 4Ω (C) 6Ω (D) 12Ω (E) 18Ω



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?



$$E = k \frac{Q}{r^2}$$

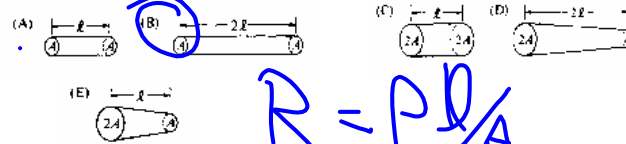
$$W = \int F \cdot dr$$

$$= 0$$

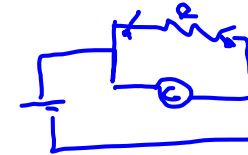


43. Points R and S are each the same distance d from two unequal charges, $+Q$ and $+2Q$, as shown above. The work required to move a charge $-Q$ from point R to point S is
 (A) dependent on the path taken from R to S (B) directly proportional to the distance between R and S
 (C) positive (D) zero (E) negative

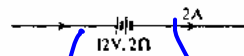
44. The five resistors shown below have the lengths and cross-sectional areas indicated and are made of material with the same resistivity. Which has the greatest resistance?



$$R = \rho L/A$$



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



$$V = IR$$

$$iR = IR'$$

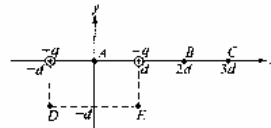
46. A galvanometer has a resistance of 99 ohms and deflects full scale when a current of 10^{-3} ampere passes through it. In order to convert this galvanometer into an ammeter with a full-scale deflection of 0.1 ampere, one should connect a resistance of
 (A) 1Ω in series with it (B) 901Ω in series with it (C) $9,900\Omega$ in series with it
 (D) 1Ω in parallel with it (E) $9,900\Omega$ in parallel with it

$$(.1A)R = .099V$$

$$R = .99\Omega$$

parallel

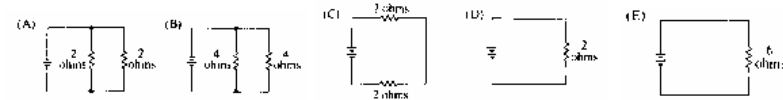
Questions 52-53



Two positive charges of magnitude q are each a distance d from the origin A of a coordinate system, as shown above.

52. At which of the following points is the electric field least in magnitude?
 (A) A (B) B (C) C (D) D (E) E
53. At which of the following points is the electric potential greatest in magnitude?
 (A) A (B) B (C) C (D) D (E) E

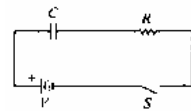
Questions 54-56



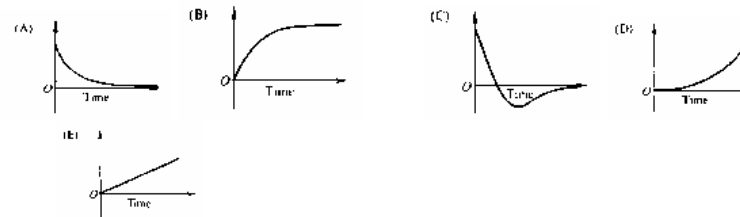
The batteries in each of the circuits shown above are identical and the wires have negligible resistance.

54. In which circuit is the current furnished by the battery the greatest?
 (A) (B) (C) (D) (E)
55. In which circuit is the equivalent resistance connected to the battery the greatest?
 (A) (B) (C) (D) (E)
56. Which circuit dissipates the least power?
 (A) (B) (C) (D) (E)

Questions 57-59 refer to the circuit shown below.



Assume the capacitor C is initially uncharged. The following graphs may represent different quantities related to the circuit as functions of time t after the switch S is closed.

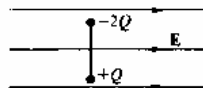


57. Which graph best represents the voltage versus time across the resistor R ?
 (A) (B) (C) (D) (E)
58. Which graph best represents the current versus time in the circuit?
 (A) (B) (C) (D) (E)
59. Which graph best represents the voltage across the capacitor versus time?
 (A) (B) (C) (D) (E)

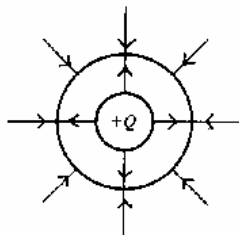
Questions 60-61

Three 6-microfarad capacitors are connected in series with a 6-volt battery.

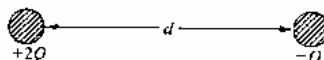
60. The equivalent capacitance of the set of capacitors is
 (A) $0.5 \mu F$ (B) $2 \mu F$ (C) $3 \mu F$ (D) $9 \mu F$ (E) $18 \mu F$
61. The energy stored in each capacitor is
 (A) $4 \mu J$ (B) $6 \mu J$ (C) $12 \mu J$ (D) $18 \mu J$ (E) $36 \mu J$



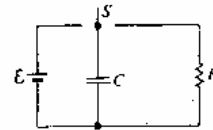
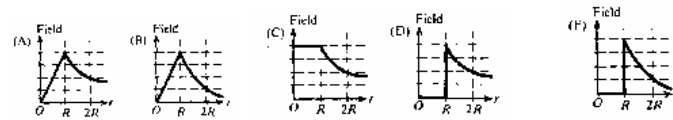
62. A rigid insulated rod, with two unequal charges attached to its ends, is placed in a uniform electric field E as shown above. The rod experiences a
- (A) net force to the left and a clockwise rotation
 - (B) net force to the left and a counterclockwise rotation
 - (C) net force to the right and a clockwise rotation
 - (D) net force to the right and a counterclockwise rotation
 - (E) rotation, but no net force



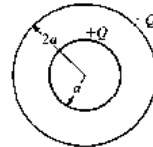
64. The electric field of two long coaxial cylinders is represented by lines of force as shown above. The charge on the inner cylinder is $+Q$. The charge on the outer cylinder is
- (A) $+3Q$
 - (B) $+Q$
 - (C) 0
 - (D) $-Q$
 - (E) $-3Q$



65. Two identical conducting spheres are charged to $+2Q$ and $-Q$, respectively, and are separated by a distance d (much greater than the radii of the spheres) as shown above. The magnitude of the force of attraction on the left sphere is F_1 . After the two spheres are made to touch and then are re-separated by distance d the magnitude of the force on the left sphere is F_2 . Which of the following relationships is correct?
- (A) $2F_1 = F_2$
 - (B) $F_1 = F_2$
 - (C) $F_1 = 2F_2$
 - (D) $F_1 = 4F_2$
 - (E) $F_1 = 3F_2$
66. An isolated capacitor with air between its plates has a potential difference V_0 and a charge Q_0 . 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) $Q=Q_0$ and $V>V_0$
 - (B) $Q=Q_0$ and $V<V_0$
 - (C) $Q>Q_0$ and $V=V_0$
 - (D) $Q<Q_0$ and $V<V_0$
 - (E) $Q>Q_0$ and $V>V_0$
67. A solid cylindrical conductor of radius R carries a current I uniformly distributed throughout its interior. Which of the following graphs best represents the magnetic field intensity as a function of r , the radial distance from the axis of the cylinder



69. In the circuit shown above, the capacitor C is first charged by throwing switch S to the left, then discharged by throwing S to the right. The time constant for discharge could be increased by which of the following?
- (A) Placing another capacitor in parallel with C (B) Placing another capacitor in series with C
 (C) Placing another resistor in parallel with the resistor R (D) Increasing battery emf \mathcal{E}
 (E) Decreasing battery emf \mathcal{E}



70. Concentric conducting spheres of radii a and $2a$ bear equal but opposite charges $+Q$ and $-Q$, respectively. Which of the following graphs best represents the electric potential V as a function of r ?

