# Electrostatics, Electrical Potential & Capacitance

**Choose the correct answers :**

1. Of the following, which physical quantity is zero for vacuum ?
   (1) Dielectric constant
   (2) Permittivity
   (3) Electric susceptibility
   (4) Velocity of e.m. waves

2. Which of the following, associated with a body, do not change when the body is in uniform motion ?
   (1) Mass and length
   (2) Kinetic energy and time
   (3) Charge and physical state
   (4) Charge

3. When a positive point charge $Q$ is brought near an isolated metal cube, then
   (1) the cube becomes negatively charged
   (2) the cube becomes positively charged
   (3) the interior becomes positively charged and the surface becomes negatively charged
   (4) the interior remains charge free and the surface gets non-uniform charge distribution

4. Five small identical spheres $A$, $B$, $C$, $D$ and $E$ are such that $A$ repels $B$ and $D$ repels $E$. $A$ attracts $C$ and $D$, while $E$ attracts $C$ and $B$. From this information, it can be concluded that sphere $C$ is
   (1) positively charged (2) negatively charged
   (3) uncharged (4) charged, (– or +)

5. Two point charges placed at a distance $r$ in air experience a certain force. Then the distance at which these will experience the same force in a medium of dielectric constant $K$ is
   (1) $Kr$ (2) $r/K$
   (3) $r/\sqrt{K}$ (4) $r\sqrt{K}$

6. A charge $q$ is to be divided on two conducting spheres. What should be the value of the charges on the spheres so that the force between them is maximum when these are placed close to each other in air ?
   (1) $q/2$ and $q/2$ (2) $q/4$ and $3q/4$
   (3) $q/3$ and $2q/3$ (4) $q/5$ and $4q/5$

7. Two points charges $Q$ and $-3Q$ are placed at some distance apart. If the electric field at the location of $Q$ is $E$, then that at the location of $-3Q$, is
   (1) $-E$ (2) $E/3$
   (3) $-3E$ (4) $-E/3$

8. A charge $q_1$ exerts some force on a second charge $q_2$. If a third charge $q_3$ is brought near, then force of $q_1$ exerted on $q_2$
   (1) will decrease in magnitude
   (2) will increase in magnitude
   (3) will remain unchanged
   (4) will increase if $q_3$ is of the same sign as $q_1$ and will decrease if $q_3$ is of opposite sign

9. An electron of mass $m$ is moving in a circular path of radius $r$ around a nucleus of atomic number $Z$. The time period of its revolution around the nucleus is
   (1) $\sqrt{4\pi^3 \epsilon_0 mr^2 / Ze^2}$ (2) $\sqrt{16\pi^3 \epsilon_0 mr^2 / Ze^2}$
   (3) $\sqrt{4\pi^3 \epsilon_0 m r^3 / Ze^2}$ (4) $\sqrt{16\pi^3 \epsilon_0 mr^3 / Ze^2}$

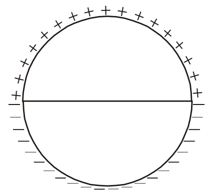
10. Four point charges of 2μC, 2 μC, –5μC and –5μC are placed at the vertices $A$, $B$, $C$ and $D$, respectively, of a square $ABCD$ of side $10\sqrt{2}$ cm and a fifth charge of 5 μC is placed at the centre $O$ of the square. The force experienced by the fifth charge is
    (1) zero
    (2) $13.5\sqrt{2}$ N, along a line normal to $CD$
    (3) $31.5\sqrt{2}$ N, along a line normal to $CD$
    (4) $35.5\sqrt{2}$ N, along a line normal to $AB$

11. Two identical conducting balls, having positive charges $q_1$ and $q_2$ are separated by a distance $r$. If these are made to touch each other and then separated to the same distance, then the force between them will be
    (1) less than before (2) more than before
    (3) same as before (4) zero

12. In a certain region of space, electric field is along $z$-direction throughout. The magnitude of electric field is, however, not constant but increases uniformly along the positive $z$-direction, at the rate of $10^5$ $NC^{-1} m^{-1}$. The force experienced by a dipole of dipole moment $10^{-7}$ Cm is
    (1) $10^{-2}$ N in negative $z$-direction
    (2) $10^{-2}$ N in positive $z$-direction
    (3) $10^{-2}$ N in positive $x$-direction
    (4) $10^{-2}$ N in positive $y$-direction

13. Two charges are separated by a distance $d$ in air. A dielectric slab of thickness $t$ of relative permitivity $\varepsilon_r$ is introduced between them. The effective air separation between the charges is
    (1) $d - t$ (2) $d - t + t/\varepsilon_r$
    (3) $d - t + \sqrt{\varepsilon_r}\, t$ (4) $d - t + \varepsilon_r t$

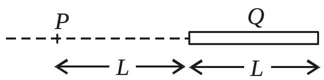
14. A thin conducting ring of radius $R$ has linear charge density $+\lambda$ and $-\lambda$ on its two halves, as shown. Electric field at its centre has a magnitude equal to



(1) zero (2) $\frac{\lambda}{\pi \epsilon_0 R}$

(3) $\frac{1}{4\pi\epsilon_0} \cdot \frac{\lambda}{R}$ (4) $\frac{1}{4\pi\epsilon_0} \cdot \frac{2\lambda}{R}$

15. A thin uniform rod of length $L$ has uniformly distributed charge $Q$. Electric intensity at a point $P$, lying on the line, along its length and at a distance $L$ from its one end is




(1) $\frac{1}{4\pi\epsilon_0} \cdot \frac{Q}{(1.5L)^2}$ (2) $\frac{1}{4\pi\epsilon_0} \cdot \frac{Q}{3L^2}$

(3) $\frac{1}{4\pi\epsilon_0} \cdot \frac{Q}{2L^2}$ (4) $\frac{1}{4\pi\epsilon_0} \cdot \frac{Q}{L^2}$

16. Two point charges $+Q_1$ and $-Q_1$ attract each other with a force of 10 N when these are of 10 cm apart in air. An infinite plate of copper of thickness 5 cm is placed between them. The new force of attraction between the charges is

(1) 10 N (2) 5 N
(3) 20 N (4) zero

17. A small spherical body of radius $r$, density $\rho$ has $n$ excess number of electrons. If it is just balanced in an electric field of intensity $E$, then its surface area is

(1) $\frac{3}{2} \cdot \frac{neE}{r\rho g}$ (2) $\frac{4neE}{r\rho g}$

(3) $\frac{4}{3} \cdot \frac{neE}{r\rho g}$ (4) $\frac{3neE}{r\rho g}$

18. A thin uniform wire is in the shape of a semi-circle of radius $R$. If linear charge density on the wire is $\lambda$, then electric intensity at its centre of curvature is

(1) $\frac{1}{4\pi\epsilon_0} \cdot \frac{2\lambda}{R^2}$ (2) $\frac{1}{4\pi\epsilon_0} \cdot \frac{2\lambda}{R}$

(3) $\frac{1}{4\pi\epsilon_0} \cdot \frac{\lambda}{R^2}$ (4) $\frac{1}{4\pi\epsilon_0} \cdot \frac{\lambda}{R}$

19. An insulated sphere of radius $R$ has a uniform volume charge density $\rho$. The electric field at a point $P$ inside the sphere and distant $r$ from the centre is

(1) $\frac{R\rho}{3\epsilon_0}$ (2) $\frac{r\rho}{3\epsilon_0}$

(3) zero (4) $\frac{2r\rho}{3\epsilon_0}$

20. A copper penny has mass of 3.2 g. Being electrically neutral, it contains equal amounts of positive and negative charges. A copper atom has a positive charge of $4.6 \times 10^{-18}$ C and a negative charge of equal amount. Given Avogadro's number = 6 × $0^{23}$ atoms/g. mole and atomic weight of copper = 64 g. Then the magnitude of each type of charge is

(1) $27.6 \times 10^5$ C (2) $1.38 \times 10^4$ C
(3) $4.3 \times 10^4$ C (4) $1.38 \times 10^5$ C

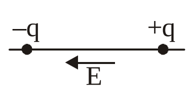
21. Atomic weight of copper is 63.5. Let us take two spherical balls of copper, each weighing 10 g, and transfer one electron from one ball to the other for every $10^6$ atoms. If Avogadro's number is $6 \times 10^{23}$ and separation between spheres is 10 cm, then Coulomb force of attraction between them is nearly

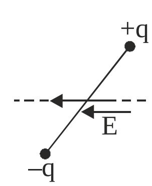
(1) $9.6 \times 10^7$ N (2) $2 \times 10^8$ N
(3) $4 \times 10^8$ N (4) $3.6 \times 10^7$ N

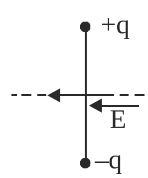
22. Two small identical spheres having equal magnitudes of charges attract each other with a force $F$. A third identical but uncharged sphere is brought in contact first with one charged sphere and then with second sphere, (without changing the positions of charged spheres) and is finally removed far away from these spheres. Now, the force between these spheres is

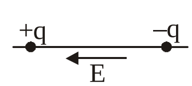
(1) $F/2$ (attractive) (2) $F/4$ (repulsive)
(3) $F/8$ (attractive) (4) $F/4$ (attractive)

23. In which of the following states is the potential energy of an electric dipole maximum?

(1) 


(2) 


(3) 


(4) 


24. An electric dipole is placed in an electric field generated by a point charge. Then

(1) the net electric force on the dipole must be zero
(2) the net electric force on the dipole may be zero
(3) the torque on the dipole must be zero
(4) the torque on the dipole may be zero

25. Electric charges $q$, $q$, $-2q$ are placed at the corners of an equilateral triangle $ABC$ of side $l$. The magnitude of the electric dipole moment of the system is

(1) $\sqrt{2}\ ql$ (2) $2\ ql$
(3) $\sqrt{3}\, ql$ (4) $2\sqrt{2}\, ql$

26. A point charge $q$ is placed at a distance $a/2$ directly above the centre of a square of side $a$. The electric flux through the square is

(1) $\frac{q}{\epsilon_0}$ (2) $\frac{q}{8\epsilon_0}$
(3) $\frac{q}{4\epsilon_0}$ (4) $\frac{q}{6\epsilon_0}$

27. The electric intensity due to a small electric dipole at a distance $r$ from its middle point, in end-on position, is $E$. At what distance $r'$, an equal electric intensity (numerically) will be obtained in the broad-side-on position ?

(1) $r' = r$ (2) $r' = r/\sqrt{2}$
(3) $r' = \frac{r}{2^{1/3}}$ (4) $r' = \frac{r^{1/3}}{2}$

28. In Millikan's oil drop experiment an oil drop carrying a charge $Q$ is held stationary by a potential difference of 2400 volt between the plates. To keep a drop of half the radius stationary the potential difference had to be made 600 volt. What is charge on the second drop ?

(1) $Q/4$ (2) $Q/2$
(3) $Q$ (4) $3Q/2$

29. A charged particle of mass $m$ and charge $q$ is released from rest in an electric field of constant magnitude $E$. The kinetic energy of the particle after a time $t$ is

(1) $\frac{2E^2t^2}{mq}$ (2) $\frac{2Eq^2}{2t^2}$
(3) $\frac{E^2q^2t^2}{2m}$ (4) $\frac{Eqm}{2t}$

30. Three charges $+9q$, $Q$ and $q$ are placed in a straight line of length $l$ at points distant 0, $l/2$ and $l$ respectively. What should be $Q$ in order to make the net force on $q$ to be zero ?

(1) $-\sqrt{3}\ q$ (2) $-2.25\ q$
(3) $-3\ q$ (4) $-4.50\ q$

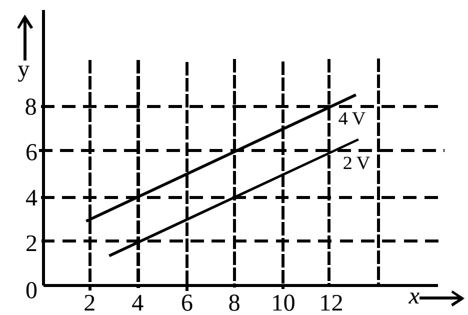
31. Three point charges, each $+q$, and placed at the vertices of an equilateral triangle. What charge should be placed at its centroid so that all the four charges are in equilibrium ?

(1) $-q/\sqrt{2}$ (2) $-q/\sqrt{3}$
(3) $-\sqrt{3}\,q/2$ (4) $-2q/\sqrt{3}$

32. Two point charges $A$ and $B$ having charges of $5 \times 10^{-6}$ C and $2 \times 10^{-6}$ C are placed at a separation of 6 cm. Work done, in moving $A$ towards $B$ through a distance of 1 cm, would be

(1) 0.65 J (2) 0.45 J
(3) 0.50 J (4) 0.30 J

33. The equipotential surfaces are at 4V and 2V in $x$-$y$ plane are shown and $x$ and $y$ are in cm. Electric fields along $x$-axis ($E_x$) and $y$-axis ($E_y$) are, respectively




(1) 50 $NC^{-1}$ and 100 $NC^{-1}$
(2) $-50 NC^{-1}$ and 100 $NC^{-1}$
(3) 50 $NC^{-1}$ and $-100$ $NC^{-1}$
(4) $-50$ $NC^{-1}$ and $-100$ $NC^{-1}$

34. A cone of base radius $R$ and height $h$ is placed where a uniform electric field of intensity $\vec{E}$ is parallel to its base. Electric flux entering the cone is

(1) $RhE$ (2) $2RhE$
(3) $2\pi RhE$ (4) $\pi R\sqrt{R^2+h^2}\,E/3$

35. The charges $q$, $2q$ and $4q$ are to be placed in order along a line 9 cm long. At what distance from charge $q$, should charge $2q$ be placed so that P.E. of the system is minimum ?

(1) 3 cm (2) 4.5 cm
(3) 6 cm (4) 7.5 cm

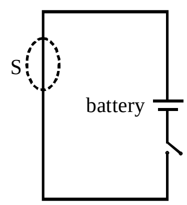
36. A large plane charged sheet having surface charge density $\sigma = 2.0 \times 10^{-6}$ C/m$^2$ lies in the $X$-$Y$ plane. Find the flux of the electric field through a circular

area of radius 1 cm lying completely in the region where *x*, *y*, *z* are all positive and with its normal making an angle of 60° with the *Z*-axis (take $\pi^2 = 10$)

(1) $36\sqrt{3}\ \text{Nm}^2\text{C}^{-1}$ (2) $18\sqrt{3}\ \text{Nm}^2\text{C}^{-1}$
(3) $36\ \text{Nm}^2\text{C}^{-1}$ (4) $18\ \text{Nm}^2\text{C}^{-1}$

37. Mark the *correct* options :
(1) Gauss's law is valid only for symmetrical charge distributions
(2) Gauss's law is valid only for charges placed in vacuum
(3) The electric field calculated by Gauss's law is the field due to the charges inside the Gaussian surface
(4) The flux of the electric field through a closed surface due to all the charges is equal to the flux due to the charges enclosed by the surface

38. A closed surface *S* is constructed around a conducting wire connected to a battery and a switch, as shown. As the switch is closed, the free electrons in the wire start moving along the wire.




In any time interval, the number of electrons entering the closed surface *S* is equal to the number of electrons leaving it. On closing the switch, the flux of the electric field through the closed surface
(1) will increase
(2) will decrease
(3) will become zero after some fluctuations
(4) will remain zero

39. A thin spherical conducting shell of radius *R* has a charge *q*. Another charge *Q* is placed at the centre of the shell. The electrostatic potential at a point *P*, distant *R*/2 from the centre of the shell, is

(1) $\dfrac{2Q+q}{4\pi\varepsilon_0 R}$. (2) $\dfrac{2(Q+q)}{4\pi\varepsilon_0 R}$

(3) $\dfrac{2Q}{4\pi\varepsilon_0 R}$ (4) $\dfrac{2(Q-q)}{4\pi\varepsilon_0 R}$

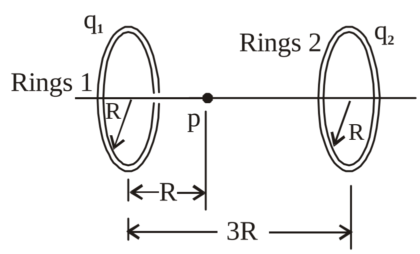
40. An uncharged metal sphere of radius *R* is placed at a distance *d* form a point charge *Q*. The potential of the sphere is

(1) $\dfrac{Q}{4\pi\in_0}\left(\dfrac{1}{d}+\dfrac{1}{R}\right)$ (2) $\dfrac{Q}{4\pi\in_0 R}$

(3) $\dfrac{Q}{4\pi\in_0 d}$ (4) $\dfrac{Q}{4\pi\in_0}\left(\dfrac{1}{d}-\dfrac{1}{R}\right)$

41. A ball of mass 1 g and charge $10^{-8}$ C moves from point *A* at potential of 760 V to another point *B* at zero potential. If velocity of ball at point *B* is 20 cm s$^{-1}$, then velocity of ball at point *A* is
(1) 18 cm s$^{-1}$ (2) 16 cm s$^{-1}$
(3) 15 cm s$^{-1}$ (4) 12.5 cm s$^{-1}$

42. Figures shows two parallel non-conducting rings arranged with their central axis along a common line. Ring-1 has uniform charge $q_1$ and radius *R*; ring-2 has uniform charge $q_2$ and the same radius *R*. The rings are separated by a distance 3*R*. The net electric field point *P* on the common line, at a distance *R* from ring -1, is zero. The ratio $q_1 / q_2$ is

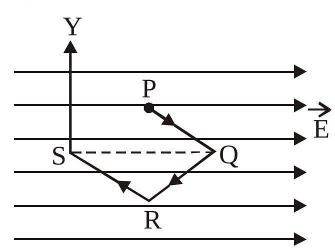



(1) $\dfrac{8}{5\sqrt{5}}$ (2) $\left(\dfrac{2}{5}\right)^{3/2}$

(3) $\dfrac{4}{5}\dfrac{\sqrt{2}}{\sqrt{5}}$ (4) $\left(\dfrac{2}{3}\right)^{3/2}$

43. When a charge of 3 coulomb is placed in a uniform electric field, it experiences a force of 3000 N within this field. The potential difference between two points, separated by 1 cm in this field, is
(1) 10 V (2) 1 V
(3) 30 V (4) 9 V

44. Point charge *q* moves from point *P* to point *S*, along the path *PQRS* (figure), in a uniform electric field *E*, pointing parallel to the positive direction of the *x*-axis. The coordinates of the points *P*, *Q*, *R* and S are (*a*, *b*, 0), (2*a*, 0, 0), (*a*, –*b*, 0) and (0, 0, 0), respectively. The work done by the field in the above process is given by expression




(1) $qEa$ (2) $-qEa$
(3) $qEa\sqrt{2}$ (4) $qE\sqrt{[(2a)^2+b^2]}$

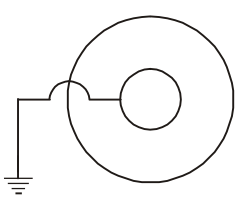
45. Two points $P_1$ and $P_2$ are symmetrical along the axis of a small electric dipole. If $E_1$ and $E_2$ are electric intensities and $V_1$ and $V_2$ are electric potentials at these points, then
(1) $E_1 = E_2$ and $V_1 = V_2$
(2) $E_1 = -E_2$ and $V_1 = -V_2$
(3) $E_1 = E_2$ and $V_1 = -V_2$
(4) $E_1 = -E_2$ and $V_1 = V_2$

46. Identical charges (– $q$ each) are placed at each corner of a cube of side $b$. The electrical P.E. of charge (+ $q$), placed at its centre, will be
(1) $\frac{-4\sqrt{2}\,q^2}{\pi \epsilon_0 b}$ (2) $\frac{-8\sqrt{2}\,q^2}{\pi \epsilon_0 b}$
(3) $\frac{-4\,q^2}{\sqrt{3}\,\pi \epsilon_0 b}$ (4) $\frac{-8\sqrt{2}\,q^2}{4\pi \epsilon_0 b}$

47. Two infinitely long parallel wires having linear charge densities $\lambda_1$ and $\lambda_2$, respectively, are placed at a distance of $R$ metres. The force per unit length on either wire will be ($K = 1/4\,\pi\epsilon_0$)
(1) $K\frac{2\lambda_1\lambda_2}{R^2}$ (2) $K\frac{2\lambda_1\lambda_2}{R}$
(3) $K\frac{\lambda_1\lambda_2}{R^2}$ (4) $K\frac{\lambda_1\lambda_2}{R}$

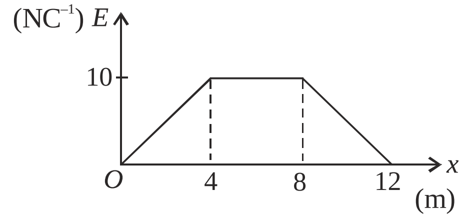
48. A charge $Q$ is distributed over two concentric hollow spheres of radii $R$ and $2R$ such that the surface densities are equal. The potential at the common centre is
(1) $\frac{2}{3}\cdot\frac{Q}{4\pi\epsilon_0 R}$ (2) $\frac{3}{4}\cdot\frac{Q}{4\pi\epsilon_0 R}$
(3) $\frac{2}{5}\cdot\frac{Q}{4\pi\epsilon_0 R}$ (4) $\frac{3}{5}\cdot\frac{Q}{4\pi\epsilon_0 R}$

49. Two concentric hollow metal spheres have radii $R_1$ and $R_2$. The outer sphere of radius $R_2$ is given a positive charge $q$ and the inner is earthed. The charge on the inner sphere is




(1) zero (2) $-q$
(3) $-R_1q(R_1+R_2)$ (4) $-R_1q/R_2$

50. Figure shows the variation of electric intensity $E$ vs distance $x$. What is the potential difference between the points $x = 4$ m and $x = 12$ m from O?

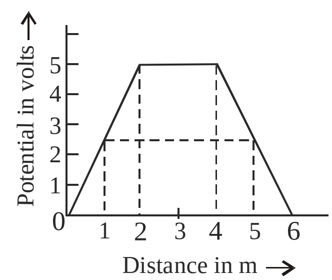



(1) 60 V (2) 40 V
(3) 20 V (4) 80 V

51. A hollow charged metal sphere has radius $r$. If the potential difference between its surface and a point at a distance $2r$ from the centre is $V$, then the electric field intensity at distance $2r$ from the centre is
(1) $V/3r$ (2) $V/4r$
(3) $V/6r$ (4) $V/2r$

52. When half the separation between plates of air-cored parallel plate capacitor is filled with a dielectric, its capacitance increases to 1.8 times. The dielectric constant of the dielectric is
(1) 18 (2) 9
(3) 20 (4) 10

53. The variation of potential with distance $R$ from a fixed point is as shown below. The electric field at $R$ = 5m would be




(1) 2.5 V/m (2) –2.5 V/m
(3) 2/5 V/m (4) –2/5 V/m

54. Two thin hollow conducting spheres of radii $R_1$ and $R_2$ are placed concentrically. Charges on the two are $Q_1$ and $Q_2$ respectively. If $R_1 > R_2$, then the potential at a point, distant $r$ from the centre, when $R_1 > r > R_2$ would be
(1) $\frac{1}{4\pi\varepsilon_0}\left[\frac{Q_1}{r}+\frac{Q_2}{r}\right]$ (2) $\frac{1}{4\pi\varepsilon_0}\left[\frac{Q_1}{r}+\frac{Q_2}{R_2}\right]$
(3) $\frac{1}{4\pi\varepsilon_0}\left[\frac{Q_1}{R_1}+\frac{Q_2}{R_2}\right]$ (4) $\frac{1}{4\pi\varepsilon_0}\left[\frac{Q_1}{R_1}+\frac{Q_2}{r}\right]$

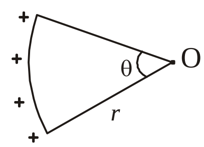
55. The insulation property of air breaks if E = $3 \times 10^6$ volt per metre. The maximum charge that can be given to a sphere of diameter 5 metre is approximately (in coulomb)

(1) $2 \times 10^{-2}$ (2) $2 \times 10^{-3}$
(3) $2 \times 10^{-4}$ (4) $2 \times 10^{-5}$

56. The electric potential $V$ at any point ($x$, $y$, $z$, all in metres) in space is given by $V = -4x^2$. Then the electric field $E$ at the point (1, 0, 2) is
(1) 8 $Vm^{-1}$ along positive direction of x-axis
(2) 8 $Vm^{-1}$ along negative direction of x-axis
(3) 4 $Vm^{-1}$ along negative direction of x-axis
(4) zero

57. Four equal charges $Q$ are placed at the four corners of a square of side $a$ each. Work done in removing a charge $-Q$ from its centre to infinity is
(1) zero (2) $\frac{\sqrt{2}\,Q^2}{4\pi\epsilon_0 a}$
(3) $\frac{\sqrt{2}\,Q^2}{\pi\epsilon_0 a}$ (4) $\frac{Q^2}{2\pi\epsilon_0 a}$

58. A uniformly charged wire of linear charge density $\lambda$ is in the form of circular arc of radius $r$ and angle $\theta$. If $k$ is Coulomb law constant then the electrical potential at the centre O is




(1) $k\lambda\theta$ (2) $k\lambda r\theta$
(3) $\frac{k\lambda\theta}{r}$ (4) $2k\lambda r\theta$

59. A dielectric slab of thickness $d$ is inserted in a parallel plate capacitor whose negative plate is at $x = 0$ and positive plate is at $x = 3d$. The slab is equidistant from the plates. The capacitor is given some charge. As $x$ goes from 0 to $3d$,
(1) the magnitude of electric field remains the same.
(2) the direction of electric field through the dielectric slab is reversed
(3) the electric potential increases continuously
(4) the magnitude of electric field is smaller through dielectric but is larger on both sides of it in the capacitor.

60. Two parallel plate capacitors of capacitance $C$ and $2C$ are connected in parallel and charged to a potential difference $V$, using a battery. The battery is then disconnected and space between the plates of capacitor of capacitance $C$ is completely filled with a material of dielectric constant 10. Now, the potential difference across the capacitors will be
(1) 0.30 V (2) 0.40 V
(3) 0.25 V (4) 0.15 V

61. A 40 μF capacitor in a defibrillator is charged to 3000 V. The energy stored in the capacitor is sent through the patient during a pulse of 2 ms. The power delivered to the patient is
(1) 45 kW (2) 90 kW
(3) 180 kW (4) 360 kW

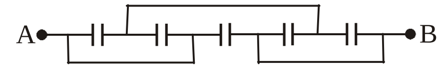
62. A spherical shell has a charge $Q$. The work done by electrical force in increasing its radius from $a$ to $b$ would be
(1) $\frac{Q^2}{4\pi\epsilon_0}\left[\frac{1}{a}-\frac{1}{b}\right]$ (2) $\frac{Q}{4\pi\epsilon_0}\left[\frac{1}{a}-\frac{1}{b}\right]$
(3) $\frac{Q^2}{8\pi\epsilon_0}\left[\frac{1}{a}-\frac{1}{b}\right]$ (4) $\frac{Q}{8\pi\epsilon_0}\left[\frac{1}{a}-\frac{1}{b}\right]$

63. A capacitor is charged to a P.D. of 100 V and is then connected across a resistor. The P.D. across the capacitor decays exponentially with respect to time. After 1 sec, the P.D. between the plates of capacitor is 80 V. After 3 sec, the P.D. across the plates will be
(1) 48.4 V (2) 40.0 V
(3) 64.0 V (4) 51.2 V

64. Two capacitors $C_1$ and $C_2$ are charged to 120 V and 200 V, respectively. When these are connected in parallel, it is found that potential on each one of these is zero. Therefore,
(1) $3C_1 + 5C_2 = 0$ (2) $5C_1 + 3C_2 = 0$
(3) $3C_1 - 5C_2 = 0$ (4) $5C_1 - 3C_2 = 0$

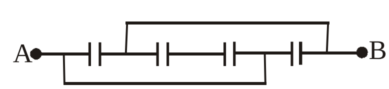
65. A parallel plate capacitor of capacitance 100 μF is charged to 500 V. Work done to decrease the separation between the plates to half the original separation
(1) would be 12.25 J (2) would be 6.25 J
(3) would be 25.0 J
(4) cannot be calculated as separation between the plates is not given

66. Capacitance of each capacitor is 2 μF in the circuit shown. The equivalent capacitance between $A$ and $B$ is




(1) 2 μF (2) 4 μF
(3) 1 μF (4) 2.5 μF

67. Four capacitors, each of capacitance $C$ are connected as shown . The resultant capacitance between $A$ and $B$ is



(1) 4.0 $C$ (2) 3.5 $C$
(3) 2.5 $C$ (4) 2.0 $C$

68. A capacitor connected to a 10 V battery collects a charge of 40 mC with air as dielectric, and 100 mC with an oil as dielectric. The dielectric constant of the oil is
(1) 4 (2) 8
(3) 2.5 (4) 1.5

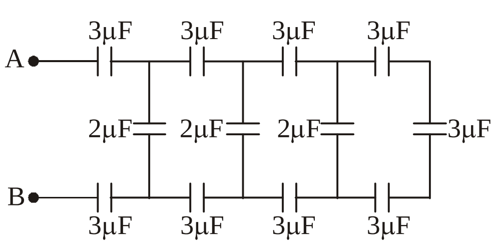
69. The force between the plates of parallel plate capacitor of capacitance $C$, distance of separation $d$ and potential difference $V$, is
(1) $CV^2/2d$ (2) $C^2V^2/2d^2$
(3) $C^2V^2/d^2$ (4) $V^2d/C$

70. A spherical capacitor has inner and outer spheres of radii $a$ and $b$, respectively. The difference between the capacitances of two capacitors formed when outer sphere is earthed and when inner sphere is earthed, is
(1) zero (2) $4\ \pi\varepsilon_0 a$
(3) $4\ \pi\varepsilon_0 b$ (4) $4\pi\varepsilon_0 \dfrac{ab}{b-a}$

71. A parallel plate air capacitor is charged to 100 volt and is then connected to an identical capacitor in parallel. The second capacitor has some dielectric between its plates. If the common potential is 20 volt, the dielectric constant of the medium is
(1) 2.5 (2) 4
(3) 5 (4) 8

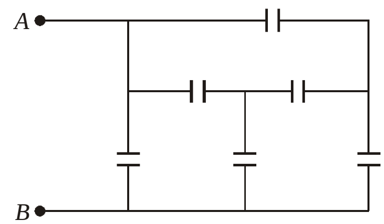
72. The capacitance of a spherical capacitor is 1μF. If the spacing between the two spheres is 1 mm, then the radius of the outer sphere is
(1) 30 cm (2) 60 cm
(3) 6 m (4) 3 m

73. The resultant capacitance between $A$ and $B$ in the following circuit is



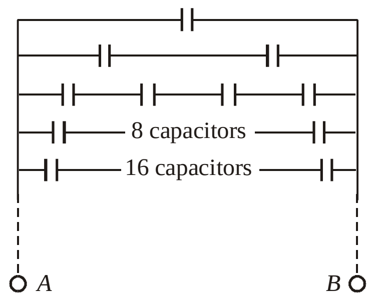

(1) 1 μF (2) 10 μF
(3) 50 μF (4) 1.5 μF

74. Six equal capacitors each ot capacitance $C$ are connected as shown in the following figure. Then the equivalent capacitance between $A$ and $B$ is



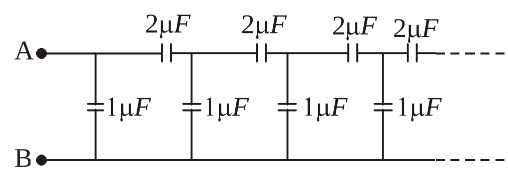

(1) 6$C$ (2) $C$
(3) 2$C$ (4) $C$/2

75. An infinite number of identical capacitors, each of capacitance 1μ$F$, is connected as shown in figure. Then the equivalent capacitance between A and B is



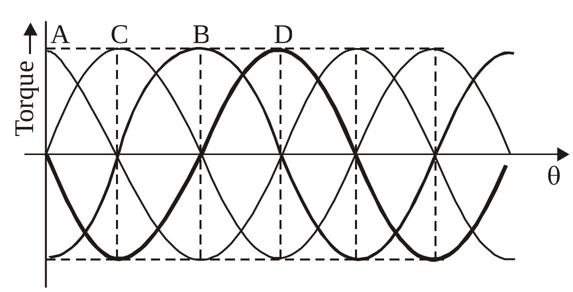

(1) 1μ$F$ (2) 2μ$F$
(3) 0.5μ$F$ (4) ∞

76. In the network of capacitors given below, the resultant capacitance between points A and B is



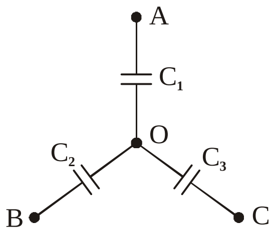

(1) infinity (2) 1 μ$F$
(3) 2 μ$F$ (4) 2/3 μ$F$

77. The electric dipole is situated in a uniform electric field in the plane of the paper. The dipole is rotated about an axis perpendicular to the plane of the paper in clock-wise direction with respect to the field. The graph between torque and θ will be represented by




(1) A (2) B
(3) C (4) D

78. Three uncharged capacitors of capacitances $C_1$, $C_2$ and $C_3$ are connected, as shown in figure, to one another and to points $A$, $B$ and $D$ at potentials $V_A$, $V_B$ and $V_D$, respectively. Then, the potential at $O$ will be



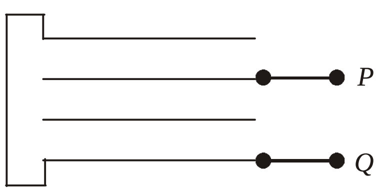

(1) $\dfrac{V_A C_1 + V_B C_2 + V_C C_3}{(C_1 + C_2 + C_3)/3}$

(2) $\dfrac{V_A C_1 + V_B C_2 + V_C C_3}{C_1 + C_2 + C_3}$

(3) $\dfrac{V_A C_2 + V_B C_3 + V_C C_1}{C_1 + C_2 + C_3}$

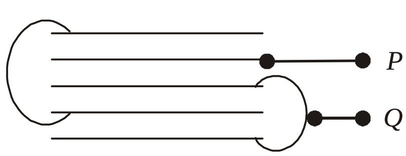
(4) $\dfrac{V_A C_1 + V_B C_2 + V_C C_3}{} \times \left[\dfrac{1}{C_1} + \dfrac{1}{C_2} + \dfrac{1}{C_3}\right]$

79. The following arrangement consists of four identical metal plates. The area of each plate is $A$ and separation between successive plates is $d$. The effective capacitance between $P$ and $Q$ is




(1) $^3/_2(\in_0 A/d)$ (2) $^2/_3(\in_0 A/d)$
(3) $^4/_3(\in_0 A/d)$ (4) $3(\in_0 A/d)$

80. The following arrangement consists of five identical metal plates parallel to each other. Area of each plate is $A$ and separation between the successive plates is $d$. The effective capacitance between $P$ and $Q$ is




(1) $5(\in_0 A/d)$ (2) $^7/_3(\in_0 A/d)$
(3) $^4/_3(\in_0 A/d)$ (4) $^5/_3(\in_0 A/d)$

81. An uncharged parallel plate capacitor having a dielectric of constant $K$ is connected to a similar air cored parallel capacitor charged to a potential $V$. The two share the charge and the common potential is $V'$. The dielectric constant $K$ is

(1) $\dfrac{V'-V}{V'+V}$ (2) $\dfrac{V'-V}{V'}$

(3) $\dfrac{V'-V}{V}$ (4) $\dfrac{V-V'}{V'}$

82. An electric dipole is placed along the x-axis at the origin $O$. A point $P$ is at a distance of 20 cm from this origin such that $OP$ makes an angle $\pi/3$ with the x-axis. If the electric field at $P$ makes as angle $\theta$ with x-axis, the value of $\theta$ is

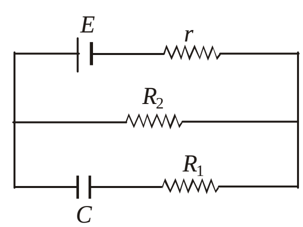
(1) $\dfrac{\pi}{3} - \tan^{-1}\dfrac{\sqrt{3}}{2}$ (2) $\dfrac{\pi}{3} + \tan^{-1}\dfrac{\sqrt{3}}{2}$

(3) $\dfrac{3\pi}{3}$ (4) $\tan^{-1}\dfrac{\sqrt{3}}{2} - \dfrac{\pi}{3}$

83. N drops of mercury of equal radii and possessing equal charges combine to form a bigger spherical drop. The ratio of potential energy of the bigger drop to that of individual smaller drop is
(1) N (2) $N^{2/3}$
(3) $N^{1/3}$ (4) $N^{5/3}$

84. A capacitor of 20 μF, charged to 500 V, is connected in parallel with another capacitor of 10 μF charged to 200 V. The common potential of the combination would be
(1) 350 V (2) 375 V
(3) 400 V (4) 300 V

85. The numerical value of the charge on either side of the capacitor C shown in the following figure is




(1) $CE$ (2) $\dfrac{CER_1}{R_2 + r}$

(3) $\dfrac{CER_2}{R_2 + r}$ (4) $\dfrac{CER_1}{R_1 + r}$

86. Three capacitors, with capacitance of 1μF, 2μF and 3μF are connected in series. Each capacitor gets punctured if a potential difference just exceeding 100 volt is applied. If the group is connected across a 300 volt circuit then the capacitor, most likely to puncture first, is

(1) of capacitance $1\mu F$
(2) of capacitance $2\mu F$
(3) of capacitance $3\mu F$
(4) of capacitance either $1\mu F$, or $2\mu F$ or $3\mu F$

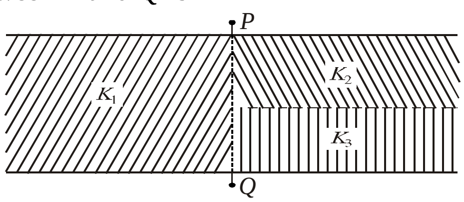
87. A capacitor of capacitance 50 $\mu F$ is connected to a battery through a $10^4$ ohm resistor. If the charge given to the capacitor from 0 to 0.5 second is $Q_1$ and that from 0.5 second to 1 second is $Q_2$, then
(1) $Q_1 = Q_2$ (2) $Q_1 > Q_2$
(3) $Q_1 < Q_2$ (4) $Q_1 \le Q_2$

88. A capacitor of capacitance $C_1$ is charged to a potential $V_0$. The electrostatic energy stored in it is $u_0$. It is connected to another uncharged capacitor of capacitance $C_2$, in parallel. The energy dissipated in the process is
(1) $\left(\frac{C_2}{C_1+C_2}\right)u_0$ (2) $\left(\frac{C_1}{C_1+C_2}\right)u_0$
(3) $\left(\frac{C_1-C_2}{C_1+C_2}\right)^2 u_0$ (4) $\frac{C_1 C_2}{2(C_1+C_2)}u_0$

89. To form a composite 16 $\mu F$, 1000 volt capacitor from a supply of identical capacitors marked 8 $\mu F$, 250 volt, we require a minimum number of ..... capacitors.
(1) 40 (2) 32
(3) 8 (4) 2

90. The diameter of each plate of an air capacitor is 4 cm. To make the capacitance of this plate capacitor equal to that of a conducting sphere of diameter 20 cm, the distance between the plates will be
(1) $4 \times 10^{-3}$ m (2) $1 \times 10^{-3}$ m
(3) 1 cm (4) $1 \times 10^{-3}$ cm

91. The air space between the plates of a parallel plate capacitor has thickness $d$ and area $A$. Three dielectric slabs of constants $K_1$, $K_2$ and $K_3$ are used to completely fill the air gap. The slab of dielectric constant $K_1$ has area $A/2$ and thickness $d$ while the slabs of dielectric constants $K_2$ and $K_3$ have area $A/2$ and thickness $d/2$ each. Then the capacitance between $P$ and $Q$ is

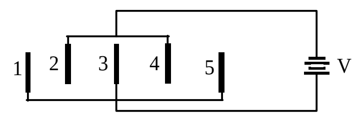



(1) $\frac{\epsilon_0 A}{d}K_1$ (2) $\frac{\epsilon_0 A}{d}K_1K_2K_3$
(3) $\frac{\epsilon_0 A}{d}K_2K_3$ (4) $\frac{\epsilon_0 A}{d}\left(\frac{K_1}{2}+\frac{K_2K_3}{K_2+K_3}\right)$

92. The work done in charging a capacitor to 100 V is 0.5 J. If two such capacitors are joined in parallel, then work done in charging them to 150 V would be
(1) 1.5 J (2) 4.5 J
(3) 2.25 J (4) 3.75 J

93. Two identical charged spheres are suspended by strings of equal length, from same common point. The strings make an angle of 30º with each other. When suspended in a liquid of density 0.8 g cm$^{-3}$, the angle between the strings remain same. If density of material of the sphere is 1.6 g cm$^{-3}$, then the dielectric constant of the liquid is
(1) 2.5 (2) 2.0
(3) 4.0 (4) 5.0

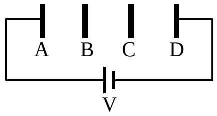
94. Five identical thin plates, each of area $A$, are placed at equal distance $d$ from one another and then connected as shown. Charges on plates 2 and 3 are, respectively,




(1) $-\frac{2\epsilon_0 A}{d}V$ and $+\frac{\epsilon_0 A}{d}V$
(2) $-\frac{2\epsilon_0 A}{d}V$ and $+\frac{2\epsilon_0 A}{d}V$
(3) $-\frac{\epsilon_0 A}{d}V$ and $+\frac{2\epsilon_0 A}{d}V$
(4) $-\frac{\epsilon_0 A}{d}V$ and $+\frac{\epsilon_0 A}{d}V$

95. A uniformaly charged non-conducting sphere of radius $R$ has total charge $Q$. Electric potential at a point distant $x$ ($x < R$) from its centre would be
(1) $\frac{1}{4\pi\epsilon_0}.\frac{Q[2R^2-x^2]}{R^3}$ (2) $\frac{1}{4\pi\epsilon_0}\frac{Q[3R^2-x^2]}{2R^3}$
(3) $\frac{1}{4\pi\epsilon_0}.\frac{Q[2R-x]}{R^2}$ (4) $\frac{1}{4\pi\epsilon_0}\frac{Q[3R-x]}{2R^2}$

96. Four identical thin plates $A$, $B$, $C$ and $D$, each of area $A$, are placed at equal distance $d$ from one another and are connected across a $dc$ source of potential difference $V$. When $B$ and $C$ are connected, then the electric field between $A$ and $B$




(1) will increase by $V/6d$
(2) will decrease by $V/6d$
(3) will remain unaffected
(4) will increase by $V/3d$

97. In the above question, energy of the system

(1) will decrease by $\frac{\epsilon_0 A}{6d}V^2$

(2) will increase by $\frac{\epsilon_0 A}{6d}V^2$

(3) will decrease by $\frac{\epsilon_0 A}{12d}V^2$

(4) will increase by $\frac{\epsilon_0 A}{12d}V^2$

98. Two small dipoles of dipole moments $p_1$ and $p_2$, when placed co-axially, have separation of $r$ between them. Electric force between these dipoles would be

(1) $\frac{1}{4\pi\epsilon_0}\frac{3p_1p_2}{r^4}$ (2) $\frac{1}{4\pi\epsilon_0}\frac{6p_1p_2}{r^4}$

(3) $\frac{1}{4\pi\epsilon_0}.\frac{3p_1p_2}{r^3}$ (4) $\frac{1}{4\pi\epsilon_0}.\frac{6p_1p_2}{r^3}$

99. A metal plate is moved with a constant acceleration $a$, parallel to its plane. If $m$ is the mass of electron, then the surface charge density ($\sigma$), developed on its face is

(1) $\epsilon_0 ma/2e$ (2) $2\epsilon_0 ma/e$
(3) $\epsilon_0 ma/e$ (4) zero

100. A point charge +Q is placed at a distance $d$ from a large conducting plate. The force exerted by the plate on the point charge is

(1) $\frac{1}{4\pi\varepsilon_0}.\frac{Q}{d^2}$ (2) $\frac{1}{4\pi\varepsilon_0}.\frac{Q^2}{d^2}$

(3) $\frac{1}{4\pi\varepsilon_0}.\frac{Q}{4d^2}$ (4) $\frac{1}{4\pi\varepsilon_0}.\frac{Q^2}{4d^2}$

* * * * *

**Choose the correct answers :**

1. 10,000 alpha particles per minute are passing through a straight tube of radius *r*. The resulting electric current is approximately
(1) $0.5 \times 10^{-16}$ A (2) $0.5 \times 10^{-14}$ A
(3) $0.5 \times 10^{-15}$ A (4) $1 \times 10^{-12}$ A

2. In the Bohr's model of hydrogen atom the electron moves around the nucleus in a circular orbit of radius $5 \times 10^{-11}$ m with time period $1.5 \times 10^{-16}$ s. The current associated with the electron motion is
(1) zero (2) $1.07 \times 10^{-4}$
(3) 0.17 A (4) $1.07 \times 10^{-3}$ A

3. In neon gas discharge tube, $2.9 \times 10^{18}$ $Ne^+$ ions move to the the right through a cross-section of the tube each second, while $1.2 \times 10^{18}$ electrons move to the left in this time. The electronic charge is $1.6 \times 10^{-19}$ coulomb. Then the net electric current in the tube is
(1) 1 A to the right
(2) 0.66 A to the right
(3) 0.66 A to the left
(4) zero

4. In cosmic rays, 0.15 protons/cm$^2$ are entering the earth's atmosphere, per second. If the radius of the earth is 6400 km, the current received by the earth in the form of cosmic rays is nearly
(1) 0.12 A (2) 1.2 A
(3) 120 A (4) 12 A

5. A charge of $4.8 \times 10^5$ coulomb passes through an electrolytic solution of copper sulphate. The number of $Cu^{++}$ ions liberated from the electrolyte is nearly
(1) $3 \times 10^{24}$ (2) $1.5 \times 10^{24}$
(3) $7.68 \times 10^{14}$ (4) $1.25 \times 10^{13}$

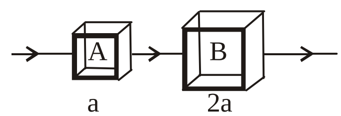
6. In silver voltameter, electrolyte is $AgNO_3$. During electrolysis, the drift speed of $Ag^+$ is $v_1$ and that of $NO_3^-$ is $v_2$. Then,
(1) $v_1 = v_2$ (2) $v_1 > v_2$
(3) $v_1 < v_2$ (4) none of these

7. If length of a wire is doubled and area of cross-section is halved, but potential difference across the wire remains the same, then drift velocity of electrons in the wire will be
(1) unaffected (2) doubled
(3) halved (4) one-fourth

8. Specific resistance of a material depends on
(1) its dimensions and temperature
(2) temperature and pressure
(3) nature of the material and its dimensions
(4) none of the above, as it is a constant

9. The masses of three wires of copper are in the ratio 1 : 3 : 5. and lengths are in the ratio 5 : 3 : 1. Then the ratio of their electrical resistances is
(1) 1 : 3 : 5 (2) 5 : 3 : 1
(3) 1 : 15 : 25 (4) 125 : 15 : 1

10. As shown in the figure below, metal plates *A* and *B* are square in shape and have the same thickness. The side of *B* is twice the side of *A*. These are connected in a circuit so that a current flows as shown by the arrow marks. Compare their resistances.




(1) The resistance of *B* is twice that of *A*
(2) The resistance of *A* is twice that of *B*
(3) Both have the same resistance
(4) The resistance of *B* is four times that of *A*

11. Two wires of equal length, one of aluminium and the other of copper have same resistance. If $\rho_{Al} = 2.64 \times 10^{-8}\,\Omega$m and $\rho_{Cu} = 1.72 \times 10^{-8}\,\Omega$m and the respective relative densities are 2.7 and 8.91, then the ratio of their masses is
(1) 20 : 43 (2) 10 : 23
(3) 5 : 13 (4) 4 : 13

12. A current of 10 A is maintained in a conductor of cross-section $10^{-4}$ m$^2$. If free-electron density is $9 \times 10^{28}$ m$^{-3}$, then drift velocity of free-electrons is nearly
(1) $6.9 \times 10^{-5}$ ms$^{-1}$ (2) $6.9 \times 10^{-6}$ ms$^{-1}$
(3) $6.9 \times 10^{-3}$ ms$^{-1}$ (4) $6.9 \times 10^{-2}$ ms$^{-1}$

13. The current density (*J*), charge density ($\rho$) and drift velocity ($v_d$) are related by the relation
(1) $J = \rho/v_d$ (2) $J = v_d/\rho$
(3) $J = \rho.v_d$ (4) $J.\rho.v_d = 1$

14. The current density (*J*) and the conductivity ($\sigma$) of a conducting wire of length *L*, across which a potential difference *V* is applied, are related as
(1) $\sigma.L = J.V$ (2) $\sigma.V = J.L$
(3) $\sigma.J = V.L$ (4) none of these

15. If on stretching a wire its radius decreases by 1%, then its resistance will
(1) increase by 1% (2) increase by 2%
(3) increase by 4% (4) not change

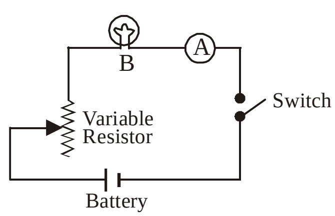
16. Temperature coefficient of resistance of carbon is $-0.0005\ ^{\circ}C^{-1}$ and that of copper is $0.0068\ ^{\circ}C^{-1}$. What resistance of copper should be added in series with a resistance of 3.4 Ω of carbon so that the resistance of the combination is independent of temperature ?
(1) 0.10 Ω (2) 0.15 Ω
(3) 0.20 Ω (4) 0.25 Ω

17. The temperature co-efficient of resistance of a wire is $0.00125^{\circ}\ C^{-1}$. At 300 K its resistance is one ohm. The resistance of the wire will be 2 ohm at
(1) 1100 K (2) 1127 K
(3) 1154 K (4) 1400 K

18. If diameter of a wire is doubled but current through it remains same, then how will resistance of wire, drift velocity of electrons and applied voltage across the wire will change ?

| | *Resistance* | *Drift velocity* | *Applied voltage* |
|---|---|---|---|
| (1) | One-fourth | unaffected | four times |
| (2) | One-half | doubled | one-fourth |
| (3) | One-fourth | one-fourth | one-fourth |
| (4) | One-fourth | four times | unaffected |

19. In the circuit of the given figure, bulb *B* does not light although ammeter *A* indicates that the current is flowing. Why does the bulb not light ?




(1) The bulb is fused
(2) There is a break in the circuit between bulb and ammeter
(3) The resistance of variable resistor is too large
(4) There is a break in the circuit between bulb and variable resistor

20. Two electric bulbs, one of 200V, 40W and the other of 200V, 100W, are connected in series to a 200 V line, then
(1) the potential drop across each bulb is same
(2) the potential drop across 40W bulb is greater than the potential drop across 100W bulb
(3) the potential drop across 100W bulb is greater than the potential drop across 40W bulb
(4) the potential drop across each bulb is 200V

21. A uniform wire of radius *R* and resistance 1Ω is stretched uniformly so that its diameter becomes one-third. The resistance of the stretched wire will be
(1) 9 Ω (2) 27 Ω
(3) 81 Ω (4) 243 Ω

22. The resistance of a thick wire is *R*. Only one-eighth of its length is stretched out uniformly into a thinner wire so that total length of the resultant wire becomes 1.5 times the original length of the wire. Now, the resistance of this deformed wire will be
(1) 3.5 *R* (2) 2.0 *R*
(3) 4.0 *R* (4) 4.5 *R*

23. 12 identical cells, are connected in series and are kept in a closed box. Some of the cells are wrongly connected. This battery is connected in series with an ammeter and 2 cells identical with others. Current is 4A when the cells and battery aid each other; and 2A when the cells and battery oppose each other. The number of cells connected wrongly in the battery should be
(1) 1 (2) 2
(3) 3 (4) 4

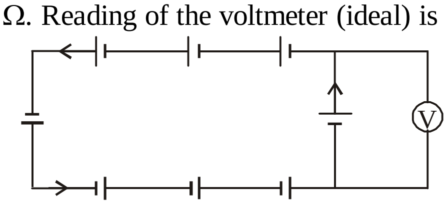
24. Two similar cells, whether joined in series or in parallel, give same current through an external resistance of *R*. The internal resistance of each cell is
(1) 2 *R* (2) *R*
(3) *R*/2 (4) *R*/3

25. The *incorrect* statement about a fuse wire is
(1) its current capacity is independent of its length
(2) it has high resistance and low melting point
(3) it has high resistance and high melting point
(4) its current capacity varies with its radius as $r^{3/2}$

26. The maximum power dissipated by an external resistance *R* by a cell of e.m.f. *E* and internal resistance *r* is $E^2/4r$. This is obtained when
(1) $R = r$ (2) $R > r$
(3) $R < r$ (4) any value of *R*

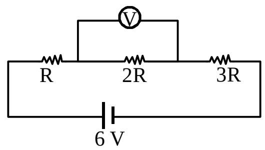
27. A fuse wire with a circular cross-sectional radius of 0.2 mm blows out with a current of 5 ampere. For what value of current, another fuse wire made from the same material but with cross-sectional radius of 0.3 mm will blow out ?
(1) 5 amp (2) $5 \times \frac{3}{2}$ amp
(3) $5 \times \sqrt{\frac{3}{2}}$ amp (4) $5 \times \sqrt{\frac{27}{8}}$ amp

28. EMF of each cell is 5 V and internal resistance is 0.2 Ω. Reading of the voltmeter (ideal) is



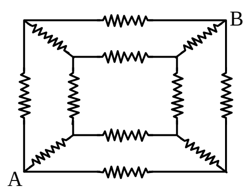
(1) 5.0 V (2) 2.5 V
(3) zero (4) 3 V

29. In the circuit shown, voltmeter of 2 Ω resistance, when added across 2 Ω resistance, will show the reading of



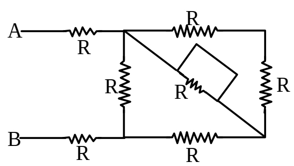

(1) 2 V (2) 1.2 V
(3) 1.0 V (4) 1.5 V

30. In the following circuit, resistance of each resister is *R*. The resistance between point *A* and *B* of the circuit is



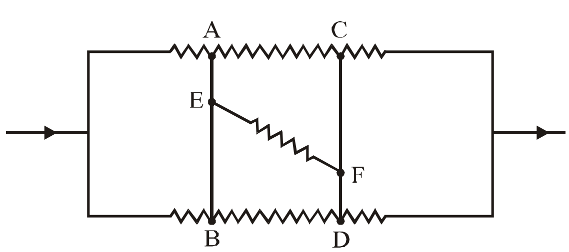

(1) 2 R (2) 0.75 R
(3) 1.5 R (4) 3 R

31. In the following circuit, the effective resistance between points *A* and *B* would be



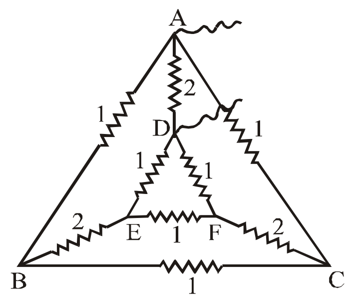

(1) 2.50 *R* (2) 3.0 *R*
(3) 2.75 *R* (4) 3.5 *R*

32. Two conductors *AB* and *CD* are connected in between two parallel resistors in such a way that no current flows through them. Then a wire is connected in between *E* and *F*. Tick mark the correct one



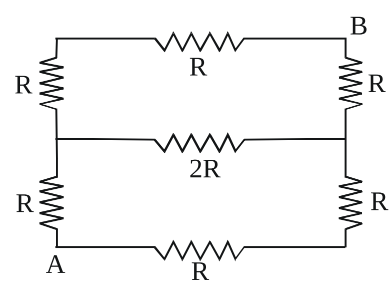

(1) there is no current in *EF*
(2) there is current from *E* to *F*
(3) there is current from *F* to *E*
(4) none of these

33. A network of 9 resistors connect six points *A*, *B*, *C*, *D*, *E* and *F* as shown. The figures denote resistances is ohms. The equivalent resistance between A and D is




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

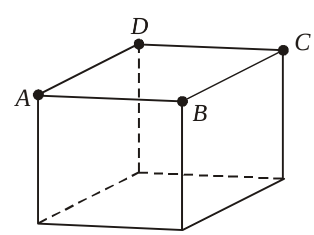
34. The equivalent resistance of the circuit, given below, between *A* and *B*




(1) 6R/5 (2) 10R/7
(3) 5R/3 (4) 3R/2

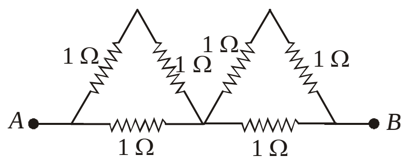
35. Twelve wires, each of equal resistance *R*, are connected to form a cube. The effective resistance between any two diagonal ends will be
(1) 5*R*/6 (2) 6*R*/5
(3) 12 *R* (4) 3 *R*

36. Twelve wires, each having resistance *R*, form the cube as shown. The resistance between *A* and *C* is



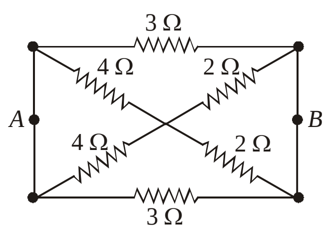

(1) 5*R*/ 6 (2) 4*R*/ 3
(3) 3*R*/ 2 (4) 3*R*/ 4

37. The effective resistance between points *A* and *B* in the figure is



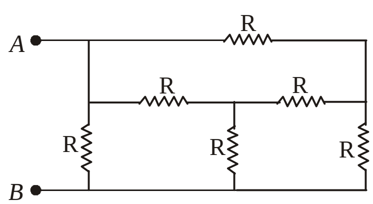

(1) 4/3 Ω (2) 3/2 Ω
(3) 7 Ω (4) 8/7 Ω

38. In the network shown, the resistance between *A* and *B* is



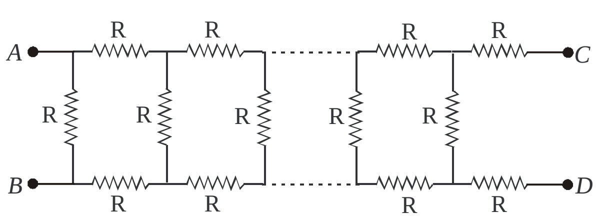

(1) 1 Ω (2) 2 Ω
(3) 3 Ω (4) 4 Ω

39. Equivalent resistance between *A* and *B*, in the following electrical network of resistances, is



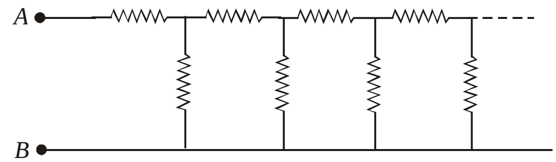

(1) *R* (2) 0.5 *R*
(3) 2 *R* (4) 3 *R*

40. In the following figure, the value of resistor to be connected between *C* and *D*, so that the resistance of the entire circuit between *A* and *B* does not change with the number of elementary sets used, is



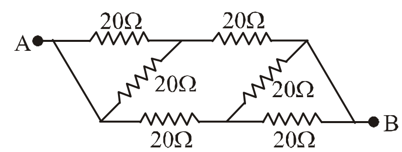

(1) *R* (2) $R(\sqrt{3}-1)$
(3) 3*R* (4) $R(\sqrt{3}+1)$

41. The equivalent resistance between points *A* and *B* of an infinite network of resistances, each of 1 ohm, connected as shown is



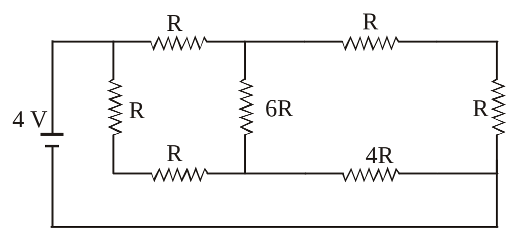

(1) infinite (2) 2 ohm
(3) $\frac{\sqrt{5}+1}{2}$ ohm (4) $\frac{\sqrt{5}-1}{2}$ ohm

42. In the following circuit, resistance betwen points *A* and *B* is



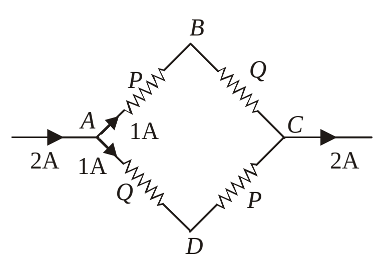

(1) 40 Ω (2) 30 Ω
(3) 20 Ω (4) 15 Ω

43. A battery of internal resistance 4 Ω is connected to the network of resistances as shown. In order to give the maximum power to the network, the value of *R* is




(1) 4/9 Ω (2) 8/9 Ω
(3) 2 Ω (4) 18 Ω

44. The potential difference between points *B* and *D* in the following circuit diagram is




(1) *P* – *Q* (2) *Q* – *P*
(3) $\frac{PQ}{P+Q}$ (4) $\frac{PQ}{P-Q}$

45. A battery of emf 2V and internal resistance 0.1 Ω, in series with an external resistance of 0.4 Ω, is being charged with a current of 2.0 A. Potential difference between the terminals of the battery should be
(1) 1.2 V (2) 2.2 V
(3) 3.0 V (4) 4.0 V

46. Which one of the following statements is *not* correct ?
(1) Deflection per unit current is called *current sensitivity* of the galvanometer
(2) Reciprocal of current sensitivity is called *figure of merit* of the galvanometer
(3) An ammeter reads smaller current than what flows in the circuit before it is used
(4) A galvanometer is converted into an ammeter by adding a low resistance in series with it

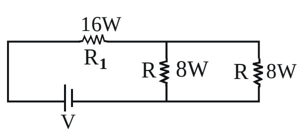
47. Shunting a galvanometer
(1) does not affect its sensitivity
(2) decreases its sensitivity
(3) increases its sensitivity
(4) converts it into a voltmeter

48. Two resistances $R_1$ and $R_2$ are first joined in series and then in parallel. When used across same mains the ratio of heats produced is

(1) $\frac{R_1+R_2}{R_1-R_2}$ (2) $\frac{R_1R_2}{(R_1+R_2)^2}$

(3) $\frac{(R_1+R_2)^2}{R_1R_2}$ (4) $\frac{R_1^2+R_2^2}{(R_1+R_2)^2}$

49. In the circuit, rate of production of heat in the various resistors are as shown. $R_1$ equals

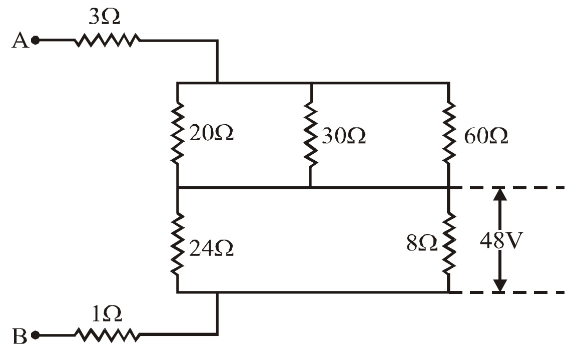



(1) $R$ (2) $2R$
(3) $R/2$ (4) $R/4$

50. In the above question, if $V = 8$ volt, then current drawn from the cell and the resistance $R$ are, respectively,
(1) 0.5 A and 8 Ω (2) 1.0 A and 1 Ω
(3) 2.0 A and 2 Ω (4) 4.0 A and 2 Ω

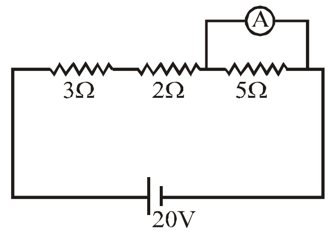
51. Five cells each of emf $E$ and internal resistance $r$ are connected in series. If due to oversight, one cell is connected wrongly, then the equivalent e.m.f. and internal resistance of the combination are
(1) $3E$ and $3r$ (2) $5E$ and $5r$
(3) $3E$ and $5r$ (4) $5E$ and $5r$

52. The potential difference across 8 Ω resistance is 48 V as shown in the figure. The value of potential difference across points $A$ and $B$ will be



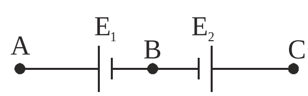

(1) 62 V (2) 80 V
(3) 128 V (4) 160 V

53. As shown in the figure, the reading of the ammeter is (consider Ammeter as ideal)



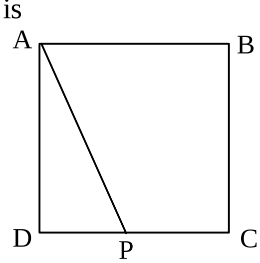

(1) zero (2) 4 A
(3) 2 A (4) 8 A

54. Two cells of emf $E_1$ and $E_2$ ($E_1 > E_2$) are connected as shown in figure. When a potentiometer is connected between $A$ and $B$, the balancing length of the potentiometer wire is 300 cm. On connecting the same potentiometer between $A$ and $C$, the balancing length is 100 cm. The ratio $E_1 : E_2$ is




(1) 3 : 1 (2) 5 : 3
(3) 4 : 3 (4) 3 : 2

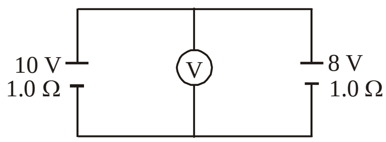
55. A wire of uniform cross-section and resistance 4Ω is bent in the form of a square $ABCD$. Point $A$ is connected to a point $P$ on $DC$ by a wire $AP$ of resistance 1Ω. When a potential difference is applied between $A$ and $C$, the points $B$ and $P$ are seen to be at the same potential. The resistance of the part $DP$ of the wire is




(1) $(2-\sqrt{2})\Omega$ (2) $(\sqrt{2}-1)\Omega$
(3) $(\sqrt{2}-1)/2\,\Omega$ (4) $(\sqrt{2}+1)/4\,\Omega$

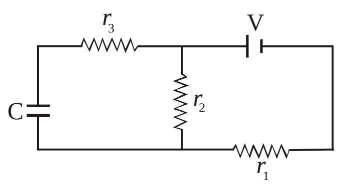
56. When two batteries of different e.m.f.'s and different internal resistances are connected in series with each other and with an external load resistor, the current is 3.0 A. When the polarity of one battery is reversed, the current becomes 1.0 A. The ratio of the e.m.f.'s of the two batteries is
(1) 2.5 (2) 2.0
(3) 1.5 (4) 1.0

57. In the circuit shown below, the reading of voltmeter (ideal) is




(1) 9.0 V (2) 2.0 V
(3) 18.0 V (4) 8.6 V

58. In the circuit of figure, the final voltage drop across the capacitor C is

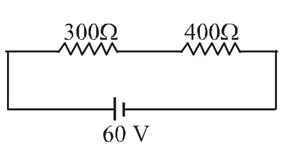



(1) $\frac{V r_3}{r_1 + r_2}$ (2) $\frac{V r_2}{r_1 + r_2}$
(3) $\frac{V(r_1+r_2)}{r_2}$ (4) $\frac{V(r_1+r_2)}{r_1+r_2+r_3}$

59. A cell of e.m.f. $E$ is connected across a resistance $r$. The potential difference between the terminals of the cell is found to be $V$. The internal resistance of the cell must be :
(1) $2(E-V)V/r$ (2) $2(E-V)\,r/E$
(3) $(E-V)\,r/V$ (4) $(E-V)\,r$

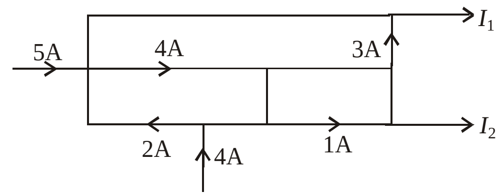
60. A carbon resistor has coloured rings as brown, green, orange and silver, respectively. The resistance is
(1) 15 kΩ ± 10% (2) 10 kΩ ± 10%
(3) 15 kΩ ± 5% (4) 10 kΩ ± 5%

61. In the following electrical circuit, a voltmeter measures a potential difference of 30V across 400 Ω resistance. The potential difference measured by the same voltmeter across 300 Ω resistance will be



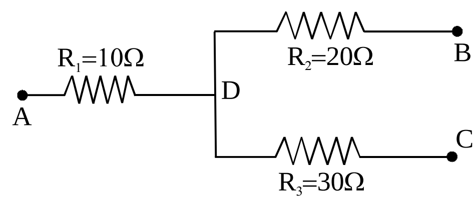

(1) 22.5 V (2) 24.0 V
(3) 20.0 V (4) 27.5 V

62. In the given circuit currents $I_1$ and $I_2$ are



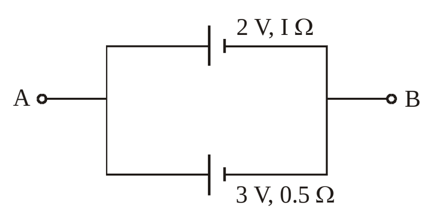

(1) 5A, 4A (2) 6A, 3A
(3) 7A, 2A (4) 6A, 2A

63. In the circuit shown, $R_1$ = 10 ohm, $R_2$ = 20 ohm and $R_3$ = 30 ohm. The potentials of points *A*, *B* and *C* are 10V, 6V and 5V respectively. The current through resistance $R_1$ is



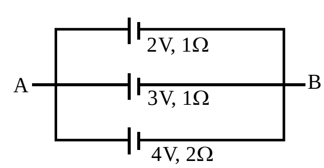

(1) 0.1 A (2) 0.2 A
(3) 0.3 A (4) 0.4 A

64. In the given circuit, the potential difference between the points A and B is



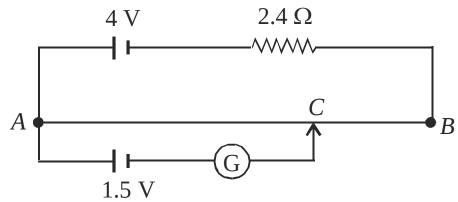

(1) 2.5 V (2) 3.0 V
(3) 2.67 V (4) 2.33 V

65. In the following circuit, emf across *A* and *B* is



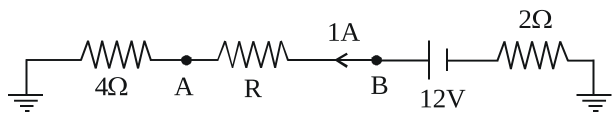

(1) 3.0 V (2) 3.2 V
(3) 2.5 V (4) 2.8 V

66. A simple potentiometer circuit is shown in the figure. The internal resistance of the 4V battery is negligible. *AB* is a uniform wire of length 100 cm and resistance 2Ω. For what length *AC*, the galvanometer shows no deflection?



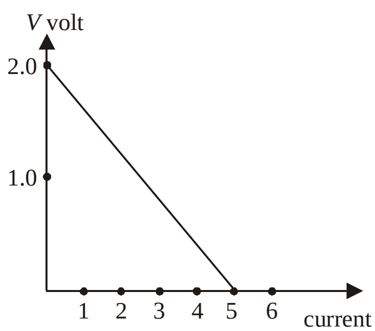

(1) 78.5 cm (2) 84.5 cm
(3) 82.5 cm (4) 80.5 cm

67. In the circuit shown,



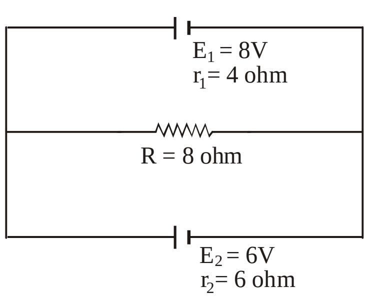

(1) $R$ = 8 ohms
(2) $R$ = 6 ohms
(3) $R$ = 10 ohms
(4) P.D. between $A$ and $B$ is 2V

68. For a cell, the graph between the potential difference $V$ across terminals and current $i$ drawn through the cell is shown in the following diagram. The e.m.f. and the internal resistance of the cell are




(1) 2 V, 0.4 Ω (2) 5 V, 2.0 Ω
(3) 0.4 V, 2.0 Ω (4) 5 V, 0.4 Ω

69. The current in 8 ohm resistor, in the following circuit, would be



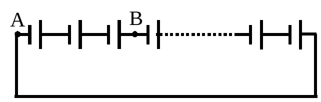

(1) 0.69 ampere (2) 0.92 ampere
(3) 1.30 ampere (4) 1.6 ampere

70. A 220 V house electric supply line is protected by a 9 A fuse. The maximum number of 60 W bulbs in parallel that can be used is
(1) 44 (2) 22
(3) 20 (4) 33

71. Two resistances $R_1$ and $R_2$, when connected across a 120 volt line, consume power at the rate of 25 watt and 100 watt, respectively, when connected in series and parallel across the same 120 volt line. Then the ratio of $R_1$ to that by $R_2$ is
(1) 1 : 1 (2) 1 : 2
(3) 2 : 1 (4) 4 : 1

72. A metre bridge with resistances $R_1$ and $R_2$ connected in the two gaps is balanced at 0.4 m from the zero end. If the smaller resistance is connected in series with a 10 Ω resistor, the balance point is shifted to 0.4 m from the other end. The value of the smaller resistance is
(1) 6 Ω (2) 20 Ω
(3) 10 Ω (4) 8 Ω

73. $N$ identical cells, each of emf $E$ and internal resistance $r$, are added in series as shown. The current flowing from $A$ to $B$ is

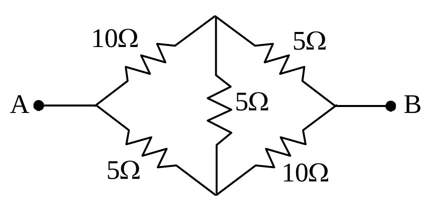



(1) $N (E/r)$ (2) $3 (E/r)$
(3) $E/r$ (4) None of these

74. In the above question, potential difference between points $A$ and $B$ is
(1) 3 $E$ (2) 2 $E$
(3) $E$ (4) zero

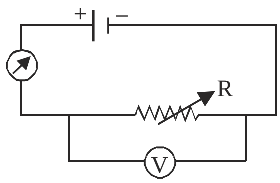
75. The number of 100-V, 50-W electric lamps connected in parallel that can burn at full intensity when power is supplied from a storage battery of emf = 120 V and internal resistance $r$ = 10 Ω is
(1) 2 (2) 3
(3) 4 (4) 5

76. The equivalent resistance between $A$ and $B$, in the following circuit, is



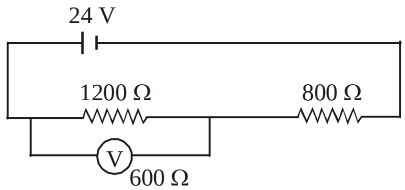

(1) 9.5Ω (2) zero
(3) 7Ω (4) 7.5 Ω

77. A voltmeter is connected in parallel with a variable resistance $R$ which is in series with an ammeter and a cell as shown in the figure. For one value of $R$, the meters read 0.3 A and 0.9 V. For another value of $R$ the readings are 0.25 A and 1.0 V. What is the internal resistance of the cell ?



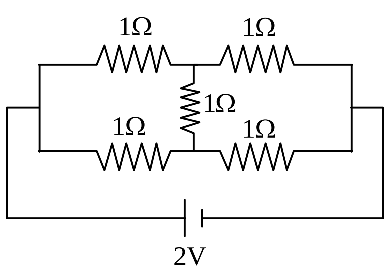

(1) 0.5 Ω (2) 2.0 Ω
(3) 1.2 Ω (4) 1.0 Ω

78. A voltmeter of resistance 600 Ω is connected in a circuit as shown in the figure. What will be the reading of the voltmeter ?



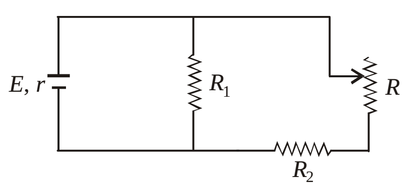

(1) 20 V (2) 12 V
(3) 16 V (4) 8 V

79. In the circuit shown below, power delivered by the battery is




(1) 5 W (2) 4 W
(3) 2 W (4) 4.5 W

80. The current through $R_1$ is independent of value of $R$, only if

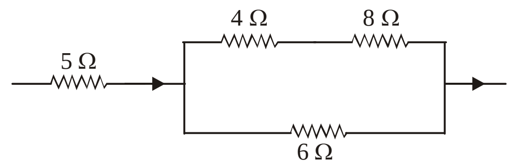



(1) $R_1 = R$ (2) $R_2 - R_1 = R$
(3) $r = 0$ (4) $R = (R_1 + R_2)/2$

81. A cell sends a current through a resistance $R$ for time $t$. Next the same cell sends current through another resistance $r$ for the same time. If same amount of heat is developed in both the resistances, then the internal resistances of cell is

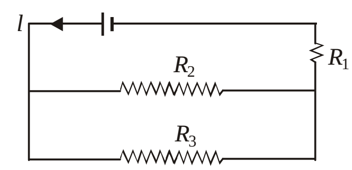
(1) $(R-r)/2$ (2) $(R+r)/2$
(3) $\sqrt{Rr}$ (4) $Rr/2$

82. In the circuit shown in the figure, the heat produced in 5 ohm resistor, due to a current flowing in it, is 4.5 calories per second. The heat produced in 4 ohm resistor is




(1) 0.2 cal per sec (2) 0.4 cal per sec
(3) 0.8 cal per sec (4) 2.4 cal per sec

83. Refer to the circuit shown below. What will be the total power dissipation in the circuit if $P$ is the power dissipated in $R_1$ ? It is given that $R_2 = 4\,R_1$ and $R_3 = 12\,R_1$




(1) 4$P$ (2) 7$P$
(3) 13$P$ (4) 17$P$

84. At 1000ºC the resistance of a wire is found to be four times its resistance at zero deg. C. Calculate the temperature coefficient of resistance of the material of the wire.
(1) 0.002 per degree celsius
(2) 0.001 per degree celsius
(3) 0.004 per degree celsius
(4) 0.003 per degree celsius

85. An electric kettle has two coils. When one of these is switched on, the water in the kettle boils in 6 minutes. When the other coil is switched on, the water boils in 3 minutes. If the two coils are connected in series, the time taken to boil water in the kettle, is
(1) 4 minutes (2) 6 minutes
(3) 4.5 minutes (4) 9 minutes

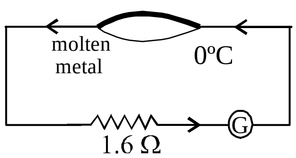
86. An electric kettle has two coils. When one of these is switched on, the water in the kettle boils in 6 minutes. When the other coil is switched on, the water boils in 3 minutes. If the two coils are connected in parallel, the time taken to boil water in the kettle, is
(1) 1.5 minutes (2) 4.5 minutes
(3) 2 minutes (4) 9 minutes

87. Two electric bulbs rated $P_1$ watt, $V$ volt and $P_2$ watt, $V$ volt are connected in series across $V$ volt mains. Then their total power is

(1) $P_1 + P_2$ (2) $\sqrt{P_1 P_2}$

(3) $\frac{P_1 P_2}{P_1 + P_2}$ (4) $\frac{P_1 + P_2}{P_1 P_2}$

88. A thermocouple circuit consists of two thermal junctions, a galvanometer of resistance 8.0 Ω and a resistance of 1.6 Ω, all in series. The thermocouple developes an emf of 10 microvolt per degree celsius difference of temperature between its two junctions. When one junction of thermocouple is kept at 0ºC and the other in a molten metal, the galvanometer reads 8 mV. Assuming that thermo-emf varies linearly with temperature difference, the temperature of the molten metal is




(1) 720ºC (2) 900ºC
(3) 640ºC (4) 960ºC

89. The e.m.f. $E$ (in mV) of a certain thermocouple is found to vary with θ, in accordance with the relation, $E = 40\,\theta - \frac{\theta^2}{20}$, where θ is the temperature of the hot junction, the cold junction being at 0ºC. The neutral temperature of the thermocouple is

(1) 200º C (2) 400º C
(3) 320º C (4) 640º C

90. A certain thermocouple produces an emf of 40 micro volts per degree celsius in the linear range of temperature. A galvanometer of resistance 20 ohm and capable of detecting currents of the order of 1 micro-ampere is employed. What is the smallest temperature change that can be detected by this galvanometer ?

(1) 0.25ºC (2) 0.125ºC
(3) 0.50ºC (4) 1.0ºC

91. During electrolysis of water, $v_H$ is the speed of hydrogen ions and $v_O$ is the speed of oxygen ions, towards their respective electrodes through the acidulated water. Then

(1) $v_H = 2\,v_O$ (2) $v_H = 8\,v_O$
(3) $v_H = v_O$ (4) $v_H = 16\,v_O$

92. During electrolysis of water, the ratio of masses of hydrogen gas and that of oxygen, collected at their respective electrodes, is

(1) 1 : 16 (2) 1 : 8
(3) 1 : 32 (4) 1 : 4

93. Which one of the following statements is *not* correct, regarding chemical effects of current, where symbols have their usual meanings ?

(1) $F = eN_A$ (2) $E = ZF$

(3) $F = 96500$ C (4) $\frac{m_1}{m_2} = \frac{E_1}{E_2}$

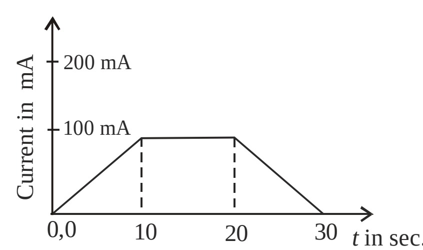
94. How many coulomb of charge must pass through acidulated water to release 22.4 litres of hydrogen at N.T.P. ?

(1) 96500 C (2) 19300 C
(3) 1 C (4) 193000 C

95. A silver and a zinc voltameter are connected in series and a current $i$ is passed through them for a time $t$, liberating $W$ gram of zinc. The weight of silver deposition, in gram, is nearly (atomic mass of silver is 108 and atomic mass of zinc is 65)

(1) $W$ (2) 1.7 $W$
(3) 2.4 $W$ (4) 3.4 $W$

96. In a copper voltameter, mass deposited in thirty seconds is $m$ grams. If the time-current graph is as shown in the following diagram, then E.C.E. of copper is (in grams per coulomb)




(1) $m$ (2) $m/2$
(3) 0.1 $m$ (4) 0.6 $m$

97. Silver and copper voltameters are connected in parallel with a battery of e.m.f. 12 volt. In 30 minutes, 1 g of silver and 1.8 g of copper are liberated. The energy supplied by the battery per second is (Take 1F = 96500 C g $mol^{-1}$, atomic mass of silver = 108 and molecular mass of copper = 63.0) )

(1) 42.72 $Js^{-1}$ (2) 24.34 $Js^{-1}$

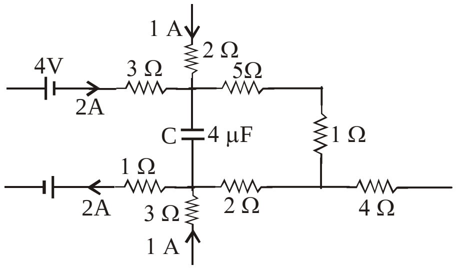
(3) 4.272 $Js^{-1}$ (4) 2.434 $Js^{-1}$

98. The e.m.f. of a thermocouple, one junction of which is at 0ºC, is given by the relation : $e = at + bt^2$. The Peltier coefficient is ($t$ is in centigrade)

(1) $\left(-\frac{a}{2b}\right)°C$ (2) $\left(-\frac{a}{b}\right)°C$

(3) $T(2b)$ (4) $(t + 273)(a + 2bt)$

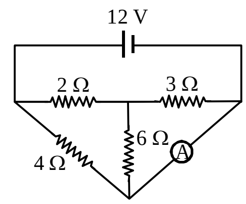
99. In the following part of net-work of an electrical circuit, energy stored in the capacitor is




(1) $4 \times 10^{-5}$ J (2) $4 \times 10^{-6}$ J

(3) $8 \times 10^{-3}$ J (4) $8 \times 10^{-4}$ J

100. In the circuit shown, current passing through the ammeter is




(1) 6 A (2) 4 A

(3) 3 A (4) 2 A

# Assertion-Reason Type Questions (For AIIMS)

**Each of the questions given below consists of two statements, an assertion (*A*) and reason (*R*). Darken the number corresponding to the appropriate alternative on the answer sheet as follows :**

(1) If both ***A*** and ***R*** are true and ***R*** is the correct explanation of ***A***, then mark **1**

(2) If both ***A*** and ***R*** are true but ***R*** is not the correct explanation of ***A***, then mark **2**

(3) If ***A*** is true but ***R*** is false, then mark **3**

(4) If both ***A*** and ***R*** are false, then mark **4**

1. *A*. Using Ohm's law [$V = IR$], we can also define ampere as the fundamental unit of current in S.I. system of units.
   *R*. Ohm's law is a universal law.

2. *A*. If a glass rod is rubbed with silk, glass rod becomes positively charged and silk becomes negatively charged.
   *R*. Work-function of glass is smaller than that of silk.

3. *A*. Inside a hollow charged sphere, there is no electric field.
   *R*. Electric lines of force are not continuous.

4. *A*. At any point on the equatorial line, electric potential is zero, but intensity of electric field is not zero.
   *R*. Electric potential is a scalar quantity while intensity of electric field is a vector quantity.

5. *A*. It is possible to have a negatively charged body at positive potential, and a positively charged body at zero potential.
   *R*. Charge of a body is not affected by the charges on the neighbouring bodies, but potential of the body is affected by the neighbouring charged bodies.

6. *A*. If the size of the cell is increased, then its e.m.f. will also increase.
   *R*. Larger cell will have large number of charge carriers, producing large potential difference.

7. *A*. Random velocity of electrons in a conducting wire is of the order of $10^5$ m $s^{-1}$, whereas drift velocity of the electrons, through the same conducting wire is a few mm $s^{-1}$.
   *R*. Applied electric field across the wire produces smaller electric force to move the electrons along the wire.

8. *A*. Current is a scalar quantity but current density is a vector quantity.
   *R*. Unit of current is A but that of current density is A $m^{-2}$.

9. *A*. Potential difference, measured by a voltmeter, across any part of an electrical circuit, is always smaller than its actual potential difference before the voltmeter is applied.
   *R*. A voltmeter measures potential difference across its ends and hence across the part of the circuit across which it is applied in parallel.

10. *A*. The heat produced by the current in the filament of a bulb makes it to glow.
    *R*. So, as per Joule's law of heating, 100 W bulb has more resistance than 60 W bulb.

11. *A*. A current flows in the direction of fall of potential.
    *R*. For the current to flow between two points, there must be potential difference between the points.

12. *A*. Lightning is the cause of electrical charge in the atmosphere.
    *R*. Heat produced during lightning is responsible for ionising the air and hence producing the whole charge in the atmosphere.

# ANSWERS TO ASSIGNMENT

## ELECTROSTATICS, ELECTRICAL POTENTIAL & CAPACITANCE

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | (3) | 2. | (4) | 3. | (4) | 4. | (3) | 5. | (3) |
| 6. | (1) | 7. | (4) | 8. | (3) | 9. | (4) | 10. | (3) |
| 11. | (2) | 12. | (2) | 13. | (3) | 14. | (2) | 15. | (3) |
| 16. | (4) | 17. | (4) | 18. | (2) | 19. | (2) | 20. | (4) |
| 21. | (2) | 22. | (3) | 23. | (1) | 24. | (4) | 25. | (3) |
| 26. | (4) | 27. | (3) | 28. | (2) | 29. | (3) | 30. | (2) |
| 31. | (2) | 32. | (4) | 33. | (3) | 34. | (1) | 35. | (1) |
| 36. | (4) | 37. | (4) | 38. | (4) | 39. | (1) | 40. | (3) |
| 41. | (2) | 42. | (3) | 43. | (1) | 44. | (2) | 45. | (3) |
| 46. | (3) | 47. | (2) | 48. | (4) | 49. | (4) | 50. | (1) |
| 51. | (4) | 52. | (2) | 53. | (1) | 54. | (4) | 55. | (2) |
| 56. | (1) | 57. | (3) | 58. | (1) | 59. | (4) | 60. | (3) |
| 61. | (2) | 62. | (3) | 63. | (4) | 64. | (1) | 65. | (2) |
| 66. | (2) | 67. | (3) | 68. | (3) | 69. | (1) | 70. | (3) |
| 71. | (2) | 72. | (4) | 73. | (1) | 74. | (3) | 75. | (2) |
| 76. | (3) | 77. | (3) | 78. | (2) | 79. | (1) | 80. | (4) |
| 81. | (4) | 82. | (2) | 83. | (4) | 84. | (3) | 85. | (3) |
| 86. | (1) | 87. | (2) | 88. | (1) | 89. | (2) | 90. | (2) |
| 91. | (4) | 92. | (3) | 93. | (2) | 94. | (2) | 95. | (2) |
| 96. | (1) | 97. | (4) | 98. | (2) | 99. | (3) | 100. | (4) |

## CURRENT ELECTRICITY, THERMAL & CHEMICAL EFFECTS OF CURRENT

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | (1) | 2. | (4) | 3. | (2) | 4. | (1) | 5. | (2) |
| 6. | (1) | 7. | (3) | 8. | (2) | 9. | (4) | 10. | (3) |
| 11. | (1) | 12. | (2) | 13. | (3) | 14. | (2) | 15. | (3) |
| 16. | (4) | 17. | (2) | 18. | (3) | 19. | (3) | 20. | (2) |
| 21. | (3) | 22. | (3) | 23. | (3) | 24. | (2) | 25. | (3) |
| 26. | (1) | 27. | (4) | 28. | (3) | 29. | (2) | 30. | (2) |
| 31. | (1) | 32. | (2) | 33. | (3) | 34. | (2) | 35. | (1) |
| 36. | (4) | 37. | (1) | 38. | (1) | 39. | (2) | 40. | (2) |
| 41. | (3) | 42. | (4) | 43. | (3) | 44. | (2) | 45. | (2) |
| 46. | (4) | 47. | (2) | 48. | (2) | 49. | (3) | 50. | (4) |
| 51. | (3) | 52. | (4) | 53. | (2) | 54. | (4) | 55. | (2) |
| 56. | (2) | 57. | (1) | 58. | (2) | 59. | (3) | 60. | (1) |
| 61. | (1) | 62. | (2) | 63. | (2) | 64. | (3) | 65. | (4) |
| 66. | (3) | 67. | (2) | 68. | (1) | 69. | (1) | 70. | (4) |
| 71. | (1) | 72. | (4) | 73. | (3) | 74. | (4) | 75. | (3) |
| 76. | (3) | 77. | (2) | 78. | (4) | 79. | (2) | 80. | (3) |
| 81. | (3) | 82. | (2) | 83. | (1) | 84. | (4) | 85. | (4) |
| 86. | (3) | 87. | (3) | 88. | (4) | 89. | (2) | 90. | (3) |
| 91. | (3) | 92. | (2) | 93. | (3) | 94. | (4) | 95. | (4) |
| 96. | (2) | 97. | (2) | 98. | (4) | 99. | (4) | 100. | (2) |

## ASSERTION-REASON TYPE QUESTIONS (FOR AIIMS)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | (4) | 2. | (1) | 3. | (1) | 4. | (1) | 5. | (1) |
| 6. | (4) | 7. | (3) | 8. | (2) | 9. | (2) | 10. | (3) |
| 11. | (2) | 12. | (4) | | | | | | |

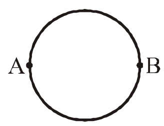
## CBSE - PMT

1. Three capacitors each of capacitance $C$ and of breakdown voltage $V$ are joined in series. The capacitance and breakdown voltage of the combination will be

(1) $3C, 3V$ (2) $\frac{C}{3}, \frac{V}{3}$

(3) $3C, \frac{V}{3}$ (4) $\frac{C}{3}, 3V$

2. A wire of resistance 12 ohms per meter is bent to form a complete circle of radius 10 cm. The resistance between its two diametrically opposite points, A and B as show in the figure, is




(1) 6 Ω (2) 0.6 πΩ
(3) 3 Ω (4) 6 πΩ

3. The electric potential at a point $(x, y, z)$ is given by $V - x^2y - xz^3 + 4$

The electric field $\vec{E}$ at that point is

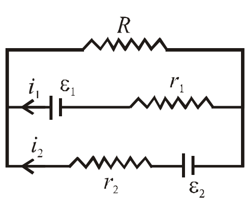
(1) $\vec{E} = \hat{i}(2xy - z^3) + \hat{j}\,xy^2 + \hat{k}3z^2x$

(2) $\vec{E} = \hat{i}(2xy - z^3) + \hat{j}\,x^2 + \hat{k}3xz^2$

(3) $\vec{E} = \hat{i}\,2xy + \hat{j}(x^2 + y^2) + \hat{k}(3xz - y^2)$

(4) $\vec{E} = \hat{i}z^2 + \hat{j}xyz + \hat{k}\,z^2$

4. See the electrical circuit shown in this figure. Which of the following equations is a correct equation for it?




(1) $\varepsilon_1 - (i_1 + i_2) R + i_1 r_1 = 0$
(2) $\varepsilon_1 - (i_1 + i_2) R - i_1 r_1 = 0$
(3) $\varepsilon_2 - i_2 r_2 - \varepsilon_1 - i_1 r_1 = 0$
(4) $-\varepsilon_1 - (i_1 + i_2) R + i_2 r_2 = 0$

5. Three concentric spherical shells have radii $a$, $b$ and $c$ $(a < b < c)$ and have surface charge densities σ, –σ and σ respectively. if $V_A$, $V_B$ and $V_C$ denote the potentials of the three shells, then, for $c = a + b$, we have

(1) $V_C = V_B = V_A$ (2) $V_C = V_A \neq V_B$
(3) $V_C = V_B \neq V_A$ (4) $V_C \neq V_B \neq V_A$

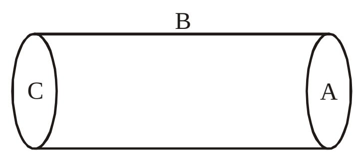
6. A student measures the terminal potential difference ($V$) of a cell (of emf ε and internal resistance $r$) as a function of the current ($I$) flowing through it. The slope, and intercept, of the graph between $V$ and $I$, then, respectively, equal

(1) –ε and $r$ (2) ε and $-r$
(3) $-r$ and ε (4) $r$ and –ε

7. The mean free path of electrons in metal is $4 \times 10^{-8}$ $m$. The electric field which can give on an average 2 eV energy to an electron in the metal will be in units of V/m

(1) $5 \times 10^7$ (2) $8 \times 10^7$
(3) $5 \times 10^{-11}$ (4) $8 \times 10^{-11}$

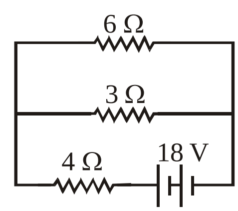
8. A hollow cylinder has a charge $q$ coulomb within it. If ϕ is the electric flux in units of voltmeter associated with the curved surface $B$, the flux linked with the plane surface A in units of voltmeter will be




(1) $\frac{q}{2\varepsilon_0}$ (2) $\frac{\phi}{3}$

(3) $\frac{q}{\varepsilon_0} - \phi$ (4) $\frac{1}{2}\left(\frac{q}{\varepsilon_0} - \phi\right)$

9. The total power dissipated in Watts in the circuit shown here is




(1) 40
(2) 54
(3) 4
(4) 16

10. Three resistance $P$, $Q$, $R$ each of 2Ω and an unknown resistance $S$ form the four arms of a Wheatstone bridge circuit. When a resistance of 6Ω is connected in parallel to $S$ the bridge gets balanced. What is the value of $S$?

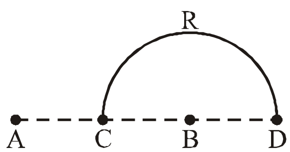
(1) 3 Ω (2) 6 Ω
(3) 1 Ω (4) 2 Ω

11. A steady current of 1.5 amp flows through a copper voltameter for 10 minutes. If the electrochemical equivalent of copper is $30 \times 10^{-5}$ gm coulomb$^{-1}$, the mass of copper deposited on the electrode will be

(1) 0.50 gm (2) 0.67 gm
(3) 0.27 gm (4) 0.40 gm

12. Dimensions of resistance in an electrical circuit, in terms of dimension of mass *M*, of length *L*, of time *T* and of current *I*, would be
(1) $ML^2T^{-2}$ (2) $ML^2T^{-1}I^{-1}$
(3) $ML^2T^{-3}I^{-2}$ (4) $ML^2T^{-3}I^{-1}$

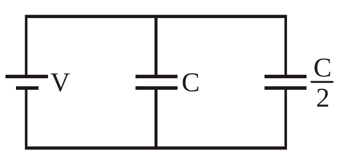
13. Charges +*q* and –*q* are placed at points *A* and *B* respectively which are at a distance 2l apart, *C* is the midpoint between *A* and *B*. The work done in moving a charge +*Q* along the semicircle *CRD* is




(1) $\frac{qQ}{2\pi\varepsilon_0 L}$ (2) $\frac{qQ}{6\pi\varepsilon_0 L}$
(3) $-\frac{qQ}{6\pi\varepsilon_0 L}$ (4) $\frac{qQ}{4\pi\varepsilon_0 L}$

14. A charged particle (charge *q*) is moving in a circle of radius *R* with uniform speed *v*. The associated magnetic moment μ is given by ]
(1) $qvR^2$ (2) $qvR^2/2$
(3) $qvR$ (4) $qvR/2$

15. Two condensers, one of capacity C and the other of capacity C/2, are connected to a V-volt battery, as shown. The work done in charging fully both the condensers is
(1) $\frac{1}{4}CV^2$
(2) $\frac{3}{4}CV^2$
(3) $\frac{1}{2}CV^2$
(4) $\frac{3}{2}CY^2$

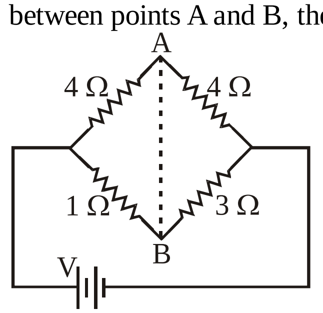



16. The resistance of an ammeter is 13 Ω and its scale is graduated for a current upto 100 Amps. After an additional shunt has been connected to this ammeter it becomes possible to measure currents upto 750 Amperes by this meter. The value of shunt-resistance is
(1) 2 Ω (2) 0.2 Ω
(3) 2 kΩ (4) 20 Ω

17. If the cold junction of a thermocouple is kept at 0°C and the hot junction is kept at T°C, then the relation between neutral temperature ($T_n$) and temperature of inversion ($T_i$) is
(1) $T_n = 2T_i$ (2) $T_n = T_i - T$
(3) $T_n = T_i + T$ (4) $T_n = T_i/2$

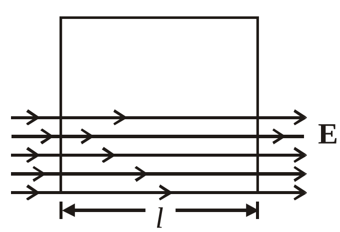
18. Two cells, having the same e.m.f. are connected in series through an external resistance R. Cells have internal resistance $r_1$ and $r_2$ ($r_1 > r_2$) respectively. When the circuit is closed, the potential difference across the first cell is zero. The value of R is
(1) $\frac{r_1 - r_2}{2}$ (2) $r_1 + r_2$
(3) $r_1 - r_2$ (4) $\frac{r_1 + r_2}{2}$

19. In the circuit shown, if a conducting wire is connected between points A and B, the current in this wire will




(1) be zero
(2) flow from B to A
(3) flow from A to B
(4) flow in the direction which will be decided by the value of V

20. A square surface of side L metres is in the plane of the paper. A uniform electric field E (volt/m), also in the plane of the paper, is limited only to the lower half of the square surface, (see figure). The electric flux in SI units associated with the surface is



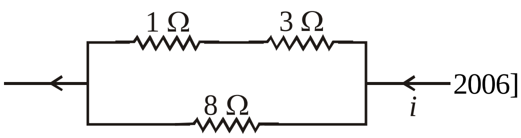

(1) zero (2) $EL^2$
(3) $EL^2/(2\varepsilon_0)$ (4) $EL^2/2$

21. A parallel plate air capacitor is charged to a potential difference of V volts. After disconnecting the charging battery the distance between the plates of the capacitor is increased using an insulating handle. As a result the potential difference between the plates

(1) becomes zero (2) increases
(3) decreases (4) does not change

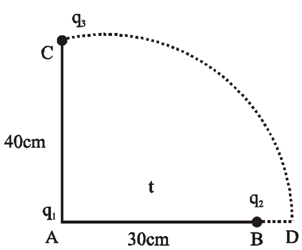
22. Kirchhoff's first and second laws for electrical circuits are consequences of
(1) conservation of electric charge
(2) conservation of energy and electric charge respectively
(3) conservation of energy
(4) conservation of electric charge and energy respectively

23. Power dissipated across the $8\Omega$ resistor in the circuit shown here is 2 watt. The power dissipated in watt units across the $3\Omega$ resistor is




(1) 0.5 (2) 3.0
(3) 2.0 (4) 1.0

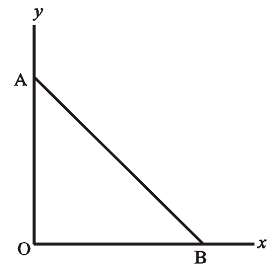
24. Two charges $q_1$ and $q_2$ are placed 30 cm apart, as shown in the figure. A third charge $q_3$ is moved along the arc of a circle of radius 40 cm from $C$ to $D$. The change in the potential energy of the system is $\frac{q_3}{4\pi\varepsilon_0}k$, where $k$ is




(1) $8\ q_2$ (2) $6\ q_2$
(3) $8\ q_1$ (4) $6\ q_1$

25. A 5-ampere fuse wire can withstand a maximum power of 1 watt in the circuit. The resistance of the fuse wire is
(1) 5 ohm (2) 0.04 ohm
(3) 0.2 ohm (4) 0.4 ohm

26. As per diagram a point charge $+q$ is placed at the origin $O$. Work done in taking another point charge $-Q$ from the point $A$ [coordinates $(0, a)$] to another point $B$ [coordinates $(a, 0)$] along the straight path $AB$ is

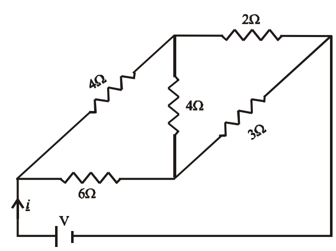



(1) $\left(\frac{-qQ}{4\pi\varepsilon_0}\frac{1}{a^2}\right)\sqrt{2}\,a$ (2) zero

(3) $\left(\frac{qQ}{4\pi\varepsilon_0}\frac{1}{a^2}\right)\frac{a}{\sqrt{2}}$ (4) $\left(\frac{qQ}{4\pi\varepsilon_0}\frac{1}{a^2}\right)\sqrt{2}\,a$

27. When a wire of uniform cross-section $a$, length $l$ and resistance $R$ is bent into a complete circle, resistance between any two of diametrically opposite points will be
(1) $R/2$ (2) $R/4$
(3) $R/8$ (4) $4R$

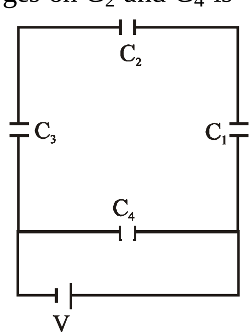
28. For the network shown in the figure the value of the current $i$ is




(1) $\frac{18V}{5}$ (2) $\frac{5V}{9}$

(3) $\frac{9V}{35}$ (4) $\frac{5V}{18}$

29. A network of four capacitors of capacity equal to $C_1 = C$, $C_2 = 2C$, $C_3 = 3C$ and $C_4 = 4C$ are connected to a battery as shown in the figure. The ratio of the charges on $C_2$ and $C_4$ is



(1) $\frac{7}{4}$ (2) $\frac{22}{3}$

(3) $\frac{3}{22}$ (4) $\frac{4}{7}$

30. An electric dipole has the magnitude of its charge as $q$ and its dipole moment is $p$. It is placed in a uniform electric field $E$. If its dipole moment is along the direction of the field, the force on it and its potential energy are respectively [

(1) $q.E$ and maximum

(2) $2q.E$ and minimum

(3) $q.E$ and $p.E$

(4) zero and minimum

31. A battery is charged at a potential of 15 V for 8 hours when the current flowing is 10 A. The battery on discharge supplies a current of 5 A for 15 hours. The mean terminal voltage during discharge is 14 V. The "Watt-hour" efficiency of the battery is

(1) 87.5% (2) 82.5%

(3) 80% (4) 90%

32. The electric resistance of a certain wire of iron is $R$. If its length and radius are both doubled, then

(1) the resistance and the specific resistance will both remain unchanged

(2) the resistance will be doubled and the specific resistance will be halved

(3) the resistance will be halved and the specific resistance will remain unchanged

(4) the resistance will be halved and the specific resistance will be doubled

33. A galvanometer acting as a voltmeter will have

(1) a low resistance in series with its coil

(2) a high resistance in parallel with its coil

(3) a high resistance in series with its coil

(4) a low resistance in parallel with its coil

34. When three identical bulbs of 60 watt, 200 volt rating are connected in series to a 200 volt supply, the power drawn by them will be

(1) 20 watt (2) 60 watt

(3) 180 watt (4) 10 watt

35. Resistances $n$, each of $r$ ohm, when connected in parallel give an equivalent resistance of $R$ ohm. If these resistances were connected in series, the combination would have a resistance in ohms, equal to

(1) $nR$ (2) $n^2R$

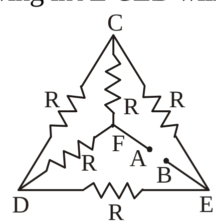
(3) $R/n^2$ (4) $R/n$

36. A bullet of mass 2 g is having a charge of 2 μC. Through what potential difference must it be accelerated, starting from rest, to acquire a speed of 10 m/s ?

(1) 50 V (2) 5 kV

(3) 50 kV (4) 5 V

37. Five equal resistances each of resistance $R$ are connected as shown in the figure. A battery of $V$ volts is connected between $A$ and $B$. The current flowing in $AFCEB$ will be




(1) $\frac{2V}{R}$ (2) $\frac{3V}{R}$

(3) $\frac{V}{R}$ (4) $\frac{V}{2R}$

38. A galvanometer of 50 ohm resistance has 25 divisions. A current of $4 \times 10^{-4}$ ampere gives a deflection of one division. To convert this galvanometer into a voltmeter having a range of 25 volt, it should be connected with a resistance of

(1) 2450 Ω in series

(2) 2500 Ω as a shunt

(3) 245 Ω as a shunt

(4) 2550 Ω in series

39. A 6 volt battery is connected to the terminals of a three metre long wire of uniform thickness and resistance of 100 ohm. The difference of potential between two points on the wire separated by a distance of 50 cm will be

(1) 1.5 volt (2) 2 volt

(3) 3 volt (4) 1 volt

40. Three capacitors each of capacity 4μF are to be connected in such a way that the effective capacitance is 6μF. This can be done by

(1) connecting them in parallel

(2) connecting two in series and one in parallel

(3) connecting two in parallel and one in series

(4) connecting all of them in series

41. The dimension of $\frac{1}{2}\epsilon_0 E^2$, where $\epsilon_0$ is permittivity of free space and E is electric field, is

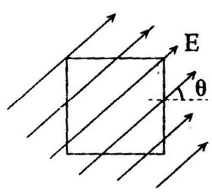
(1) $M L T^{-1}$ (2) $M L^2 T^{-2}$
(3) $M L^{-1} T^{-2}$ (4) $M L^2 T^{-1}$

42. Two positive ions, each carrying a charge *q*, are separated by a distance *d*. If *F* is the force of repulsion between the ions, the number of electrons missing from each ion will be (*e* being the charge on an electron)

(1) $\frac{4\pi\epsilon_0 Fd^2}{q^2}$ (2) $\frac{4\pi\epsilon_0 Fd^2}{e^2}$

(3) $\sqrt{\frac{4\pi\epsilon_0 Fd^2}{d^2}}$ (4) $\sqrt{\frac{4\pi\epsilon_0 Fd^2}{e^2}}$

43. A square surface of side *L* meter in the plane of the paper is placed in a uniform electric field E (volt/m) acting along the same plane at an angle θ with the horizontal side of the square as shown in figure. The electric flux linked to the surface, in units of volt m, is



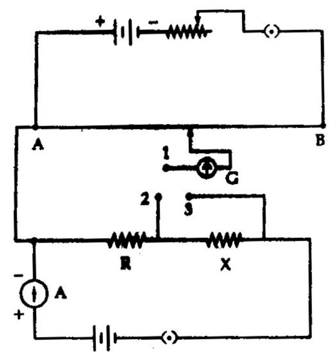

(1) Zero (2) $EL^2$
(3) $EL^2 \cos\theta$ (4) $EL^2 \sin\theta$

44. A series combination of $n_1$ capacitors, each of value $C_1$, is charged by a source of potential difference 4*V*. When another parallel combination of $n_2$ capacitors, each of value $C_2$, is charged by a source of potential difference *V*, it has the same (total) energy stored in it, as the first combination has. The value of $C_2$, in terms of $C_1$ is then

(1) $\frac{16C_1}{n_1n_2}$ (2) $\frac{2C_1}{n_1n_2}$

(3) $16\frac{n_2}{n_1}C_1$ (4) $2\frac{n_2}{n_1}C_1$

45. A potentiometer circuit is set up as shown. The potential gradient, across the potentiometer wire, is *k* volt/cm and the ammeter, present in the circuit, reads 1.0 A when two way key is switched off. The balance points, when the key between the terminals (i) 1 and 2 (ii) 1 and 3, is plugged in, are found to be at lengths $I_1$ cm and $I_2$ cm respectively. The magnitudes, of the resistors *R* and *X*, in ohms, are then, equal, respectively, to




(1) $kl_1$ and $kl_2$ (2) $k(l_2 - l_1)$ and $kl_2$
(3) $kl_1$ and $k(l_2 - l_1)$ (4) $k(l_2 - l_1)$ and $kl_1$

46. A galvanometer has a coil of resistance 100 ohm and gives a full scale deflection for 30 mA current. If it is to work as a voltmeter of 30 volt range, the resistance required to be added will be

]

(1) 1000 Ω (2) 900 Ω
(3) 1800 Ω (4) 500 Ω

47. Consider the following two statements:

(A) Kirchhoff's junction law follows from the conservation of charge.

(B) Kirchhoff's loop law follows from the conservation of energy.

Which of the following is correct?

(1) Both (A) and (B) are correct
(2) Both (A) and (B) are wrong
(3) (A) is correct and (B) is wrong
(4) (A) is wrong and (B) is correct

48. In producing chlorine by electrolysis 100 kW power at 125 V is being consumed. How much chlorine per minute is liberated (E.C.E. of chlorine is $0.367 \times 10^{-6}$ kg/C)

(1) $3.67 \times 10^{-3}$ kg (2) $1.76 \times 10^{-3}$ kg
(3) $9.67 \times 10^{-3}$ kg (4) $17.61 \times 10^{-3}$ kg

49. A charge Q is enclosed by a Gaussian spherical

surface of radius R. If the radius is doubled, then the outward electric flux will

(1) increase four times (2) be reduced to half
(3) remain the same (4) be doubled

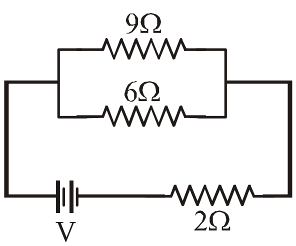
50. A parallel plate condenser has a uniform electric field E(V/m) in the space between the plates. If the distance between the plates is *d*(m) and area of each plate is A($m^2$), the energy (joules) stored in the condenser is

(1) $E^2 Ad / \epsilon_o$ (2) $\frac{1}{2} \epsilon_o E^2$
(3) $\epsilon_o EAd$ (4) $\frac{1}{2} \epsilon_o E^2 Ad$

51. A current of 2 A flows through a 2Ω resistor when connected across a battery. The same battery supplies a current of 0.5 A when connected across a 9Ω resistor. The internal resistance of the battery is

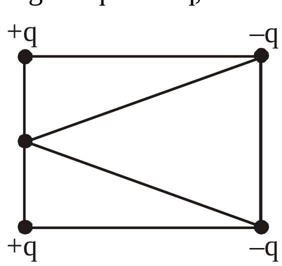
(1) 0.5 Ω (2) 1/3 Ω
(3) 1/4 Ω (4) 1 Ω

52. If power dissipated in the 9Ω resistor in the circuit shown is 36 watt, the potential difference across the 2Ω resistor is




(1) 4 volt (2) 8 volt
(3) 10 volt (4) 2 volt

53. Four electric charges +q, +q, –q and –q are placed at the corners of a square of side 2L (see figure). The electric potential at point A, midway between the two charges +q and +q, is




(1) $\frac{1}{4\pi \epsilon_o} \frac{2q}{L}(1+\sqrt{5})$ (2) $\frac{1}{4\pi \epsilon_o} \frac{2q}{L}(1+\frac{1}{\sqrt{5}})$
(3) $\frac{1}{4\pi \epsilon_o} \frac{2q}{L}(1-\frac{1}{\sqrt{5}})$ (4) zero

54. The rate of increase of thermo-e.m.f. with temperature at the neutral temperature of a thermocouple

(1) is positive
(2) is zero
(3) depends upon the choice of the two materials of the thermocouple
(4) is negative

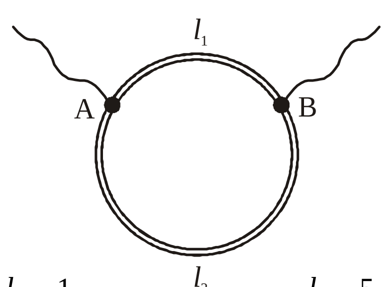
55. An electric dipole of moment '*p*' is placed in an electric field of intensity 'E'. The dipole acquires a position such that the axis of the dipole makes an angle θ with the direction of the field. Assuming that the potential energy of the dipole to be zero when θ = 90°, the torque and the potential energy of the dipole will respectively be

(1) pE cosθ, – pE sinθ (2) pE sinθ, – pE cosθ
(3) pE sinθ, – 2pE cosθ (4) pEsinθ, 2pEcosθ

56. Four point charges –*Q*, –*q*, 2*q* and 2*Q* are placed, one at each corner of the square. The relation between Q and *q* for which the potential at the centre of the square is zero is

(1) $Q = \frac{1}{q}$ (2) $Q = -q$
(3) $Q = -\frac{1}{q}$ (4) $Q = q$

57. A ring is made of a wire having a resistance $R_0$ = 12 Ω. Find the points A and B, as shown in the figure, at which a current carrying conductor should be connected so that the resistance R of the sub circuit between these points is equal to $\frac{8}{3}\Omega$



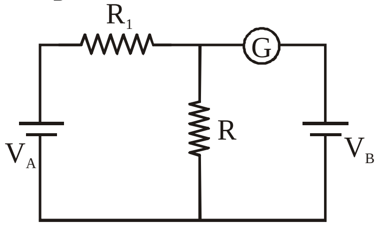

(1) $\frac{l_1}{l_2} = \frac{1}{2}$ (2) $\frac{l_1}{l_2} = \frac{5}{8}$
(3) $\frac{l_1}{l_2} = \frac{1}{3}$ (4) $\frac{l_1}{l_2} = \frac{3}{8}$

58. What is the flux through a cube of side '*a*' if a point charge of $q$ is at one of its corner?    ]

(1) $\frac{q}{2\epsilon_0}6a^2$  (2) $\frac{2q}{\epsilon_0}$

(3) $\frac{q}{8\epsilon_0}$  (4) $\frac{q}{\epsilon_0}$

59. In the circuit shown the cells A and B have negligible resistances. For $V_A = 12V$, $R_1 = 500\ \Omega$ and $R = 100\ \Omega$ the galvanometer (G) shows no deflection. The value of $V_B$ is




(1) 6 V  (2) 4 V
(3) 2 V  (4) 12 V

60. If voltage across a bulb rated 220 Volt-100 Watt drops by 2.5% of its rated value, the percentage of the rated value by which the power would decrease is

(1) 10%  (2) 20%
(3) 2.5%  (4) 5%

61. A milli voltmeter of 25 milli volt range is to be converted into an ammeter of 25 ampere range. The value (in ohm) of necessary shunt will be

(1) 0.05  (2) 0.001
(3) 0.01  (4) 1

## CBSE MAINS

1. Two parallel metal plates having charges +Q and –Q face each other at a certain distance between them. If the plates are now dipped in kerosene oil tank, the electric field between the plates will

(1) becomes zero  (2) increase
(3) decrease  (4) remain same

2. The electric field at a distance $\frac{3R}{2}$ from the centre of a charged conducting spherical shell of radius R is E. The electric field at a distance $\frac{R}{2}$ from the centre of the sphere is

(1) zero  (2) E

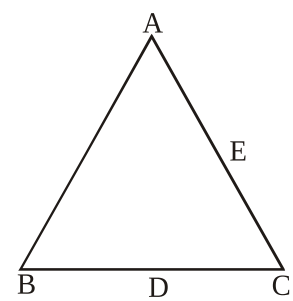
(3) $\frac{E}{2}$  (4) $\frac{E}{3}$

3. A condenser of capacity C is charged to a potential difference of $V_1$. The plates of the condenser are then connected to an ideal inductor of inductance L. The current through the inductor when the potential difference across the condenser reduces to $V_2$ is

(1) $\left(\frac{C(V_1 - V_2)^2}{L}\right)^{1/2}$  (2) $\frac{C(V_1^2 - V_2^2)}{L}$

(3) $\frac{C(V_1^2 + V_2^2)}{L}$  (4) $\left(\frac{C(V_1^2 - V_2^2)}{L}\right)^{1/2}$

4. Three charges, each +q, are placed at the corners of an isosceles triangle ABC of sides BC and AC, 2a. D and E are the mid points of BC and CA. The work done in taking a charge Q from D to E is



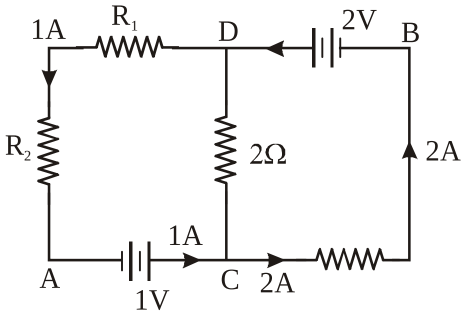

(1) $\frac{3qQ}{4\pi\varepsilon_o a}$  (2) $\frac{3qQ}{8\pi\varepsilon_o a}$

(3) $\frac{qQ}{4\pi\varepsilon_o a}$  (4) zero

5. The electric potential V at any point (x, y, z) all in meters in space is given by $V = 4x^2$ volt. The electric field at the point (1, 0, 2) in volt/meter, is

(1) 8 along negative X-axis
(2) 8 along positive X-axis
(3) 16 along negative X-axis
(4) 16 along positive X-axis

6. In the circuit shown in the figure, if the potential at point A is taken to be zero, the potential at point B is




(1) + 1V (2) – 1V

(3) + 2V (4) – 2V

7. Two metallic spheres of radii 1 cm and 3 cm are given charges of $-1 \times 10^{-2}$ C and $5 \times 10^{-2}$ C, respectively. If these are connected by a conducting wire, the final charge on the bigger sphere is

(1) $1 \times 10^{-2}$ C (2) $2 \times 10^{-2}$ C

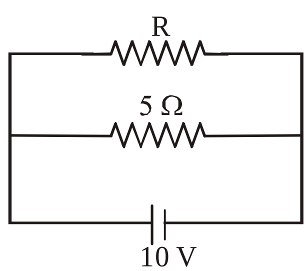
(3) $3 \times 10^{-2}$ C (4) $4 \times 10^{-2}$ C

8. A parallel plate capacitor has a uniform electric field E in the space between the plates. If the distance between the plates is *d* and area of each plate is A, the energy stored in the capacitor is

(1) $\varepsilon_o EAd$ (2) $\frac{1}{2}\varepsilon_o E^2$

(3) $E^2 Ad/\varepsilon_o$ (4) $\frac{1}{2}\varepsilon_o E^2 Ad$

9. The power dissipated in the circuit shown in the figure is 30 Watts. The value of R is

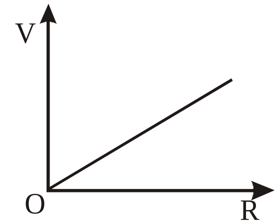



(1) 30 Ω (2) 20 Ω

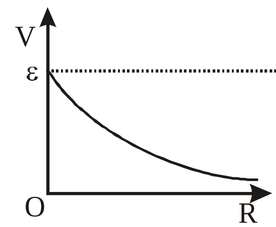
(3) 15 Ω (4) 10 Ω

10. A cell having an emf ε and internal resistance *r* is connected across a variable external resistance R. As the resistance R is increased, the plot of potential difference V across R is given by

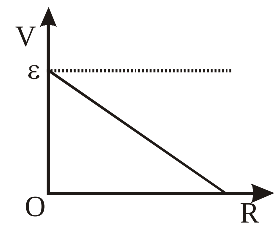
(1)



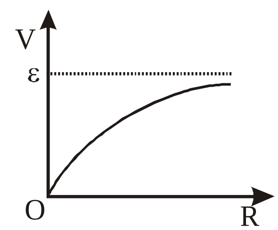

(2)




(3)




(4)




## NEET

1. The internal resistance of a 2.1 V cell which gives a current of 0.2 A through a resistance of 10 Ω is

(1) 0.8 Ω (2) 1.0 Ω

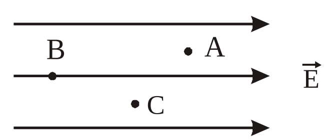
(3) 0.2 Ω (4) 0.5 Ω

2. A wire of resistance 4Ω is stretched to twice its original length. The resistance of stretched wire would be

(1) 0.8 Ω (2) 16 Ω

(3) 2 Ω (4) 4 Ω

3. A, B and C are three points in a uniform electric field. The electric potential is



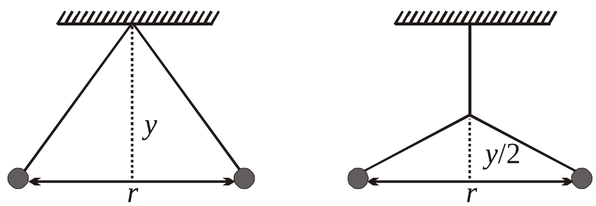

(1) maximum at C

(2) same at all the three points A, B and C

(3) maximum at A

(4) maximum at B

4. Two pith balls carrying equal charges are suspended from a common points by strings of equal length, the equilibrium separation between them is r. Now the strings are rigidly clamped at half the height. The equilirbium separation between the balls now become

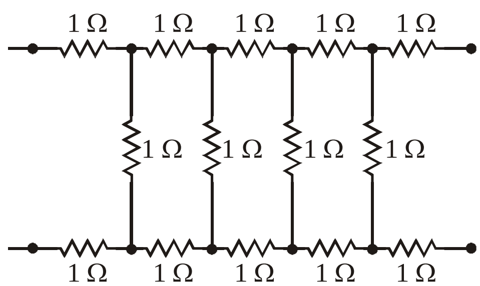



(1) $\left(\frac{2r}{\sqrt{3}}\right)$ (2) $\left(\frac{2r}{3}\right)$

(3) $\left(\frac{1}{\sqrt{2}}\right)^2$ (4) $\left(\frac{r}{\sqrt[3]{2}}\right)$

## DPMT

1. The current (in amperes) drawn from a 12 V supply by the infinite network shown in the following figure is




(1) 2.7 (2) 3.3
(3) 4.4 (4) 5.2

2. Top of the stratosphere has an electric field E (in units of V/m) nearly equal to

(1) 0 (2) 10

(3) 100 (4) 1000

3. The surface charge density (in C/m$^2$) of the earth is about

(1) $10^{-9}$ (2) $-10^{9}$

(3) $10^{9}$ (4) $-10^{-9}$

4. Gauss's law is valid for

(1) any closed surface

(2) only regular closed surfaces

(3) any open surfaces

(4) only irregular open surfaces

5. One of the following is *not* a property of field lines

(1) field lines are continuous curves without any breaks

(2) two field lines cannot cross each other

(3) field lines start at positive charges and end at negative charges

(4) they form closed loops

6. Nichrome or Manganin is widely used in wire bound standard resistors because of their

(1) temperature independent resistivity

(2) very weakly temperature dependent resistivity

(3) strong dependence of resistivity with temperature

(4) mechanical strength

7. A water molecule has an electric dipole moment $6.4 \times 10^{-30}$ C.m when it is in vapor state. The distance in meter between the centre of positive and negative charge of the molecule is

(1) $4 \times 10^{-10}$ (2) $4 \times 10^{-11}$

(3) $4 \times 10^{-12}$ (4) $4 \times 10^{-13}$

8. What is $\frac{e}{m}$ ratio of electron ?

(1) $2.76 \times 10^{10}$ (2) $2.76 \times 10^{10}$

(3) $1.76 \times 10^{10}$ (4) $1.76 \times 10^{11}$

9. What is charge on 90 kg of electrons.

(1) $1.58 \times 10^{13}$ (2) $2.3 \times 10^{12}$

(3) $2.53 \times 10^{12}$ (4) none of these

10. If charge and distance between them is reduced to half. Force between them

(1) remains same

(2) increases four times

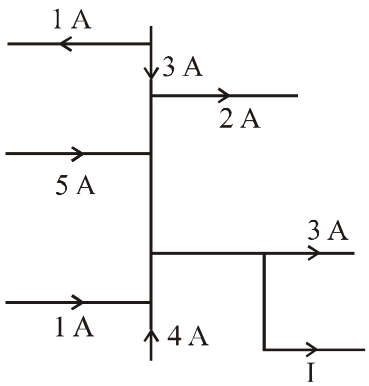
(3) reduce four times

(4) none of these

11. An electron and proton are placed at distance 4.3 nm. What is dipole moment ? (C-M)

(1) $3.44 \times 10^{-28}$ (2) $2 \times 10^{-28}$

(3) $6.85 \times 10^{-28}$ (4) none of these

12. 


What is current $I$.

(1) 6 A (2) 5 A

(3) 7 A (4) 8 A

13. If the colour code of carbon resistor is as follows, then give the value of its resistance in KΩ.

Colour of I strip – yellow

Colour of II strip – blue

Colour of III strip – orange

Colour of IV strip – gold

(1) (46 ± 5%) (2) 0.46 ± 5%

(3) 46 ± 10% (4) 0.46 ± 10%

14. In the potentiometer experiment the are 10 lines in the potentiometer. In first situation null point is at 7$^{th}$ line. If we want to obtain the null point in the 9$^{th}$ line then it can be done by

(1) increasing resistance R in series with the battery whose e.m.f. is to be measured

(2) decreasing resistance R in series with the battery whose e.m.f. is to be measured

(3) increasing resistance R in main circuit

(4) decreasing resistance R in main circuit

15. Cu and Al wire each of length $l$ = 20 cm and Area of cross section A = 50 mm$^2$. Their resistivity $\rho_{Cu}$ = 1.69 × $10^{-8}$Ωm and $\rho_{Al}$ = 2.75 × $10^{-8}$ Ωm. If they are joined end to end then total resistance of combination is ]

(1) 0.01 × $10^{-2}$ (2) 4.44

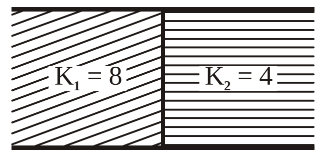
(3) 0.888 (4) 1 × $10^{-2}$

16. If the resistance of the wire is made four times keeping potential difference across it constant then the number of times heat produced in it varies by

(1) 4 (2) 1/4

(3) 2 (4) 1/2

17. A capacitor having capacitor 1 μF with air is filled with two dielectric as shown. How many times capacitance will increase




(1) 12 (2) 6

(3) 8/3 (4) 3

18. 27 small drops each having charge $q$ and radius $r$ form by drop. How many times charge and capacitance will become

(1) 3, 27 (2) 27, 3

(3) 27, 27 (4) 3, 3

19. What is not true for equipotential surface for uniform electric field

(1) equipotential surface is flat

(2) equipotential surface is spherical

(3) electric lines are perpendicular to equipotential surface

(4) work done is zero

20. Two copper wires of length $l$ and 2$l$ have radii $r$ and 2$r$ respectively. What is ratio of their specific resistances

(1) 1 : 2 (2) 2 : 1

(3) 1 : 1 (4) 1 : 3

21. Across each of two capacitors of capacitances 1 μF and 4μF, a potential difference of 10V is applied. Then positive plate of one is connected to the negative plate of the other; and negative plate of one is connected to the positive plate of the other. After contact,

(1) charge on each is zero

(2) charge on each is same but non-zero

(3) charge on each is different but non-zero

(4) none of these

22. Kirchoff law of junction, $\Sigma I = 0$, is based on

(1) conservation of energy

(2) conservation of charge

(3) conservation of energy as well as charge

(4) conservation of momentum

23. Charges 4$Q$, $q$ and $Q$ are placed along $x$-axis at positions $x$ = 0, $x$ = $l$/2 and $x$ = $l$, respectively. Find the value of $q$ so that force on charge $Q$ is zero.

(1) $Q$ (2) $Q$/2

(3) –$Q$/2 (4) –$Q$

24. Two small charged spheres *A* and *B* have charges $10\mu C$ and $40\mu C$, respectively, and are held at a separation of 90 cm from each other. At what distance from *A*, electric intensity would be zero?

(1) 22.5 cm (2) 18 cm
(3) 36 cm (4) 30 cm

25. Graph between velocity and displacement of a particle, executing SHM, is
(1) a straight line (2) a parabola
(3) a hyperbola (4) an elipse

26. If percentage change in current through a resistor is 1%, then the change in power through it would be

(1) 1% (2) 2%
(3) 1.7% (4) 0.5%

27. 3 identical bulbs are connected in series and these together dissipate a power *P*. If now the bulbs are connected in parallel, then the power dissipated will be
(1) *P*/3 (2) 3*P*
(3) 9*P* (4) *P*/9

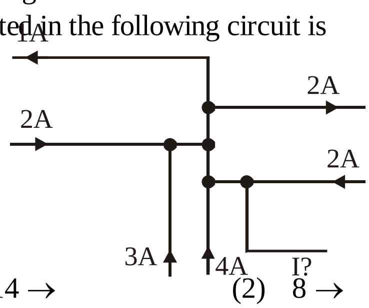
28. Six identical cells, each of emf *V* are connected in parallel. The net emf across the battery is

(1) 6 V
(2) 36 V
(3) 0
(4) between 6 V and 36 V

29. A ball with charge –50 *e* is placed at the centre of a hollow spherical shell which has a net charge of –50 *e*. What is the charge on the shell's outer surface? ]
(1) –50 *e* (2) zero
(3) –100 *e* (4) + 100 *e*

30. If the charge on a capacitor is doubled, the value of its capacitance C will be
(1) doubled (2) halved
(3) remain the same (4) none of these

31. The magnitude and direction of current I (in A) indicated in the following circuit is




(1) 14 → (2) 8 →
(3) ← 4 (4) ← 8

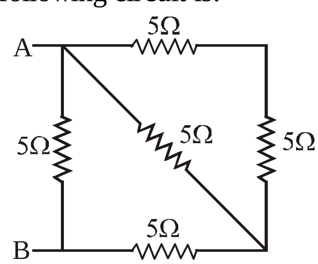
32. An electric motor operating on 15 V supply draws a current of 5 A and yield mechanical power of 60 W. The energy lost as heat in one hour (in kJ) is
(1) 0.54 (2) 5.4
(3) 54 (4) 540

33. The electric dipole moment of an electron and a proton 4.3 nm apart is
(1) $6.88 \times 10^{-28}$ cm (2) $2.56 \times 10^{-29}$ c²/m
(3) $3.72 \times 10^{-14}$ c/m (4) $1.1 \times 10^{-46}$ c²/m

34. A parallel plate capacitor of a capacitance of 1 farad would have the plate area of about

(1) 100 m² (2) 1 km²
(3) 100 km² (4) 1000 km²

35. The equivalent resistance between the points A and B is the following circuit is:




(1) 3.12 Ω (2) 1.56 Ω
(3) 6.24 Ω (4) 12.48 Ω

36. A galvanometer coil has a resistance of 10 Ω and the meter shows full scale deflection for a current of 1 mA. The shunt resistance required to convert the galvanometer into an ammeter of range 0 – 100 mA is about
(1) 10 Ω (2) 1 Ω
(3) 0.1 Ω (4) 0.01 Ω

37. A thermo-emf V appears across a conductor maintained at a temperature difference T. The Thomson coefficient is then given by

(1) $-T^2\dfrac{d^2V}{dT^2}$ (2) $T^2\dfrac{dV}{dT}$
(3) $-\dfrac{1}{T}\dfrac{d^2V}{dT^2}$ (4) $-\dfrac{1}{T^2}\dfrac{dV}{dT}$

38. How much current should be passed through a silver voltameter to deposit 200 gm of silver per hour on the cathode? (Faraday constant = 96500 C/mol and relative atomic mass of silver is 108)

(1) 50 mA (2) 50 A

(3) 15 mA (4) 15 A

39. If $10^{10}$ electrons are acquired by a body every second, the time required for the body to get a total charge of 1 C will be
(1) two hours (2) two days
(3) two years (4) 20 years

40. Domestic electrical wiring has three wires

(1) positive, negative and neutral
(2) positive, negative and earth
(3) live, neutral and earth
(4) positive, negative and live

41. Which of the following is not true?
(1) For a point charge, the electrostatic potential varies as $1/r$
(2) For a dipole, the potential depends on the position vector and dipole moment vector
(3) The electric dipole potential varies as $1/r$ at large distance
(4) For a point charge, the electrostatic field varies as $1/r^2$

42. The mobility of charge carriers increases with

(1) increase in the average collision time
(2) increase in the electric field
(3) increase in the mass of the charge carriers
(4) decrease in the charge of the mobile carriers

43. A charged cloud system produces an electric field in the air near the earth's surface. A particle of charge $-2 \times 10^{-9}$ C is acted on by a downward electrostatic force of $3 \times 10^{-6}$ N when placed in this field. The gravitational and electrostatic force, respectively, exerted on a proton placed in this field

(1) $1.64 \times 10^{-26}$ N, $2.4 \times 10^{-16}$ N
(2) $1.64 \times 10^{-26}$ N, $1.5 \times 10^{3}$ N
(3) $1.56 \times 10^{-18}$ N, $2.4 \times 10^{-16}$ N
(4) $1.5 \times 10^{3}$ N, $2.4 \times 10^{-16}$ N

44. The frequency of oscillation of an electric dipole moment having dipole moment p and rotational inertia I, oscillating in a uniform electric field E is given by
(1) $(1/2\pi)\sqrt{I/pE}$ (2) $(1/2\pi)\sqrt{pE/I}$
(3) $(2\pi)\sqrt{pE/I}$ (4) $(2\pi)\sqrt{I/pE}$

45. What is the net charge on a conducting sphere of radius 10 cm? Given that the electric field 15 cm from the center of the sphere is equal to $3 \times 10^{3}$ N/C and is directed inward
(1) $-7.5 \times 10^{-5}$ C (2) $-7.5 \times 10^{-9}$ C
(3) $7.5 \times 10^{-5}$ C (4) $7.5 \times 10^{-9}$ C

46. How many 1 μF capacitors must be connected in parallel to store a charge of 1 C with a potential of 110 V across the capacitors?]
(1) 990 (2) 900
(3) 9090 (4) 909

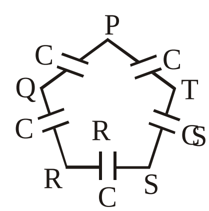
47. A 1250 W heater operates at 115 V. What is the resistance of the heating coil?
(1) 1.6 Ω (2) 13.5 Ω
(3) 1250 Ω (4) 10.6 Ω

## AIIMS

1. Two parallel large thin metal sheets have equal surface charge densities ($\sigma = 26.4 \times 10^{-12}$ C/m$^2$) of opposite signs. The electric field between these sheets is
(1) 1.5 N/C (2) $1.5 \times 10^{-10}$ N/C
(3) 3 N/C (4) $3 \times 10^{-10}$ N/C

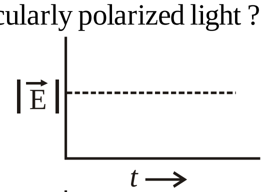
2. The voltage of clouds is $4 \times 10^{6}$ volt with respect to ground. In a lightening strike lasting 100 m sec, a charge of 4 coulombs is delivered to the ground. The power of lightening strike is
(1) 160 MW (2) 80 MW
(3) 20 MW (4) 500 KW

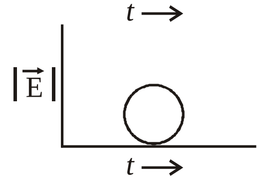
3. Five capacitors, each of capacitance value $C$ are connected as shown in the figure. The ratio of capacitance between $P$ and $R$, and the capacitance between $P$ and $Q$ , is ]

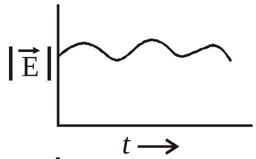


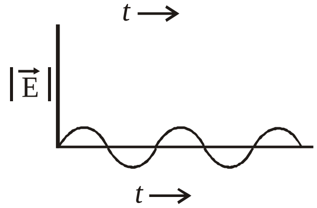

(1) 3 : 1 (2) 5 : 2
(3) 2 : 3 (4) 1 : 1

4. Which of the following diagrams represent the variation of electric field vector with time for a circularly polarized light ?

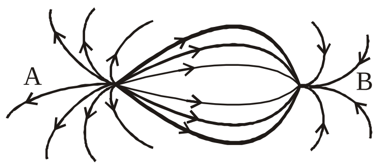
(1)



(2)


(3) 


(4) 


5. The spatial distribution of the electric field due to charges ($A$, $B$) is shown in figure. Which one of the following statements is correct.]



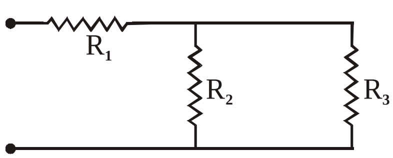

(1) $A$ is +ve and $B$ –ve and $|A| > |B|$
(2) $A$ is –ve and $B$ +ve; $|A| = |B|$
(3) Both are +ve but $A > B$
(4) Both are –ve but $A > B$

6. Two infinitely long parallel conducting plates having surface charge densities $+\sigma$ and $-\sigma$ respectively, are separated by a small distance. The medium between the plates is vacuum. If $\varepsilon_0$ is the dielectric permittivity of vacuum, then the electric field in the region between the plates is

(1) 0 volts/meter (2) $\frac{\sigma}{2\varepsilon_0}$ volts/meter

(3) $\frac{\sigma}{\varepsilon_0}$ volts/meter (4) $\frac{2\sigma}{\varepsilon_0}$ volts/meter

7. For ensuring dissipating of same energy in all three resistors ($R_1$, $R_2$, $R_3$) connected as shown in figure, their values must be related as

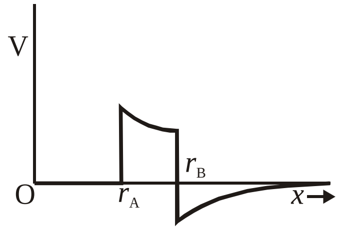


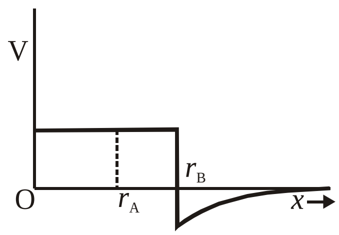
]

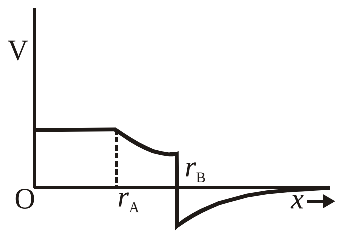
(1) $R_1 = R_2 = R_3$
(2) $R_2 = R_3$ and $R_1 = 4R_2$
(3) $R_2 = R_3$ and $R_1 = \frac{1}{4} R_2$
(4) $R_1 = R_2 + R_3$

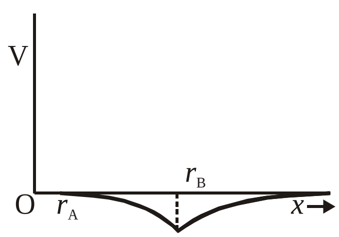
8. Dimension of electrical resistance is
(1) $ML^2T^3A^{-1}$ (2) $ML^2T^{-3}A^{-2}$
(3) $ML^3T^{-3}A^{-2}$ (4) $ML^{-1}L^3T^3A^2$

9. Two concentric conducting thin spherical shells A and B having radii $r_A$ and $r_B$ ($r_B > r_A$) are charged to $Q_A$ and $-Q_B$ ($|Q_B| > |Q_A|$). The electrical field along a line, (passing through the centre) is [

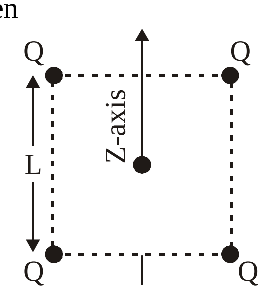
(1) 


(2) 


(3) 


(4) 


10. Four point +ve charges of same magnitude (Q) are placed at four corners of a rigid square frame as shown in figure. The plane of the frame is perpendicular to Z axis. If a –ve point charge is placed at a distance $z$ away from the above frame ($z << L$) then



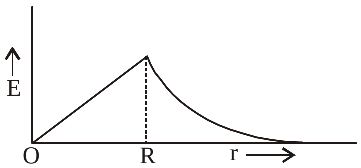
[

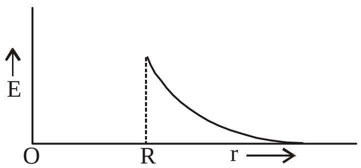
(1) –ve charge oscillates along the Z-axis
(2) It moves away from the frame

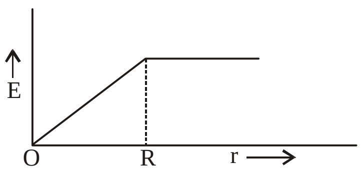
(3) It moves slowly towards the frame and stays in the plane of the frame

(4) It passes through the frame only once

11. The electric field due to a uniformly charged sphere of radius $R$ as a function of the distance from its center is represented graphically by

(2) 


(3) 


(4) 


12. Equipotential surfaces associated with an electric field which is increasing in magnitude along the $x$-direction are

(1) planes parallel to $yz$-plane

(2) planes parallel to $xy$-plane

(3) planes parallel to $xz$-plane

(4) coaxial cylinders of increasing radii around the $x$-axis

13. A circular coil of radius $R$ carries an electric current. The magnetic field due to the coil at a point on the axis of the coil located at a distance $r$ from the centre of the coil , such that $r >> R$ varies as

(1) $1/r$ (2) $1/r^{3/2}$

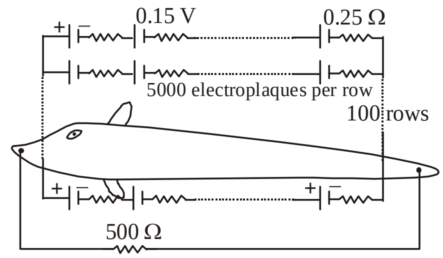
(3) $1/r^2$ (4) $1/r^3$

14. A 40 μF capacitor in a defibrillator is charged to 3000 V. The energy stored in the capacitor is sent through the patient during a pulse of duration 2 ms. The power delivered to the patient is

(1) 45 kW (2) 90 kW

(3) 180 kW (4) 360 kW

15. Eels are able to generate current with biological cells called electroplaques. The electroplaques in an eel are arranged in 100 rows, each row stretching horizontally along the body of the fish containing 5000 electroplaques. The arrangement is suggestively shown below. Each electroplaques has an emf of 0.15 V and internal resistance of 0.25 Ω.

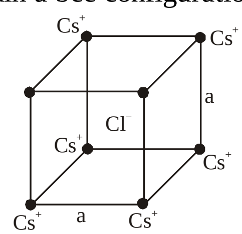



The water surrounding the eel completes a circuit between the head and its tail. If the water surrounding it has a resistance of 500 Ω, the current an eel can produce in water is

(1) 1.5 A (2) 3.0 A

(3) .15 A (4) 30 A

16. In the basic Cs Cl crystal structure, $Cs^+$ and $Cl^-$ ions are arrange din a bcc configuration as shown below




The net electrostatic force exerted by the eight $Cs^+$ ions on the $Cl^-$ ion is

(1) $\frac{1}{4\pi\epsilon_0}\frac{4e^2}{3a^2}$ (2) $\frac{1}{4\pi\epsilon_0}\frac{16e^2}{3a^2}$

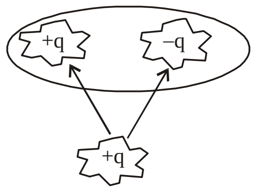
(3) $\frac{1}{4\pi\epsilon_0}\frac{32e^2}{3a^2}$ (4) zero

17. A capacitor of capacitance 2μF is connected in the tank circuit of an oscillator oscillating with frequency of 1 kHz. If the current flowing in the circuit is 2 mA, the voltage across the capacitor will be

(1) 0.16 V (2) 0.32 V

(3) 79.5 V (4) 159 V

18. Shown below is a distribution of charges. The flux of electric field due to these charges through the surface is




(1) $3q/\in_0$ (2) $2q/\in_0$

(3) $q/\in_0$ (4) zero

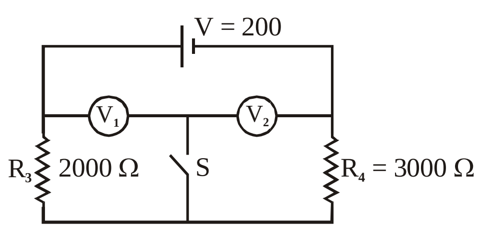
## Science Olympiad

1. A 12 volt battery has an internal resistance of 0.5 Ω. The resistance should be connected to the battery which makes terminal voltage of cell 11.0 volt is

(1) 3.5 Ω (2) 5.5 Ω

(3) 5 Ω (4) 0.5 Ω

2. Voltmeters $V_1$ and $V_2$ having resistances 3000 Ω and 2000 Ω respectively are connected in circuit as shown in the figure. Reddings of $V_1$ & $V_2$, when switch S is closed




(1) 80 V, 120 V (2) 120 V, 80 V

(3) 70 V, 130 V (4) 100 V, 100 V

3. Two uniformly charged spherical shells each of radius 1 m and charge 2 μC are brought together. What is total electric energy of the system when distances between their centers is 5 m.. Assume charge distribution is undisturbed. ] (1) 22.5 mJ (2) 33.5 mJ

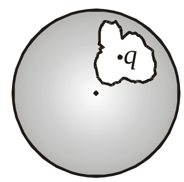
(3) 43.2 mJ (4) 48.9 mJ

4. A point B is 10 m away in North east direction from point A. A particle having charge 3 μC and mass 2 mg is projected from point A in east direction, with velocity V, what is the maximum value of V so that particle reaches point B. Magnetic field 4 T is directed along AB.

(1) 13.5 m/sec (2) 15 m/sec

(3) 10 m/sec (4) 11.74 m/sec.

5. A perfectly conducting sphere with a cavity inside, carries a charge $q$ inside the cavity. The sphere is placed in uniform electric field.




(1) Both the charge and sphere will experience force of equal magnitude but opposite direction
(2) Net force on the charge will be zero and net force on the sphere will be non zero.
(3) Both the sphere and charge will experience same force
(4) none of them will experience any force

6. A charge at rest can be set in motion by ]

(1) static magnetic field
(2) time varying magnetic field
(3) non uniform magnetic field
(4) by electric-field only

# ANSWERS :
## QUESTIONS FROM COMPETITIVE EXAMS

### CBSE - PMT

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | (4) | 2. | (2) | 3. | (2) | 4. | (2) | 5. | (2) |
| 6. | (3) | 7. | (1) | 8. | (4) | 9. | (2) | 10. | (1) |
| 11. | (3) | 12. | (3) | 13. | (3) | 14. | (4) | 15. | (4) |
| 16. | (1) | 17. | (4) | 18. | (3) | 19. | (2) | 20. | (1) |
| 21. | (2) | 22. | (4) | 23. | (2) | 24. | (1) | 25. | (2) |
| 26. | (2) | 27. | (2) | 28. | (4) | 29. | (3) | 30. | (4) |
| 31. | (1) | 32. | (3) | 33. | (3) | 34. | (1) | 35. | (2) |
| 36. | (3) | 37. | (4) | 38. | (1) | 39. | (4) | 40. | (2) |
| 41. | (3) | 42. | (4) | 43. | (4) | 44. | (1) | 45. | (3) |
| 46. | (2) | 47. | (1) | 48. | (4) | 49. | (3) | 50. | (4) |
| 51. | (2) | 52. | (3) | 53. | (3) | 54. | (2) | 55. | (2) |
| 56. | (2) | 57. | (1) | 58. | (3) | 59. | (3) | 60. | (4) |
| 61. | (2) | | | | | | | | |

### CBSE MAINS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | (3) | 2. | (1) | 3. | (4) | 4. | (4) | 5. | (1) |
| 6. | (1) | 7. | (3) | 8. | (4) | 9. | (4) | 10. | (4) |

### NEE

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | (4) | 2. | (2) | 3. | (4) | 4. | (4) |

### DPMT

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | (1) | 2. | (2) | 3. | (4) | 4. | (1) | 5. | (1, 4) |
| 6. | (2) | 7. | (2) | 8. | (4) | 9. | (1) | 10. | (1) |
| 11. | (3) | 12. | (4) | 13. | (1) | 14. | (3) | 15. | (1) |
| 16. | (2) | 17. | (2) | 18. | (2) | 19. | (2) | 20. | (3) |
| 21. | (3) | 22. | (2) | 23. | (4) | 24. | (4) | 25. | (4) |
| 26. | (2) | 27. | (3) | 28. | (2) | 29. | (3) | 30. | (3) |
| 31. | (2) | 32. | (3) | 33. | (1) | 34. | (4) | 35. | (1) |
| 36. | (3) | 37. | (1) | 38. | (1) | 39. | (4) | 40. | (3) |
| 41. | (3) | 42. | (1) | 43. | (1) | 44. | (2) | 45. | (2) |
| 46. | (3) | 47. | (4) | | | | | | |

### AIIMS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | (3) | 2. | (1) | 3. | (3) | 4. | (1) | 5. | (1) |
| 6. | (3) | 7. | (3) | 8. | (2) | 9. | (1) | 10. | (1) |
| 11. | (2) | 12. | (1) | 13. | (4) | 14. | (2) | 15. | (1) |
| 16. | (4) | 17. | (1) | 18. | (4) | | | | |

### SCIENCE LYMPIAD

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | (2) | 2. | (4) | 3. | (3) | 4. | (1) | 5. | (2) |
| 6. | (2) | | | | | | | | |