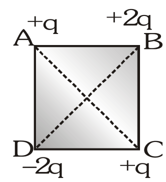
ELECTROSTATICS LEVEL 1

SELECT THE CORRECT ALTERNATIVE (ONLY ONE CORRECT ANSWER)

1. Using mass (M), length (L), time (T) and current (A) as fundamental quantities, the dimension of permittivity is :
(A) $ML^{-2}T^2A$ (B) $M^{-1}L^{-3}T^4A^2$ (C) $MLT^{-2}A$ (D) $ML^2T^{-1}A^2$

2. Two point charges + 9e and +e are kept 16 cm. apart from each other. Where should a third charge q be placed between them so that the system is in equilibrium state :
(A) 24 cm from + 9e (B) 12 cm from +9e (C) 24 cm from + e (D) 12 cm from + e

3. Four charges are arranged at the corners of a square ABCD as shown in the figure. The force on the charge kept at the centre O will be :

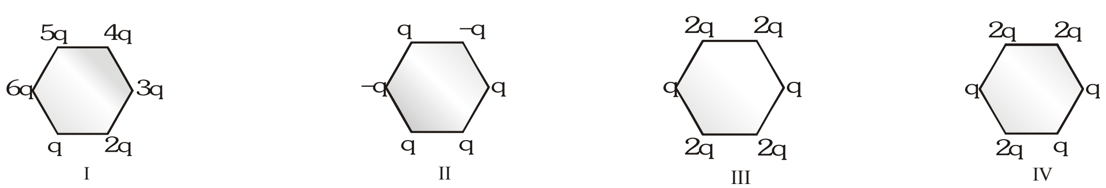


(A) perpendicular to side AB (B) along the diagonal BD
(C) along the diagonal AC (D) zero

4. When charge is given to a soap bubble, it shows :
(A) an increase in size (B) sometimes an increase and sometimes a decrease in size
(C) no change in size (D) none of these

5. Two equal negative charges –q are fixed at point (0, –a) and (0, a) on y–axis. A positive charge Q is released from rest at the point (2a, 0) on the x–axis. The charge Q will :
(A) execute simple harmonic motion about the origin
(B) move to the origin and remain at rest
(C) move to infinity
(D) execute oscillatory but not simple harmonic motion

6. Figures below show regular hexagon, the charges are placed at the vertices. In which of the following cases the electric field at the centre is zero.

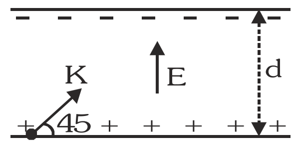


(A) IV (B) III (C) I (D) II

7. Two infinite linear charges are placed parallel to each other at a distance 0.1 m from each other. If the linear charge density on each is 5 μC/m, then the force acting on a unit length of each linear charge will be :
(A) 2.5 N/m (B) 3.25 N/m (C) 4.5 N/m (D) 7.5 N/m

8. An electron of mass m_e, initially at rest, moves through a certain distance in a uniform electric field in time t_1. A proton of mass m_p, also, initially at rest, takes time t_2 to move through an equal distance in this uniform electric field. Neglecting the effect of gravity, the ratio t_2/t_1 is nearly equal to :
(A) 1 (B) $(m_p/m_e)^{1/2}$ (C) $(m_e/m_p)^{1/2}$ (D) 1836

9. An electron is projected as in figure with kinetic energy K, at an angle θ = 45 between two charged plates. The magnitude of the electric field so that the electron just fails to strike the upper plate, should be greater than:

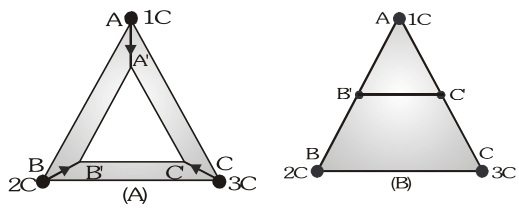


(A) $\frac{K}{qd}$ (B) $\frac{2K}{qd}$ (C) $\frac{K}{2qd}$ (D) Infinite

10. A point charge 50 μC is located in the XY plane at the point of position vector $\vec{r}_0 = (2\hat{i} + 3\hat{j})$ meter. What is the electric field at the point of position vector $\vec{r} = (8\hat{i} - 5\hat{j})$ meter:

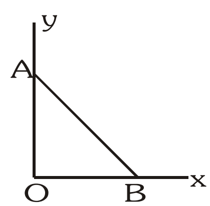
(A) 1200 V/m (B) 0.04 V/m (C) 900 V/m (D) 4500 V/m

11. Three point charges 1C, 2C and 3C are placed at the corners of an equilateral triangle of side 1m. The work required to move these charges to the corners of a smaller equilateral triangle of side 0.5m in two different ways as in fig. (A) and fig. (B) are W_a and W_b then:



(A) $W_a > W_b$ (B) $W_a < W_b$ (C) $W_a = W_b$ (D) $W_a = 0$ and $W_b = 0$

12. As per this diagram a point charge +q is placed at the origin O. Work done in taking another point charge −Q from the point A (0, a) to another point B (a,0) along the straight path AB is :



(A) $(\frac{-qQ}{4\pi \epsilon_0} \frac{1}{a^2}) \sqrt{2}\, a$ (B) zero (C) $(\frac{qQ}{4\pi \epsilon_0} \frac{1}{a^2}) \frac{1}{\sqrt{2}}$ (D) $(\frac{qQ}{4\pi \epsilon_0} \frac{1}{a^2}) \sqrt{2}\, a$

13. Two identical thin rings, each of radius R meter are coaxially placed at distance R meter apart. If Q_1 and Q_2 coulomb are respectively the charges uniformly spread on the two rings, the work done in moving a charge q from the centre of one ring to that of the other is :

(A) zero (B) $\frac{q(Q_1 - Q_2)(\sqrt{2} - 1)}{(4\sqrt{2}\pi \epsilon_0 R)}$ (C) $\frac{q\sqrt{2}(Q_1 + Q_2)}{4\pi \epsilon_0 R}$ (D) $\frac{q(Q_1 - Q_2)(\sqrt{2} + 1)}{(4\sqrt{2}\pi \epsilon_0 R)}$

14. Two identical particles of mass m carry a charge Q each. Initially one is at rest on a smooth horizontal plane and the other is projected along the plane directly towards first particle from a large distance with speed v. The closest distance of approach be :

(A) $\frac{1}{4\pi\varepsilon_0} \frac{Q^2}{mv}$ (B) $\frac{1}{4\pi\varepsilon_0} \frac{4Q^2}{mv^2}$ (C) $\frac{1}{4\pi\varepsilon_0} \frac{2Q^2}{mv^2}$ (D) $\frac{1}{4\pi\varepsilon_0} \frac{3Q^2}{mv^2}$

15. In a regular polygon of n sides, each corner is at a distance r from the center. Identical charges are placed at (n–1) corners. At the centre, the intensity is E and the potential is V. The ratio V/E has magnitude :

(A) nr (B) (n–1)r (C) (n–1) /r (D) r (n–1)/n

16. An alpha particle of energy 5 MeV is scattered through 180 by a fixed uranium nucleus. The distance of closest approach is of the order :

(A) 1 Å (B) 10^{-10} cm (C) 10^{-12} cm (D) 10^{-15} cm

17. A charge 3 coulomb experiences a force 300 N when placed in a uniform electric field. The potential difference between two points separated by a distance of 10 cm along the field line is :

(A) 10 V (B) 90 V (C) 1000 V (D) 9000 V

18. Uniform electric field of magnitude 100 V/m in space is directed along the line y=3 +x. Find the potential difference between point A (3,1) & B(1,3) :

(A) 100 V (B) 200 $\sqrt{2}$ V (C) 200V (D) 0

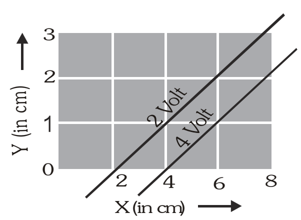
19. The equation of an equipotential line in an electric field is y=2x, then the electric field strength vector at (1, 2) may be :

(A) $4\tilde{i}+3\tilde{j}$ (B) $4\tilde{i}+8\tilde{j}$ (C) $8\tilde{i}+4\tilde{j}$ (D) $-8\tilde{i}+4\tilde{j}$

20. In a certain region of space, the potential is given by $V=k\,(2x^2 - y^2 + z^2)$. The electric field at the point (1, 1, 1) has magnitude :

(A) $k\sqrt{6}$ (B) $2k\sqrt{6}$ (C) $2k\sqrt{3}$ (D) $4k\sqrt{3}$

21. The figure below shows two equipotential lines in XY plane for an electric field. The scales are marked. The X–component E_x and Y–component E_y of the electric field in the space between these equipotential lines are respectively :



(A) +100 V/m, –200 V/m (B) +200 V/m, +100 V/m

(C) –100 V/m, +200 V/m (D) –200 V/m, –100 V/m

22. A non–conducting ring of radius 0.5 m carries a total charge 1.11 10^{-10} C distributed non–uniformly on its circumference producing an electric field E every where in space. The value of the integral $\int_{\ell=\infty}^{\ell=0} -\vec{E}\cdot d\vec{\ell}$ (ℓ= 0 being centre of the ring) in volt is :

(A) +2 (B) –1 (C) –2 (D) zero

23. Two point charges + q and –q are held fixed at (–d, 0) and (d, 0) respectively of a x–y co–ordinate system. Then which of the following statement is incorrect :

(A) The electric field E at all points on the x–axis has the same direction

(B) No work has to be done in bringing a test charge from ∞ to the origin

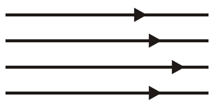
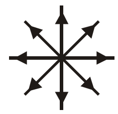
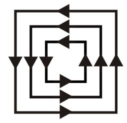
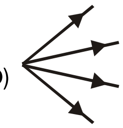
(C) Electric field at all point on y–axis is parallel to x–axis

(D) The dipole moment is 2 qd along the –ve x–axis

24. The work done in rotating an electric dipole of dipole moment p in an electric field E through an angle θ from the direction of electric field, is :

(A) $pE(1 - \cos\theta)$ (B) pE (C) zero (D) $-pE\cos\theta$

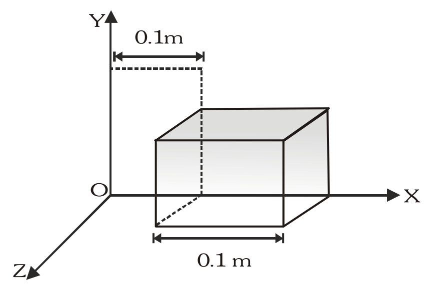
25. Which one of the following pattern of electric line of force can't possible :

(A)  (B)  (C)  (D) 

26. A sphere of radius R and charge Q is placed inside an imaginary sphere of radius 2R whose centre coincides with the given sphere. The flux related to imaginary sphere is :

(A) $\frac{Q}{\epsilon_0}$ (B) $\frac{Q}{2\epsilon_0}$ (C) $\frac{4Q}{\epsilon_0}$ (D) $\frac{2Q}{\epsilon_0}$

27. Due to a charge inside a cube the electric field is $E_x = 600\ x^{1/2}$, $E_y = 0$, $E_z = 0$. The charge inside the cube is (approximately) :

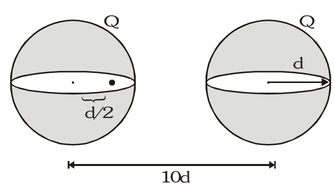


(A) 600 μC (B) 60 μC (C) 7 μμC (D) 6 μμC

28. Electric flux through a surface of area $100\ m^2$ lying in the xy plane is (in V–m) if $E = \tilde{i} + \sqrt{2}\tilde{j} + \sqrt{3}\tilde{k}$:

(A) 100 (B) 141.4 (C) 173.2 (D) 200

29. Two spherical, nonconducting, and very thin shells of uniformly distributed positive charge Q and radius d are located at a distance 10d from each other. A positive point charge q is placed inside one of the shells at a distance d/2 from the center, on the line connecting the centers of the two shells, as shown in the figure. What is the net force on the charge q?



(A) $\frac{qQ}{361\pi\varepsilon_0 d^2}$ to the left

(B) $\frac{qQ}{361\pi\varepsilon_0 d^2}$ to the right

(C) $\frac{362qQ}{361\pi\varepsilon_0 d^2}$ to the left

(D) $\frac{360qQ}{361\pi\varepsilon_0 d^2}$ to the right

30. A solid metallic sphere has a charge + 3Q. Concentric with this sphere is a conducting spherical shell having charge –Q. The radius of the sphere is a and that of the spherical shell is b (b > a). What is the electric field at a distance R (a < R < b) from the centre ?

(A) $\frac{4Q}{2\pi\varepsilon_0 R^2}$ (B) $\frac{3Q}{4\pi\varepsilon_0 R^2}$ (C) $\frac{3Q}{2\pi\varepsilon_0 R^2}$ (D) $\frac{Q}{2\pi\varepsilon_0 R}$

31. A hollow metal sphere of radius 5 cm is charged such that the potential on its surface is 10V. The potential at the distance 3 cm from the centre of the sphere is :

(A) zero
(B) 10 V
(C) same as at a point 5 cm away from the surface
(D) same as at a point 25 cm away from the surface

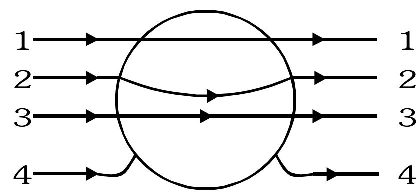
32. A solid conducting sphere having a charge Q is surrounded by an uncharged concentric conducting hollow spherical shell. Let the potential difference between the surface of the solid sphere and that of the outer surface of the hollow shell be V. If the shell is now given a charge of –3Q, the new potential difference between the same two surfaces is :

(A) V
(B) 2V
(C) 4V
(D) –2V

33. A cube of metal is given a charge (+ Q), which of the following statements is true :

(A) Potential at the surface of cube is zero
(B) Potential within the cube is zero
(C) Electric field is normal to the surface of the cube
(D) Electric field varies within the cube

34. A metallic solid sphere is placed in a uniform electric field. The lines of force follow the path(s) shown in figure as :



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

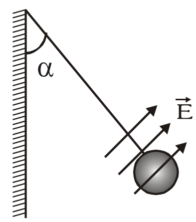
ANSWER KEY LEVEL1

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Ans.	B	B	B	A	D	B	C	B	C	D	C	B	B	B	B	C	A	D	D
Que.	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34				
Ans.	B	C	A	A	A	C	A	C	C	A	B	B	A	C	D				

ELECTROSTATICS LEVEL -II

Select the correct alternatives (one or more than one correct answers)

1. A charged cork of mass m suspended by a light string is placed in uniform electric field of strength E = $(\tilde{i}+\tilde{j})\times 10^5$ NC^{-1} as shown in the figure. If in equilibrium position tension in the string is $\frac{2mg}{(1+\sqrt{3})}$ then angle 'α'with the vertical is :

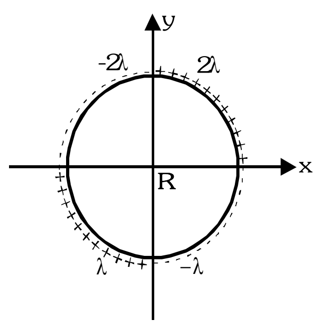


(A) 60^0 (B) 30^0 (C) 45^0 (D) 18^0

2. A charged particle having some mass is resting in equilibrium at a height H above the centre of a uniformly charged non–conducting horizontal ring of radius R. The force of gravity acts downwards.; The equilibrium of the particle will be stable :

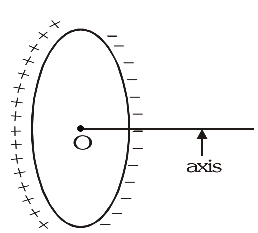
(A) for all values of H (B) only if H > $\frac{R}{\sqrt{2}}$ (C) only if H < $\frac{R}{\sqrt{2}}$ (D) only if H = $\frac{R}{\sqrt{2}}$

3. The charge per unit length of the four quadrant of the ring is 2λ, -2λ, λ and $-\lambda$ respectively. The electric field at the centre is :



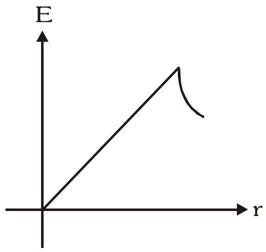
(A) $\frac{-\lambda}{2\pi\varepsilon_0 R}\tilde{i}$ (B) $\frac{\lambda}{2\pi\varepsilon_0 R}\tilde{j}$ (C) $\frac{\sqrt{2}\lambda}{4\pi\varepsilon_0 R}\tilde{i}$ (D) None

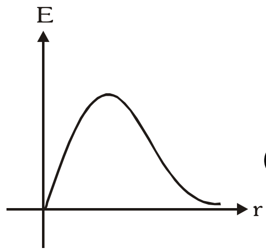
4. The figure shows a nonconducting ring which has positive and negative charge non uniformly distributed on it such that the total charge is zero. Which of the following statements is true?

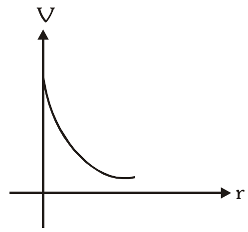


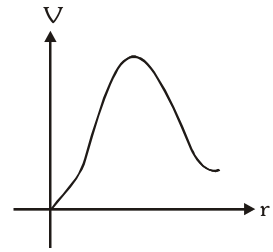
(A) The potential at all the points on the axis will be zero.
(B) The electric field at all the points on the axis will be zero.
(C) The direction of electric field at all points on the axis will be along the axis.
(D) If the ring is placed inside a uniform external electric field then net torque and force acting on the ring would be zero.

5. A circular ring carries a uniformly distributed positive charge. The electric field (E) and potential (V) varies with distance (r) from the centre of the ring along its axis as :

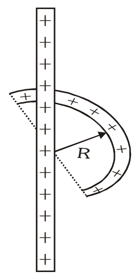
(A) 

(B) 

(C) 

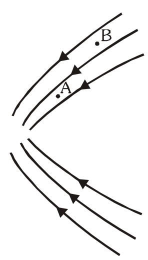
(D) 

6. Find the force experienced by the semicircular rod charged with a charge q, placed as shown in figure. Radius of the wire is R and the infinite line of charge with linear charge density λ is passing through its centre and perpendicular to the plane of rod.



(A) $\frac{-\lambda q}{2\pi^2\varepsilon_0 R}$ (B) $\frac{\lambda q}{\pi^2\varepsilon_0 R}$ (C) $\frac{\lambda q}{4\pi^2\varepsilon_0 R}$ (D) $\frac{\lambda q}{4\pi\varepsilon_0 R}$

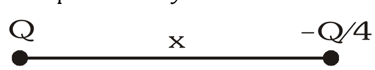
7. Which of the following is true for the figure showing electric lines of force ? (E is electrical field, V is potential)



(A) $E_A > E_B$ (B) $E_B > E_A$ (C) $V_A > V_B$ (D) $V_B > V_A$

8. An electric charge 10^{-8} C is placed at the point (4m, 7m, 2m). At the point (1m, 3m, 2m), the electric :
(A) potential will be 18 V
(B) field has no Y–component
(C) field will be along Z–axis
(D) potential will be 1.8 V

9. Two point charges Q and –Q/4 are separated by a distance x. Then :



(A) potential is zero at a point on the axis which is at a distance x/3 on the right side of the charge –Q/4
(B) potential is zero at a point on the axis which is at a distance x/5 on the left side of the charge –Q/4
(C) electric field is zero at a point on the axis which is at a distance x on the right side of the charge–Q/4
(D) there exist two points on the axis where electric field is zero

10. Two positively charged particles X and Y are initially far away from each other and at rest. X begins to move towards Y with some initial velocity. The total momentum and energy of the system are p and E :
(A) If Y is fixed, both p and E are conserved
(B) If Y is fixed, E is conserved, but not p
(C) If both are free to move, p is conserved but not E
(D) If both are free, E is conserved, but not p

11. Two particles X and Y, of equal mass and with unequal positive charges, are free to move and are initially far away from each other. With Y at rest, X begins to move towards it with initial velocity u. After a long time, finally :

(A) X will stop, Y will move with velocity u
(B) X and Y will both move with velocities u/2 each
(C) X will stop, Y will move with velocity < u
(D) both will move with velocities < u/2

12. In a uniform electric field, the potential is 10V at the origin of coordinates, and 8V at each of the points (1, 0, 0), (0, 1, 0) and (0, 0, 1). The potential at the point (1, 1, 1) will be :

(A) 0 (B) 4V (C) 8V (D) 10V

13. Four charges of $1\mu C$, $2\mu C$, $3\mu C$, and $-6\mu C$ are placed one at each corner of the square of side 1m. The square lies in the x–y plane with its centre at the origin.

(A) The electric potential is zero at the origin.
(B) The electric potential is zero everywhere along the x–axis only if the sides of the sqaure are parallel to x and y axis.
(C) The electric potential is zero everywhere along the z–axis for any orientation of the square in the x–y plane.
(D) The electric potential is not zero along the z–axis except at the origin.

14. Potential at a point A is 3 volt and at a point B is 7 volt, an electron is moving towards A from B :

(A) It must have some K.E. at B to reach A
(B) It need not have any K.E. at B to reach A
(C) To reach A it must have more than or equal to 4 eV KE at B
(D) When it will reach A, it will have K.E. more than or at least equal to 4 eV if it was released from rest at B

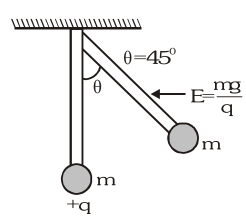
15. A particle of charge 1μC & mass 1 gm moving with a velocity of 4 m/s is subjected to a uniform electric field of magnitude 300 V/m for 10 sec. Then it's final speed cannot be :

(A) 0.5 m/s (B) 4 m/s (C) 3 m/s (D) 6 m/s

16. A particle of mass m and charge q is thrown in a region where uniform gravitational field and electric field are present. The path of particle :

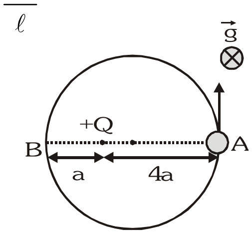
(A) may be a straight line (B) may be a circle (C) may be a parabola (D) may be a hyperbola

17. A horizontal electric feild (E = (mg)/q) exists as shown in figure and a mass m attached at the end of a light rod. If mass m is released from the position shown in figure find the angular velocity of the rod when it passes through the bottom most position :



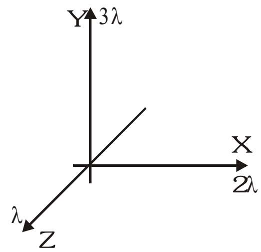
(A) $\sqrt{\frac{g}{\ell}}$ (B) $\sqrt{\frac{2g}{\ell}}$ (C) $\sqrt{\frac{3g}{\ell}}$ (D) $\sqrt{\frac{5g}{\ell}}$

18. The diagram shows a small bead of mass m carrying charge q. The bead can freely move on the smooth fixed ring placed on a smooth horizontal plane. In the same plane a charge + Q has also been fixed as shown. The potential at the point A due to +Q is V. The velocity with which the bead should proejcted from the point A so that it can complete a circle should be greater than :



(A) $\sqrt{\frac{6qV}{m}}$ (B) $\sqrt{\frac{qV}{m}}$ (C) $\sqrt{\frac{3qV}{m}}$ (D) None of these

19. The diagram shows three infinitely long uniform line charges placed on the X,Y and Z axis. The work done in moving a unit positive charge from (1, 1, 1) to (0, 1, 1) is equal to:



(A) $\frac{(\lambda \ell n2)}{2\pi\varepsilon_0}$ (B) $\frac{(\lambda \ell n2)}{\pi\varepsilon_0}$ (C) $\frac{(3\lambda \ell n2)}{2\pi\varepsilon_0}$ (D) None

20. The electric potential decreases uniformly from V to –V along X–axis in a coordinate system as we moves from a point $(-x_0, 0)$ to $(x_0, 0)$, then the electric field at the origin :

(A) must be equal to $\frac{V}{x_0}$ (B) may be equal to $\frac{V}{x_0}$

(C) must be greater than $\frac{V}{x_0}$ (D) may be less than $\frac{V}{x_0}$

21. A proton and a deuteron are initially at rest and are accelerated through the same potential difference which of the following is false concerning the final properties of the two particles?

(A) They have different speeds (B) They have same momentum

(C) They have same kinetic energy (D) They have been subjected to same force

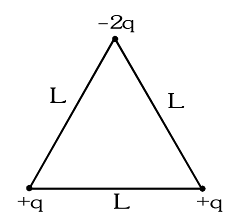
22. Three points charges are placed at the corners of an equilateral triangle of side L as shown in the figure:

(A) The potential at the centroid of the triangle is zero.

(B) The electric field at the centroid of the triangle is zero.

(C) The dipole moment of the system is $\sqrt{2}$ qL

(D) The dipole moment of the system is $\sqrt{3}$ qL



23. The dipole moment of a system of charge +q distributed uniformly on an arc of radius R subtending an angle $\pi/2$ at its centre where another charge –q is placed is

(A) $\frac{2\sqrt{2}qR}{\pi}$ (B) $\frac{\sqrt{2}qR}{\pi}$ (C) $\frac{qR}{\pi}$ (D) $\frac{2qR}{\pi}$

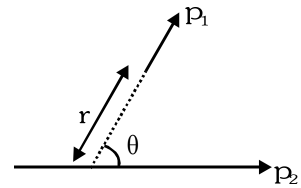
24. An electric dipole is kept on the axis of a uniformly charged ring at distance $R/\sqrt{2}$ from the centre of the ring. The direction of the dipole moment is along the axis. The dipole moment is P, charge of the ring is Q and radius of the ring is R. The force on the dipole is nearly :

(A) $\frac{4kPQ}{3\sqrt{3}R^2}$ (B) $\frac{4kPQ}{3\sqrt{3}R^3}$ (C) $\frac{2kPQ}{3\sqrt{3}R^3}$ (D) zero

25. Point P lies on the axis of a dipole. If the dipole is rotated by 90 anticlock wise, the electric field vector $\vec{E}$ at P will rotate by :

(A) 90 clockwise (B) 180 clockwise (C) 90 anticlock wise (D) 180 anticlockwise

26. Two short electric dipoles are placed as shown. The energy of electric interaction between these dipoles will be



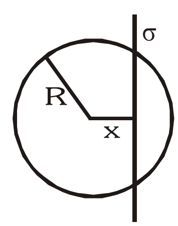
(A) $\frac{2Kp_1p_2\cos\theta}{r^3}$ (B) $\frac{-2Kp_1p_2\cos\theta}{r^3}$ (C) $\frac{-2Kp_1p_2\sin\theta}{r^3}$ (D) $\frac{-4Kp_1p_2\cos\theta}{r^3}$

27. Charges Q_1 and Q_2 lies inside and outside respectively of a closed surface S. Let E be the field at any point on S and ϕ be the flux of E over S.

(A) If Q_1 changes, both E and ϕ will change.
(B) If Q_2 changes, E will change but ϕ will not change.
(C) If Q_1=0 and $Q_2 \neq 0$ then $E \neq 0$ but ϕ=0
(D) If $Q_1 \neq 0$ and Q_2=0 then E=0 but $\phi \neq 0$

28. An electric dipole is placed at the centre of a sphere. Mark the correct answer :
(A) The flux of the electric field passing through the sphere is zero
(B) The electric field is zero at every point of the sphere
(C) The electric potential is zero everywhere on the sphere
(D) The electric potential is zero on a circle on the surface

29. An infinite, uniformly charged sheet with surface charge denisty σ cuts through a spherical Gaussian surface of radius R at a distance x from its center, as shown in the figure. The electric flux ϕ through the Gaussian surface is :

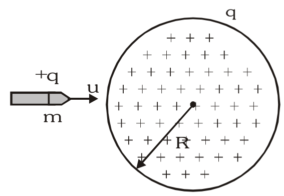


(A) $\frac{\pi R^2\sigma}{\varepsilon_0}$ (B) $\frac{2\pi\left(R^2-x^2\right)\sigma}{\varepsilon_0}$ (C) $\frac{\pi\left(R-x\right)^2\sigma}{\varepsilon_0}$ (D) $\frac{\pi\left(R^2-x^2\right)\sigma}{\varepsilon_0}$

30. At distance of 5 cm and 10 cm outwards from the surface of a uniformly charged solid sphere, the potentials are 100 V and 75 V respectively. Then :
(A) potential at its surface is 150 V
(B) the charge on the sphere is (5/3) x 10^{-10}C
(C) the electric field on the surface is 1500 V/m
(D) the electric potential at its centre is 225 V

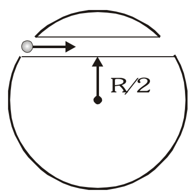
31. An electric field converges at the origin whose magnitude is given by the expression E = 100r N/C, where r is the distance measured from the origin.
(A) Total charge contained in any spherical volume with its centre at origin is negative.
(B) Total charge contained at any spherical volume, irrespective of the location of its centre, is negative.
(C) Total charge contained in a spherical volume of radius 3 cm with its centre at origin equals 3 10^{-13} C.
(D) Total charge contained in a spherical volume of radius 3 cm with its centre at origin has magnitude 3 10^{-9} C.

32. A bullet of mass m and charge q is fired towards a solid uniformly charged sphere of radius R and total charge + q. If it strikes the surface of sphere with speed u, find the minimum value of u so that it can penetrate through the sphere. (Neglect all resistnace forces or friction acting on bullet except electrostatic forces)



(A) $\frac{q}{\sqrt{2\pi\varepsilon_0 mR}}$ (B) $\frac{q}{\sqrt{4\pi\varepsilon_0 mR}}$ (C) $\frac{q}{\sqrt{8\pi\varepsilon_0 mR}}$ (D) $\frac{\sqrt{3}q}{\sqrt{4\pi\varepsilon_0 mR}}$

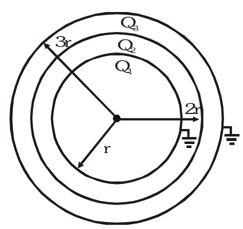
33. A unit positive point charge of mass m is projected with a velocity v inside the tunnel as shown. The tunnel has been made inside a uniformly charged non conducting sphere. The minimum velocity with which the point charge should be projected such that it can it reach the opposite end of the tunnel, is equal to :



(A) $\left[\frac{\rho R^2}{4m\varepsilon_0}\right]^{1/2}$ (B) $\left[\frac{\rho R^2}{24m\varepsilon_0}\right]^{1/2}$ (C) $\left[\frac{\rho R^2}{6m\varepsilon_0}\right]^{1/2}$

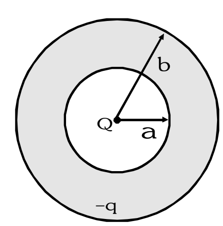
(D) zero because the initial and the final points are at same potential

34. Three concentric conducting spherical shells have radius r, 2r and 3r and Q_1, Q_2 and Q_3 are final charges respectively. Innermost and outermost shells are already earthed as shown in figure. choose the wrong statement.



(A) $Q_1 + Q_3 = -Q_2$ (B) $Q_1 = \frac{-Q_2}{4}$ (C) $\frac{Q_3}{Q_1} = 3$ (D) $\frac{Q_3}{Q_2} = \frac{-1}{3}$

35. Shown in the figure a spherical shell with an inner radius 'a' and an outer radius 'b' is made of conducting material. A point charge +Q is placed at the centre of the spherical shell and a total charge –q is placed on the shell. Charge –q is distributed on the surfaces as :



(A) –Q on the inner surface, –q, on outer surface
(B) –Q on the inner surface, –q+Q on the outer surface
(C) +Q on the inner surface, –q–Q on the outer surface
(D) The charge –q is spread uniformly between the inner and outer surface

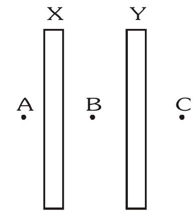
36. In the previous question assume that the electrostatic potential is zero at an infinite distance from the spherical shell. The electrostatic potential at a distance R (a < R < b) from the centre of the shell is where $\left(K = \frac{1}{4\pi\varepsilon_0}\right)$

(A) 0 (B) $\frac{KQ}{a}$ (B) $K\frac{Q-q}{R}$ (D) $K\frac{Q-q}{b}$

37. There are four concentric shells A, B, C and D of radii a, 2a, 3a and 4a respectively. Shells B and D are given charges +q and –q respectively. Shell C is now earthed. The potential difference V_A–V_C is :

(A) $\frac{Kq}{2a}$ (B) $\frac{Kq}{3a}$ (C) $\frac{Kq}{4a}$ (D) $\frac{Kq}{6a}$

38. X and Y are large, parallel conducting plates closed to each other. Each face has an area A. X is given a charge Q. Y is without any charge. Points A, B and C are as shown in figure :



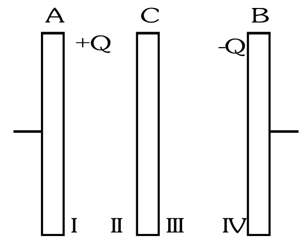
(A) The field at B is $\frac{Q}{2\varepsilon_0 A}$

(B) The field at B is $\frac{Q}{\varepsilon_0 A}$

(C) The fields at A, B and C are of the same magnitude

(D) The field at A and C are of the same magnitude, but in opposite directions

39. Plates A and B constitutes an isolated, charge parallel plate capacitor. The inner surfaces (I and IV) of A and B have charges + Q and –Q respectively. A third plate C with charge + Q is now introduced midway between A and B. Which of the following statements is not correct?



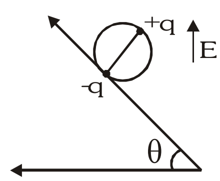
(A) The surface I and II will have equal and opposite charges

(B) The surfaces III and IV will have equal and opposite charges

(C) The charge on surace III will be greater than Q

(D) The potential difference between A and C will be equal to the potential difference between C and B

40. A wheel having mass m has charges +q and –q on diametrically opposite points. It remains in equilibrium on a rough inclined plane in the presence of uniform vertical electric field E. The value of E is :



(A) $\frac{mg}{q}$ (B) $\frac{mg}{2q}$ (C) $\frac{mg\tan\theta}{2q}$ (D) None

ANSWER KEY LEVEL -2

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	A,B	B	A	A	B	B	AD	A	ABC	B	A	B	AC	AC	A
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	AC	B	A	B	B	B	AD	A	D	A	B	ABC	AD	D	ACD
Que.	31	32	33	34	35	36	37	38	39	40					
Ans.	ABC	B	A	C	B	D	D	ACD	D	B					