Chapter 01 Electrostatics

NEET-RANKER'S STUFF

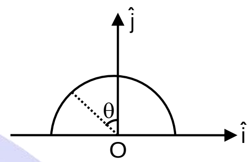
Q.1 In normal cases thin stream of water bends toward a negatively charged rod. When a positivelycharged rod is placed near the stream, it will bend in the
(1) Opposite direction
(2) Same direction
(3) It won't bend at all.
(4) Can't be predicted

Q.2 An electric charge q is kept on the axis of a uniform charged ring at a distance $\frac{R}{\sqrt{2}}$ from the centre of the ring. The charge of the ring is Q & radius of the ring is R. The force on the charge q is
(1) $\frac{kQq}{R^2}$ (2) $\frac{kQq}{3\sqrt{3}R^2}$
(3) $\frac{kQq}{2\sqrt{2}R^2}$ (4) $\frac{2kQq}{3\sqrt{3}R^2}$

Q.3 Two charges, each equal to q, are kept at x = – a and x = a on the x-axis. A particle of mass m and charge $q_0 = q/2$ is placed at the origin. If charge q_0 is given a small displacement (y <<a) along the y-axis, the net force acting on the particle is proportional to :
(1) y (2) –y (3) $\frac{1}{y}$ (4) $-\frac{1}{y}$

Q.4 Five positive equal charges are placed at vertices of a regular hexagon and net electric field at the centre is E_1. A negative charge having equal magnitude is placed sixth vertex and then net electric field is E_2. Find $\frac{E_2}{E_1}$
(1) 2 (2) 1 (3) 3 (4) 4

Q.5 A thin semi-circular ring of radius r has a positive charge q distributed uniformly over it. The net field $\vec{E}$ at the centre O is :



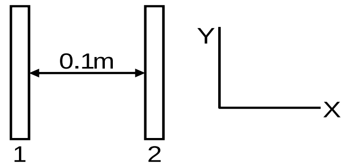
(1) $\frac{q}{4\pi^2\varepsilon_0 r^2}\hat{j}$ (2) $-\frac{q}{4\pi^2\varepsilon_0 r^2}\hat{j}$
(3) $-\frac{q}{2\pi^2\varepsilon_0 r^2}\hat{j}$ (4) $\frac{q}{2\pi^2\varepsilon_0 r^2}\hat{j}$

Q.6 The electrostatic potential inside a charged spherical ball is given by $\phi = ar^2 + b$ where r is the distance from the centre; a,b are constants. Then the charge density inside the ball is :
(1) $-24\pi a\varepsilon_0 r$ (2) $-6\pi a\varepsilon_0 r$
(3) $-24\pi a\varepsilon_0$ (4) $-6 a\varepsilon_0$

Q.7 A charge Q is placed at each of the opposite corners of a square. A charge q is placed at each of the other two corners. If the net electrical force on Q is zero, then Q/q equals:
(1) –1 (2) 1 (3) $-\frac{1}{\sqrt{2}}$ (4) $-2\sqrt{2}$

Q.8 The potential at a point x (measured in μm) due to some charges situated on the x-axis is given by $V(x) = 3x^2$ volts. The electric field E at x = 4 μm is given by :
(1) 12 volt/μm (2) 24 volt/μm
(3) 96 volt/μm (4) 75 volt/μm

Q.9 Two insulating plates are both uniformly charged in such a way that the potential difference between them is $V_2 - V_1 = 20$ V. (i.e. plate 2 is at a higher potential). The plates are separated by d = 0.1 m and can be treated as infinitely large. An electron is released from rest on the inner surface of plate 1. What is its speed when it hits plate 2? ($e = 1.6 \times 10^{-19}$ C, $m_e = 9.11 \times 10^{-31}$ kg)



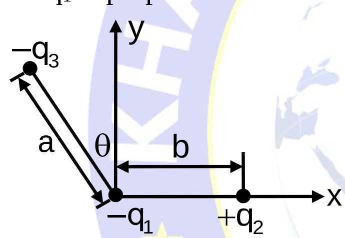
(1) 1.87×10^6 m/s (2) 32×10^{-19} m/s
(3) 2.65×10^6 m/s (4) 7.02×10^{12} m/s

Q.10 The charges on the two concentric rings having radii R and 2R are +q and –q respectively. The net potential at the centers of the two rings is

(1) zero (2) $\frac{kq}{R}$

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

Q.11 Three charges $-q_1$, $+q_2$ and $-q_3$ are placed as shown in the figure. The x-component of the force on $-q_1$ is proportional to :



(1) $\frac{q_2}{b^2} - \frac{q_3}{a^2}\cos\theta$ (2) $\frac{q_2}{b^2} + \frac{q_3}{a^2}\sin\theta$

(3) $\frac{q_2}{b^2} + \frac{q_3}{a^2}\cos\theta$ (4) $\frac{q_2}{b^2} - \frac{q_3}{a^2}\sin\theta$

Q.12 Four charges equal to –Q each are placed at the four corners of a square and a charge q is at its centre. If the system is in equilibrium, the value of q is:

(1) $-\frac{Q}{4}(1+2\sqrt{2})$ (2) $\frac{Q}{4}(1+2\sqrt{2})$

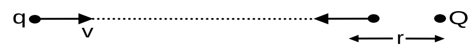
(3) $-\frac{Q}{2}(1+2\sqrt{2})$ (4) $\frac{Q}{2}(1+2\sqrt{2})$

Q.13 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 at a distance R/2 from the centre of the shell is :

(1) $\frac{2Q}{4\pi\varepsilon_0 R}$ (2) $\frac{2Q}{4\pi\varepsilon_0 R} - \frac{2q}{4\pi\varepsilon_0 R}$

(3) $\frac{2Q}{4\pi\varepsilon_0 R} + \frac{q}{4\pi\varepsilon_0 R}$ (4) $\frac{(q+Q)}{4\pi\varepsilon_0 R}\frac{2}{R}$

Q.14 A charged particle 'q' is shot towards another charged particle 'Q', which is fixed, with a speed 'v'. It approaches 'Q' upto a closest distance r and then returns. If q were given a speed of '2v', the closest distance of approach would be :



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

Q.15 Three concentric metal shells A, B and C of respective radii a, b and c (a< b < c) have surface charge densities + σ , – σ and + σ respectively. The potential of shell B is

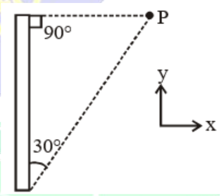
(1) $\frac{\sigma}{\varepsilon_0}\left[\frac{a^2-b^2}{a}+c\right]$

(2) $\frac{\sigma}{\varepsilon_0}\left[\frac{a^2-b^2}{b}+c\right]$

(3) $\frac{\sigma}{\varepsilon_0}\left[\frac{b^2-c^2}{b}+a\right]$

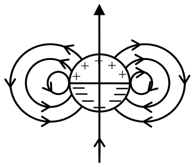
(4) $\frac{\sigma}{\varepsilon_0}\left[\frac{b^2-c^2}{c}+a\right]$

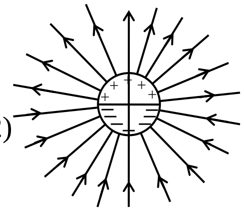
Q.16 The direction (θ) of E at point P due to uniformly charged finite rod will be

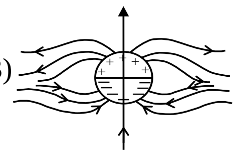


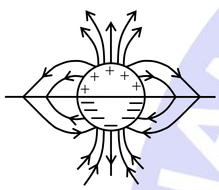
(1) at angle 30^0 from x-axis
(2) at angle 45^0 from x - axis
(3) at angle 60^0 from x-axis
(4) at angle 75^0 from x-axis

Q.17 A long cylindrical shell carries positive surface charge in the upper half and negative surface charge σ in the lower half. The electric field lines around the cylinder will look like figure given in: (figures are schematic and not drawn to scale)

(1) 

(2) 

(3) 

(4) 

Q.18 A uniform charged solid sphere of radius R has potential V_0 (measured with respect to ∞) on its surface. For this sphere the equipotential surfaces with potentials $\frac{3V_0}{2}, \frac{5V_0}{4}, \frac{3V_0}{4}$ and $\frac{V_0}{4}$ have radius R_1, R_2, R_3 and R_4 respectively. Then]

(A) $R_1 = 0$
(B) $R_2 > R$
(C) $R_3 > R$
(D) $R_4 < R$

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

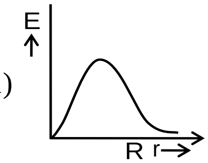
Q.19 Assume that an electric field $E = 30x^2\hat{i}$ exists in space. Then, the potential difference $V_A - V_O$, where V_O is the potential at the origin and V_A the potential at x = 2 m, is-

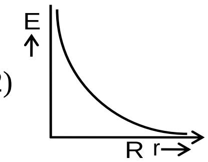
(1) 120 J/C (2) –120 J/C
(3) –80 J/C (4) 80 J/C

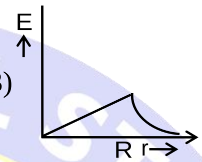
Q.20 Let $[\varepsilon_0]$ denote the dimensional formula of the permittivity of vacuum. If M = mass, L = length, T = time and A = electric current, then:

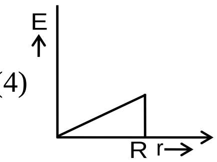
(1) $[\varepsilon_0] = [M^{-1} L^{-3} T^2 A]$
(2) $[\varepsilon_0] = [M^{-1} L^{-3} T^4 A^2]$
(3) $[\varepsilon_0] = [M^{-1} L^2 T^{-1} A^{-2}]$
(4) $[\varepsilon_0] = [M^{-1} L^2 T^{-1} A]$

Q.21 In a uniformly charged sphere of total charge Q and radius R, the electric field E is plotted as a function of distance from the center. The graph which would correspond to the above will be

(1) 

(2) 

(3) 

(4) 

Q.22 The maximum electric field at a point on the axis a uniformly charged ring is E_0. At how many points on the axis will the magnitude of electric field be $E_0/2$?

(1) 1 (2) 2 (3) 3 (4) 4

Q.23 Two identical charged spheres are suspended by strings of equal lengths. The strings make an angle of 30º with each other. When suspended in a liquid of density 0.8 g cm^{-3}, the angle remains the same. If density of the material of the sphere is 1.6 g cm^{-3}, the dielectric constant of the liquid is

(1) 4 (2) 3
(3) 2 (4) 1

Q.24 Two points *P* and *Q* are maintained at the potentials of 10 V and –4V, respectively. The work done in moving 100 electrons from *P* and

(1) 9.60×10^{-17} J (2) -2.24×10^{-16} J
(3) 2.24×10^{-16} J (4) -9.60×10^{-17} J

Q.25 An electric charge 10^{-3} C is placed at the origin (0, 0) of X – Y co-ordinate system. Two points A and B are situated at $(\sqrt{2}, \sqrt{2})$ and (2, 0) respectively. The potential difference between the points A and B will be

(1) 9 V (2) Zero
(3) 2 V (4) 4.5 V

Q.26 An electric dipole is placed at an angle of 30°to a non – uniform electric field. The dipole will experience

(1) A translational force only in a direction perpendicular to the field
(2) A torque as well as a translational force
(3) A torque only
(4) A translational force only in the direction of the field

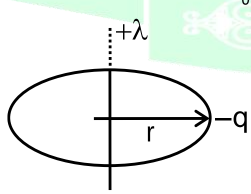
Q.27 Two spherical conductor A and B of radii 1 mm and 2 mm are separated by a distance of 5 cm and are uniformly charged. If the spheres are connected by a conducting wire then in equilibrium condition, the ratio of the magnitude of the electric fields at the surfaces of spheres A and B is

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

Q.28 Two point charges + 8 q and– 2 q are located at x = 0 and x = L respectively. The location of a point on the x axis at which then electric field due to two point charges is zero is

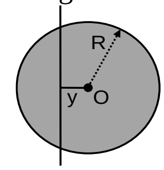
(1) $\frac{L}{4}$ (2) 2L
(3) 4L (4) 8L

Q.29 A particle of charge –q & mass m moves in a circle of radius r around an infinitely long line charge of linear charge density +λ, Then time period will be. Where $k = \frac{1}{4\pi\varepsilon_0}$



(1) $T = 2\pi r\sqrt{\frac{m}{2k\lambda q}}$ (2) $T^2 = \frac{4\pi^2 m}{2k\lambda q}$
(3) $T = \frac{1}{2\pi r}\sqrt{\frac{2k\lambda q}{m}}$ (4) $T = \frac{1}{2\pi r}\sqrt{\frac{m}{2k\lambda q}}$

Q.30 A uniformly charged and infinitely long line having a linear charge density 'λ' is placed at a normal distance y from a point O. Consider a sphere of radius R with O as centre and R > y. Electric flux through the surface of the sphere is

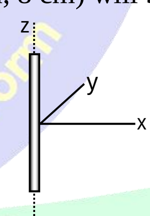


(1) zero (2) $\frac{2\lambda R}{\varepsilon_0}$
(3) $\frac{2\lambda\sqrt{R^2 - y^2}}{\varepsilon_0}$ (4) $\frac{\lambda\sqrt{R^2 + y^2}}{\varepsilon_0}$

Q.31 Potential energy of a system comprising of point charges is U_1. When a charge q is added in the system without disturbing other charges, the potential energy becomes U_2. The potential of the point where the charge q is placed in the system is

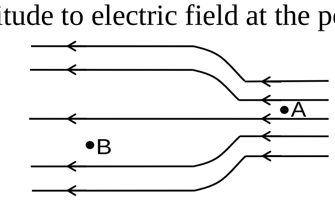
(1) $\frac{U_2 - U_1}{q}$ (2) $\frac{U_1 - U_2}{q}$
(3) $\frac{U_1 + U_2}{2q}$ (4) $\frac{U_2 - U_1}{2q}$

Q.32 An infinitely long wire is kept along z–axis from z = –∞ to z = +∞, having uniform linear charge density $\frac{10}{9}$ nC/m. The magnitude of electric field at point (6 cm, 8 cm) will be



(1) Zero (2) 50 V/m
(3) 100 V/m (4) 200 V/m

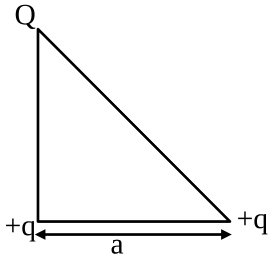
Q.33 In the electric field shown in figure, the electric field lines on the left have twice the separation as that between those on the right. If the magnitude of the field at point A is $40 NC^{-1}$,find the magnitude to electric field at the point B.



(1) $15 NC^{-1}$ (2) $20 NC^{-1}$

(3) 25 NC^{-1} (4) 30 NC^{-1}

Q.34 Three charges Q, +q and + q are placed at the vertices of a right-angled isosceles triangle as shown. The net electrostatic energy of the configuration is zero if Q is equal to:



(1) $\frac{-q}{1+\sqrt{2}}$ (2) $\frac{-2q}{2+\sqrt{2}}$

(3) -2q (4) +q

Q.35 A solid sphere of radius R is charged uniformly. At what distance from its surface is the electrostatic potential half of the potential at the centre?

(1) R (2) R/2

(3) R/3 (4) 2R

Q.36 A nonconducting ring of radius R has uniformly distributed positive charge Q. A small part of the ring, of length d, is removed (d << R). The electric field at the centre of the ring will now be :

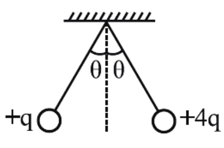
(1) Directed towards the gap, inversely proportional to R^3

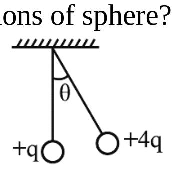
(2) Directed towards the gap, inversely proportional to R^2

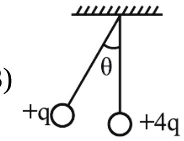
(3) Directed away from the gap, inversely proportional to R^3

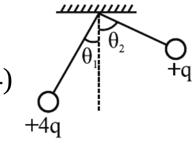
(4) Directed away from the gap, inversely proportional to R^2

Q.37 Two metal spheres of same mass are suspended from a common point by a light insulating string. The length of each string is same. The sphere are given electric charges +q on one end and +4q on the other. Which of the following diagrams best shows the resulting positions of sphere?

(1) 

(2) 

(3) 

(4) 

Q.38 When a negative charge is released and moves in electric field, it moves toward a position of

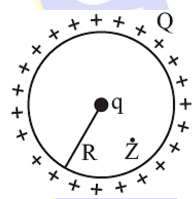
(1) lower electric potential and lower potential energy

(2) lower electric potential and higher potential energy

(3) higher electric potential and lower potential energy

(4) higher electric potential and higher potential energy

Q.39 A positive charge Q is uniformly distributed along a circular ring of radius R. A small test charge q is placed at the centre of the ring as shown in figure. Then



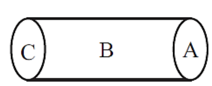
(1) If q > 0, and is displaced away from the centre in the plane of the ring, it will be pushed back towards the centre.

(2) If q < 0 and is displaced away from the centre in the plane of the ring, it will never return to the centre and will continue moving till it hits the ring.

(3) If q < 0 it will perform SHM for small displacement along the axis.

(4) All of the above

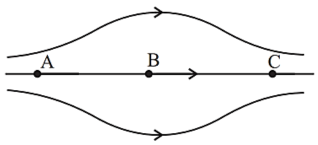
Q.40 A hollow cylinder has a charge q within it. If ϕ is the electric flux in unit of volt meter associated with the curved surface B, the flux linked with the plane surface A in unit of volt meter will be



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

(3) $\frac{\phi}{3}$ (4) $\frac{q}{\varepsilon_0}-\phi$

Q.41 The figure shows some of the electric field lines corresponding to an electric field. The figure suggests



(1) $E_A > E_B > E_C$ (2) $E_A = E_B = E_C$

(3) $E_A = E_C > E_B$ (4) $E_A > E_C > E_B$

Directions: These questions consist of two statements, each printed as Assertion and Reason. While answering these questions, you are required to choose any one of the following four responses.

(a) Both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(b) Both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(c) Assertion is correct, Reason is incorrect

(d) Assertion is incorrect and Reason is correct.

Q.42 **Assertion :** Two concentric charged shells are given. The potential difference between the shells depends on charge of inner shell.

Reason : Potential due to charge of outer charge remains same at every point inside the sphere.

(1) a (2) b (3) c (4) d

Q.43 **Assertion:** Electron move away from a region of lower potential to a region of higher potential.

Reason: An electron has a negative charge.

(1) a (2) b (3) c (4) d

Q.44 **Assertion :** Electric lines of force never cross each other.

Reason : Electric field at a point superimpose to give one resultant electric field.

(1) a (2) b (3) c (4) d

Q.45 **Assertion :** In a cavity within a conductor, the electric field is zero.

Reason : Charges in a conductor reside only at its surface.

(1) a (2) b (3) c (4) d

Q.46 **Assertion :** When bodies are charged through friction, there is a transfer of electric charge from one body to another, but no creation or destruction of charge.

Reason : This follows from conservation of electric charges.

(1) a (2) b (3) c (4) d

Q.47 **Assertion :** The tyres of aircraft are slightly conducting.

Reason : If a conductor is connected to ground, the extra charge induced on conductor will flow to ground.

(1) a (2) b (3) c (4) d

Q.48 **Assertion :** Some charge is put at the centre of a conducting sphere. It will move to the surface of the sphere.

Reason : Conducting sphere has no free electrons at the centre.

(1) a (2) b (3) c (4) d

Q.49 **Assertion :** On bringing a positively charged rod near the uncharged conductor, the conductor gets attracted towards the rod.

Reason : The electric field lines of the charged rod are perpendicular to the surface of conductor.

(1) a (2) b (3) c (4) d

Q.50 **Assertion :** In a non-uniform electric field, a dipole will have translatory as well as rotatory motion

Reason : In a non-uniform electric field, a dipole experiences a force as well as torque.

(1) a (2) b (3) c (4) d

Q.51 **Assertion :** The surface densities of two spherical conductors of different radii are equal. Then the electric field intensities near their surface are also equal.

Reason : Surface density is equal to charge per unit area.

(1) a (2) b (3) c (4) ds

ANSWER KEY

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Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	2	4	2	1	3	4	4	2	3	4	2	2	3	4	2
Que.	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
Ans.	1	1	3	3	2	3	4	3	3	2	2	2	2	1	3
Que.	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**
Ans.	1	4	2	2	3	1	1	3	4	1	3	1	1	2	1
Que.	**46**	**47**	**48**	**49**	**50**	**51**									
Ans.	1	2	1	2	1	2									