Chapter 01 Electrostatics

Practice Section-01

Q.1 When a piece of a material is rubbed with another material, mass of 9.1×10^{-20} kg is reduced from one material. Calculate the number of electrons gained by the another material.

(1) 10^{10} (2) 10^{13} (3) 10^{5} (4) 10^{11}

Q.2 Charges Q, q, Q, q are placed at the corners A, B, C, D of a square respectively. If the resultant force on the charge Q is zero due to other charges, what is the relation between Q and q ?

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

Q.3 Three charges +q, +2q and 4q are placed at point A (0, 0), B (0, a) and C (0, 2a) and connected by strings. What is ratio of tensions in the strings AB and BC.

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

Q.4 An uncharged sphere of metal is placed in between two charged plates as shown. The lines of force look like

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

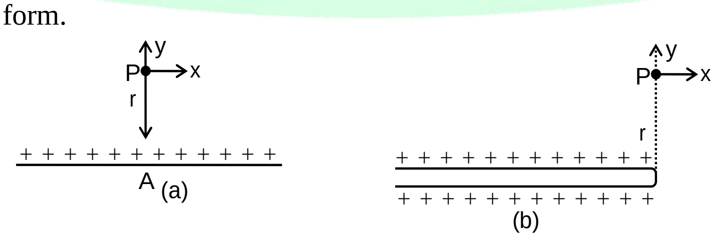
Q.5 Two charges +5μC and +10μC are placed 20 cm apart. The net electric field at the mid-Point between the two charges is :

(1) 4.5×10^{6} N/C directed towards + 5μC
(2) 4.5×10^{6} N/C directed towards +10μC
(3) 13.5×10^{6} N/C directed towards +5μC
(4) 13.5×10^{6} N/C directed towards +10μC

Q.6 Two point charges +8q and –2q are located at x=0 and x=L respectively. The location of a point on the x-axis at which the net electric field due to these two point charges is zero is :

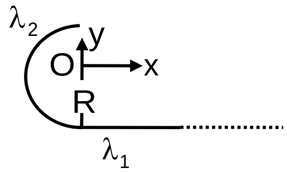
(1) 8L (2) 4L (3) 2L (4) $\frac{L}{4}$

Q.7 Electric field due to an infinite line of charge, as shown in figure at a point P at a distance r from the line is E. If wire is folded at point A. so that both parts lie alongside as shown in figure (b), then express electric field at P in vector form.



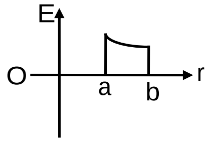
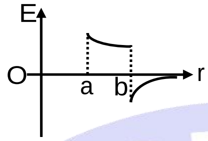
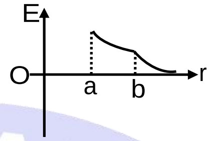
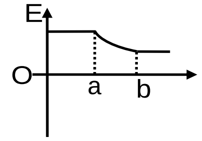
(1) $\frac{E}{2}\hat{i}+\frac{E}{2}\hat{j}$ (2) $E\hat{i}+E\hat{j}$ (3) $2E\hat{i}+2E\hat{j}$ (4) $\frac{E}{\sqrt{2}}\hat{i}+\frac{E}{\sqrt{2}}\hat{j}$

Q.8 In the figure shown, find the ratio of the linear charge densities λ_1 (on semi-infinite straight wire) and λ_2 (on semi-circular part) that is, λ_1/λ_2 so that the field at O is along y direction.



(1) 2 (2) 1.5 (3) 3 (4) 2.5

Q.9 Two concentric conducting shells of radius a and b (> a) carry charges Q and –2Q respectively. The correct variation of electric intensity E as a function of r is given by

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

Q.10 Two point charges +3μC and +8μC are repel each other by force of 40 N. If a charge of –5μC is added to each of them and the distance become half then what will be the force between them would ?

Q.11 Two point charges +6μC and –12μC attract by the forces of 100 N. If the charges are increased by 50% and the distance is reduced by 20% then what will be the new force between them ?

Q.12 A charge q = 1 μC is placed at point (1m, 2m, 4m). Find the electric field at point P(0,–4m, 3m).

Practice Section-02

Q.1 A cylinder of length L and radius b has its axis coincident with the x-axis. The electric field in this region is $\vec{E} = 200\,\hat{i}$. Find the flux through the left end of the cylinder.

(1) 0 (2) $200\,\pi b^2$ (3) $100\,\pi b^2$ (4) $-200\,\pi b^2$

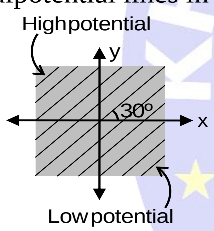
Q.2 A proton and an alpha particle placed at rest, at a distance 'a' initially. Find the ratio of kinetic energy $\left(\frac{K_p}{K_\alpha}\right)$ when separation between them is '2a'.

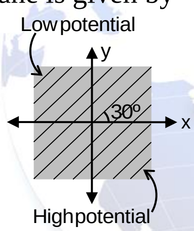
(1) 4 (2) 1 (3) $\frac{1}{4}$ (4) 2

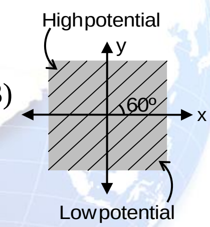
Q.3 The potential of an electric field $\vec{E} = (y\hat{i} + x\hat{j})$ is

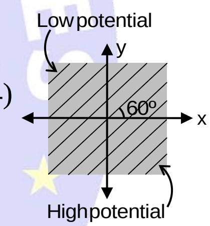
(1) V = $-xy$ + constant (2) V = $-(x + y)$ + constant
(3) V = $-(x^2 + y^2)$ + constant (4) V = constant

Q.4 The electric field intensity at all points in space in given by $\vec{E} = \sqrt{3}\,\hat{i} - \hat{j}$ volts/meter. The nature of equipotential lines in x – y plane is given by

(1) 

(2) 

(3) 

(4) 

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

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

Q.6 A hollow metal sphere of radius 5 cm is charged so that the potential on its surface is 10 V. The potential at the centre of the sphere is

(1) 0 V
(2) 10 V
(3) Same as at point 5 cm away from the surface
(4) Same as at point 25 cm away from the surface

Q.7 A charge of 5 C experiences a force of 5000 N when it is kept in a uniform electric field. What is the potential difference between two points separated by a distance of 1 cm

(1) 10 V (2) 250 V (3) 1000 V (4) 2500 V

Q.8 If a charged spherical conductor of radius 10 cm has potential V at a point distant 5 cm from its centre, then the potential at a point distant 15 cm from the centre will be

(1) $\frac{1}{3}$V (2) $\frac{2}{3}$V (3) $\frac{3}{2}$V (4) 3 V

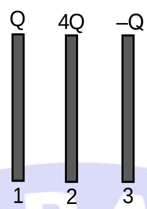
Q.9 If a unit positive charge is taken from one point to another over an equipotential surface, then

(1) Work is done on the charge (2) Work is done by the charge

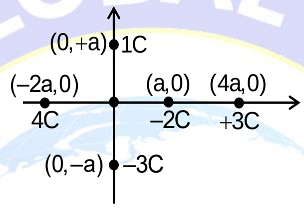
(3) Work done is constant (4) No work is done

Q.10 The electric field in a region is given by $\vec{E} = \frac{3}{5}E_0\hat{i} + \frac{4}{5}E_0\hat{j}$ with $E_0 = 2.0 \times 10^3$ N/C. Find the flux of this field through a rectangular surface of area $0.2m^2$ parallel to the Y–Z plane.

Q.11 Figure shows three large metallic plates with charges Q, 4Q and –Q respectively. Determine the final charges on all the surfaces.

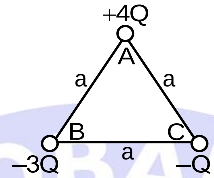


Q.12 Find the potential at origin ?



Practice Section-03

Q.1 Three charges of (+4Q), (–3Q) and (–Q) are placed at the corners A, B and C of an equilateral triangle of side a as shown in the adjoining figure. Then the dipole moment of this combination is



(1) $\frac{Qa}{\sqrt{13}}$ (2) zero (3) $Qa\sqrt{13}$ (4) $\frac{2}{\sqrt{13}}Qa$

Q.2 An electrical dipole of moment 'p' is placed in an electric field of intensity 'E'. The dipole acquired a position such that the axis of the dipole makes an angle θ with the direction of the field. Assuming 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 sinθ, 2pE cosθ (2) pE cosθ, –pE sinθ (3) pE sinθ, –pE cosθ (4) pE sinθ, –2pE cosθ

Q.3 Two charges $+3.2 \times 10^{-19}$ and -3.2×10^{-19} C placed at 2.4 Å apart form an electric dipole. It is placed perpendicularly in a uniform electric field of intensity 4×10^{5} volt/m. The electric dipole moment is
(1) 15.36×10^{-29} coulomb × m (2) 15.36×10^{-19} coulomb × m
(3) 7.68×10^{-29} coulomb × m (4) 7.68×10^{-19} coulomb × m

Q.4 An electric dipole when placed in a uniform electric field E will have minimum potential energy,, if the positive direction of dipole moment makes the following angle with E
(1) π (2) π/ 2 (3) Zero (4) 3π/ 2

Q.5 An electric dipole is kept in non-uniform electric field. It experiences
(1) A force and a torque (2) A force but not a torque
(3) A torque but not a force (4) Neither a force nor a torque

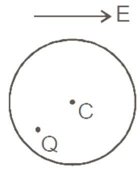
Q.6 An electric dipole consisting of two opposite charges of 2×10^{-6} C each separated by a distance of 3 cm is placed in an electric field of 2×10^{5} N/C. The maximum torque on the dipole will be
(1) 12×10^{-1} Nm (2) 12×10^{-3} Nm (3) 24×10^{-1} Nm (4) 24×10^{-3} Nm

Q.7 An electric dipole of moment $\vec{p}$ is placed normal to the lines of force of electric intensity $\vec{E}$ then the work done in deflecting it through an angle of 180° is
(1) pE (2) +2pE (3) –2pE (4) Zero

Q.8 The net charge given to an isolated conducting solid sphere :
(1) must be distributed uniformly on the surface (2) may be distributed uniformly on the surface
(3) must be distributed uniformly in the volume (4) may be distributed uniformly in the volume.

Q.9 The net charge given to a solid insulating sphere:
(1) must be distributed uniformly in its volume
(2) may be distributed uniformly in its volume.
(3) must be distributed uniformly on its surface.
(4) the distribution will depend upon whether other charges are present or not.

Q.10 A positive point charge Q is kept (as shown in the figure) inside a neutral conducting shell whose centre is at C. An external uniform electric field E is applied. Then :



(1) Force on Q due to E is zero
(2) Net force on Q is zero
(3) Net force acting on Q and conducting shell considered as a system is zero
(4) Net force acting on the shell due to E is zero.

Q.11 A conducting sphere of radius r has a charge. Then
(1) The charge is uniformly distributed over its surface, if there is an external electric field.
(2) Distribution of charge over its surface will be non-uniform if no external electric field exist in space.
(3) Electric field strength inside the sphere will be equal to zero only when no external electric field exists.
(4) Potential at every point of the sphere must be same

Q.12 If 1000 tiny drops of radii 1mm with charge 1μC on each is colesce (combined). Find the potential & electric field on bigger drop?