ELECTROSTATICS

1. Electric charge were named as positive and negative by scientist :-

(1) Faradey (2) Coulomb

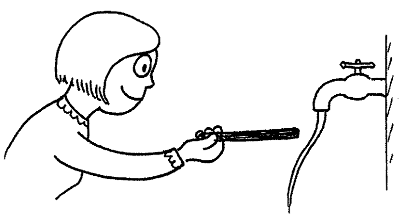
(3) Gilbert (4) Benjamin Franklin

2. Millikan's oil drop experiment attempts to measure the charge on a single electron, e, by measuring the charge on tiny oil drops suspended in an electrostatic field. It is assumed that the charge on the oil drops is due to just a small number of excess electrons. The charges 3.90×10^{-19}C, 6.50×10^{-19}C, and 9.10×10^{-19}C are measured on three drops of oil. The charge of an electron is deduced to be,

(1) 1.3×10^{-19}C (2) 1.6×10^{-19}C

(3) 2.6×10^{-19}C (4) 3.9×10^{-19}C

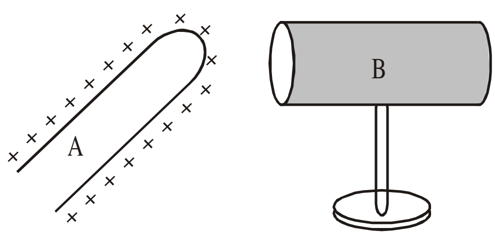
3. In normal cases thin stream of water bends toward a negatively charged rod. When a positively charged rod is placed near the stream, it will bend in the



(1) Opposite direction (2) Same direction.

(3) It won't bend at all (4) Can't be predicted.

4. A positively charged body A has been brought near a brass cylinder B mounted on a glass stand as shown in figure. The potential of B will be :-



(1) zero (2) negative

(3) positive (4) infinite

5. Gold leaves of an electroscope are negatively charged. When X–rays incident on leaves then leaves :-

(1) Converges

(2) Diverges

(3) First diverges and then converges

(4) Remains at their own position

6. In quark model, a proton and a neutron consist of three quarks each. Two types of quarks, the so called 'up' quark (denoted by u) of charge $+\frac{2}{3}e$ and the 'down' quark (denoted by d) of charge $-\frac{1}{3}e$, together with electrons build up ordinary matter. A possible mark composition of a proton and neutron is :-

(1) udd, udd (2) uud, udd

(3) uud, uud (4) ddd, uuu

7. Two identical conducting spheres M and N has charges q_m and q_n respectively. A third identical neutral sphere P is brought in contact with M and then seperated. Now sphere P is brought in contact with N then final charge on sphere P is-

(1) $\frac{q_m + 2q_n}{4}$ (2) $\frac{q_m + q_n}{4}$

(3) $q_m + \frac{q_n}{2}$ (4) $\frac{q_m + 2q_n}{2}$

8. Five balls, numbered 1 to 5 are suspended using separate threads. Pairs (1, 2), (2, 4), (4, 1) show electrostatics attraction, while pairs (2, 3) and (4, 5) show electrostatics repulsion. Therefore, the ball 1 must be

(1) positively charged. (2) negatively charged.

(3) neutral (4) made of metal

9. A positively charged rod is held near a ball suspended by an insulating thread. The ball is seen to start moving toward the charged rod. Which of the following option is most appropriate ?

(1) the ball must have had a charge opposite to that of the rod

(2) the ball must be positively charged

(3) the ball must be metallic

(4) the ball may be neutral

10. A positively charged insulator is brought near (but does not touch) two metallic spheres that are in contact. The metallic spheres are then separated. The sphere, which was initially farthest from the insulator, will have :-

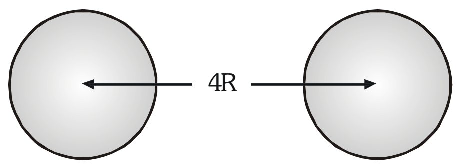
(1) no net charge

(2) a negative charge

(3) a positive charge

(4) either a positive or negative charge

11. Two identical spheres each of radius R are kept at center–to–center spacing 4R as shown in the figure. They are charged and the electrostatic force of interaction between them is first calculated assuming them like point charges at their centers and the force is also measured experimentally. The calculated and measured forces are denoted by F_c and F_m respectively. (F_c and F_m denote magnitude of force)



(1) When they carry charges of the same sign $F_c > F_m$ and when they carry charges of opposite signs $F_c < F_m$ only when they are insulator.

(2) When they carry charges of the same sign $F_c > F_m$ and when they carry charges of opposite signs $F_c < F_m$ only when they are conductor.

(3) When they carry charges of the same sign $F_c < F_m$ and when they carry charges of opposite signs $F_c > F_m$ irrespective of their material.

(4) When they carry charges of the same sign $F_c > F_m$ and when they carry charges of opposite signs $F_c < F_m$ irrespective of their material.

12. Tick the incorrect statement :-

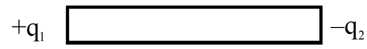
(1) There is a lower limit to the electrostatic force between two particles placed at a separation of 1 m

(2) A gravitational field can be added vectorially to an electric field to get a total field.

(3) The force on a charge due to another charge does not depend on the charges present nearby

(4) A charged particle in uniform circular motion always radiate energy

13. A thin insulator rod is placed between two unlike point charges $+q_1$ and $-q_2$. For this situation tick the wrong alternative.



(1) The total force acting on charge $+q_1$ will increase.

(2) The total force acting on charge $-q_2$ will increase.

(3) The total force acting on charge $-q_2$ will decrease.

(4) The force acting on charge $+q_1$ due to $-q_2$ will remain same.

14. Electrostatic force and gravitational force differ in which respect?

(1) Conservative force

(2) Central force

(3) Principle of superposition

(4) Dependence on the intervening medium

15. Two identical blocks are kept on a frictionless horizontal table and connected by a spring of stiffness 'k' and of natural length ℓ_0. A total charge Q is distributed on the blocks in a way such that in equilibrium spring elongates by maximum value. If this value is equal to x then value of Q is :

(1) $2\ell_0\sqrt{4\pi\varepsilon_0 k(\ell_0 + x)}$

(2) $2x\sqrt{4\pi\varepsilon_0 k(\ell_0 + x)}$

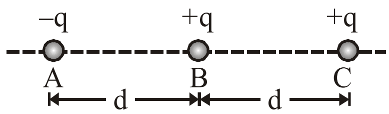
(3) $2(\ell_0 + x)\sqrt{4\pi\varepsilon_0 kx}$

(4) $(\ell_0 + x)\sqrt{4\pi\varepsilon_0 kx}$

16. Let 'e' be charge of an electron. Let point charges be present at vertices of a cube of side 'a' & let 'F' be magnitude of force between two electrons separated by distance 'a'. Which of the following cannot be the force exerted by any of the charge on any other charge present on vertices of the cube ?

(1) $\frac{F}{2}$ (2) $\frac{3F}{4}$ (3) $\frac{F}{3}$ (4) 9F

17. Consider the electric charges A, B, C shown in the figure below, where q is a positive number. Which answer correctly describes the magnitude of the net force experienced by the charges ?



(1) $F_A > F_B > F_C$ (2) $F_A > F_C > F_B$
(3) $F_B > F_A > F_C$ (4) $F_A = F_B = F_C$

18. Which of the following device invented by coulomb to measure quantity of electrostatic force:

(1) Physical balance
(2) Spring balance
(3) Torsion balance
(4) None of these

19.

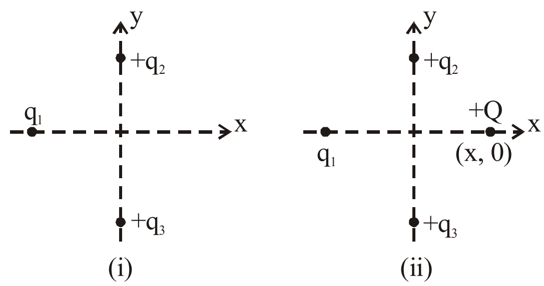


Figure shows two charge + q_2 and $+q_3$ fixed along y axis, exerts a net electric force in the +x direction on a charge q_1 fixed along x axis. If a +Q is added at (x, 0), then force on q_1 :-

(1) Shall increase along +x direction
(2) Shall decrease along +x direction
(3) Shall point along –x direction
(4) None

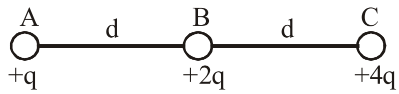
20. A positive point charge +Q is placed at x = 0 and a negative point charge –Q is placed at x = a. The magnitude of the electrostatic force between the two is F. If another point charge +Q is placed at x = –a, the net force on the charge at the origin (x = 0) is :-

(1) 2F in the negative x-direction
(2) F in the positive x-direction
(3) 5F/4 in the positive x-direction
(4) 2F in the positive x-direction

21. A point charge +Q is placed at the centroid of an equilateral traingle. When a second charge +Q is placed at a vertex of the triangle, the magnitude of the electrostatic force on the central charge is 4N. What is the magnitude of the net force on the central charge when a third charge +Q is placed at another vertex of the triangle ?

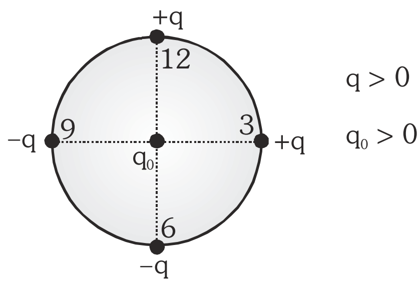
(1) Zero (2) 4N (3) $4\sqrt{2}$N (4) 8N

22. Three charges +q, +2q and +4q are connected by strings as shown in the figure. What is the ratio of tensions in the strings AB and BC.



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

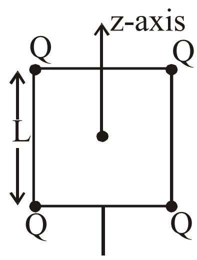
23. Four charges are placed at the circumference of a dial clock as shown in figure.



If the clock has only hour hand then the resultant force on a charge q_0, placed at the centre points in the direction which shows the time as:-

(1) 1 : 30 (2) 7 : 30 (3) 4 : 30 (4) 10 : 30

24. Four point +ve charges of same magnitude (Q) are placed at four corners of a rigid square frame in xy plane as shown in figure. The plane of the frame is perpendicular to z-axis. If a –ve point charges 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

25. Two small spheres with masses m_1 and m_2 hang on weightless, insulating threads with lengths ℓ_1 and ℓ_2. The two spheres carry a charge of q_1 and q_2 respectively. The spheres hang such that they are level with one another and the threads are inclined to the vertical at angle θ_1 and θ_2. Which of the following conditions is required if $\theta_1 = \theta_2$.

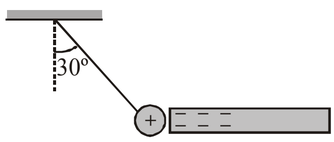
(1) $m_1 = m_2$

(2) $|q_1| = |q_2|$

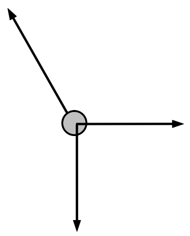
(3) $\ell_1 = \ell_2$

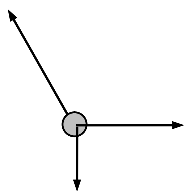
(4) None of the above

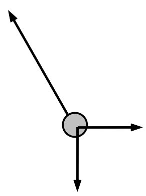
26. A small electrically charged sphere is suspended vertically from a thread. An oppositely charged rod is brought close to the sphere such that the sphere is in equilibrium when displaced from the vertical by an angle of 30°.

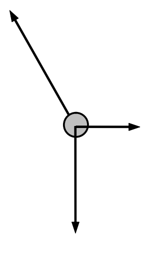


Which one of the following best represents the free body diagram for the sphere?

(1) 

(2) 

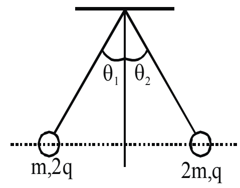
(3) 

(4) 

27. Two point charges –4Q and 9Q are placed at a distance 2 m from each other. The position at which net electric field is zero from the charge –4Q is x (in m). What is the value of x ?

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

28. Two particles which have masses and charges m and 2q and 2m and q respectively are hung by massless threads from a point as shown in equilibrium particles are on same horizontal line what can be the relation in θ_1 & θ_2. (θ_1 & θ_2 are not upto scale in figure)



(1) $\theta_1 > \theta_2$

(2) $\theta_1 < \theta_2$

(3) $\theta_1 = \theta_2$

(4) More information is required.

29. Two identical charged spheres are suspended by strings of equal lengths. The strings make an angle of 30° with each other. When suspended in a liquid of density 1 g cm^{-3}, the angle remains the same. If density of the material of the sphere is 4/3 g cm^{-3}, the dielectric constant of the liquid is:-

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

30. Pick the incorrect statement :-

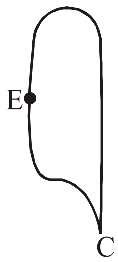
(1) If a point charge is placed off-centre inside an electrically neutral spherical metal shell, then induced charge on its inner surface is uniformly distributed.

(2) If a point charge is placed off-centre inside an electrically neutral, isolated spherical metal shell, then induced charge on its outer surface is uniformly distributed.

(3) A non metal spherical shell of uniform charge attracts or repels a charged particle that is outside the shell such as all the shell's charge were concentrated at the centre of the shell.

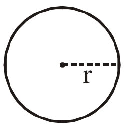
(4) If a charged particle is located inside a non metal spherical shell of uniform charge, there is no electrostatic force on the particle due to the shell.

31. In figure, charge is placed on the piece of copper. How will the charge be distributed on the object?

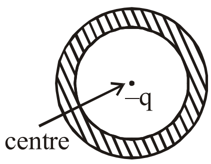


(1) Uniformly throughout the volume
(2) Uniformly over the surface
(3) With greatest density near point C on the surface
(4) With greatest density near point E on the flat surface

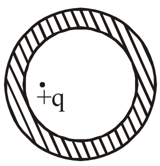
32. In which of the case(s) we will get uniform charge distribution on external spherical surface. Given every object is a conductor.

(A) 

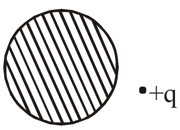
thin shell having net charge +q

(B) 

thick shell having net charge zero

(C) 

thick shell having net charge zero

(D) 

solid sphere having net charge +q

(1) Only A & B (2) Only A, B & C
(3) Only A (4) All

33. A metallic spherical shell has inner radius R_1 and outer radius R_2. A charge +Q is placed at the centre of spherical cavity. The surface charge density on inner and outer surface respectively:-

(1) $\frac{-Q}{4\pi R_1^2}, \frac{+Q}{4\pi R_2^2}$ (2) $\frac{+Q}{4\pi R_1^2}, \frac{-Q}{4\pi R_2^2}$

(3) Zero, Zero (4) $\frac{-Q}{4\pi R_1^2}, \frac{+2Q}{4\pi R_2^2}$

34. Two metal sphere one of radius R and the other of radius 2R, both have same surface charge density σ. They are brought in contact and separated. New surface charge densities on them, respectively :-

(1) $\frac{5\sigma}{3}, \frac{5\sigma}{6}$ (2) $\frac{5\sigma}{6}, \frac{5\sigma}{3}$

(3) $\frac{\sigma}{3}, \frac{2\sigma}{3}$ (4) $\frac{2\sigma}{3}, \frac{\sigma}{3}$

35. Two point charges Q_1 and Q_2 of equal magnitude are placed at a certain distance from each other. Assuming the field strength to be positive in the positive direction of x–axis

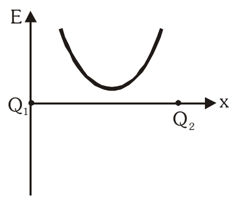


Fig. 1

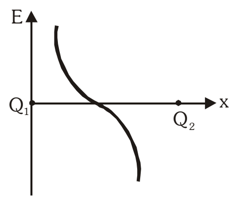


Fig. 2

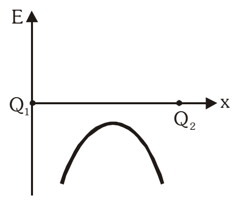


Fig. 3

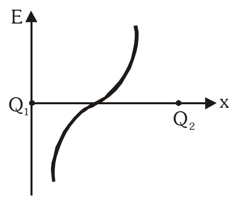
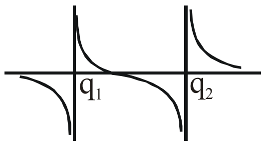
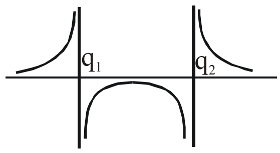
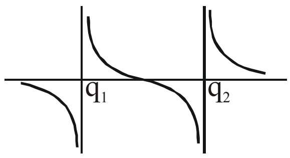
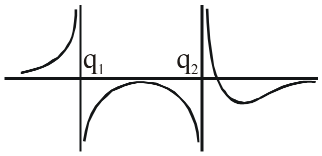


Fig. 4

The signs of the charges Q_1 and Q_2 for given graphs are

(1) +,+ ; +,– ; –,+ ; –,–
(2) +,– ; +,+ ; –,+ ; –,–
(3) –,+ ; +,– ; +,+ ; –,–
(4) +,+ ; +,– ; –,– ; –,+

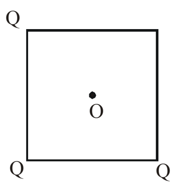
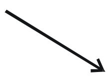
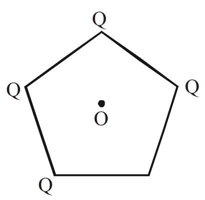
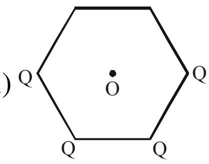
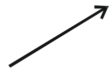
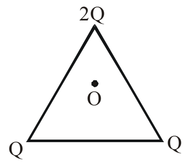
36. Variation of electric field along the line joining two charges is given in list-I. Relation between charges is given in list-II. Match the proper variation. Take electric field along right as positive

List-I	List-II
(P) 	(1) $\lvert q_1\rvert > \lvert q_2\rvert$; $q_1 < 0 ; q_2 > 0$
(Q) 	(2) $\lvert q_1\rvert = \lvert q_2\rvert$; $q_1 > 0 ; q_2 > 0$
(R) 	(3) $\lvert q_1\rvert = \lvert q_2\rvert$; $q_1 < 0 ; q_2 > 0$
(S) 	(4) $\lvert q_2\rvert > \lvert q_1\rvert$; $q_1 > 0$; $q_2 > 0$

Code:-

	P	Q	R	S
(1)	3	1	2	4
(2)	1	4	2	3
(3)	4	3	2	1
(4)	2	3	4	1

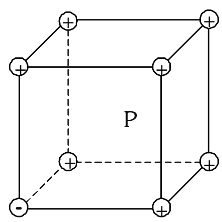
37. In the given diagrams the direction of electric field at point O is given in list-II (O is circumcenter of the given regular polygon). Charge Q is positive. Match the direction of electric field for the given arrangement:-

List-I	List-II
(P) 	(1) 
(Q) 	(2) 
(R) 	(3) 
(S) 	(4) 

Code :-

	P	Q	R	S
(1)	2	1	4	3
(2)	3	1	2	4
(3)	3	2	1	4
(4)	1	4	3	2

38. Consider a regular cube with positive point charge +Q in all corners except for one which has a negative point charge –Q. Let the distance from any corner to the center of the cube be r. What is the magnitude of electric field at point P, the center of the cube?

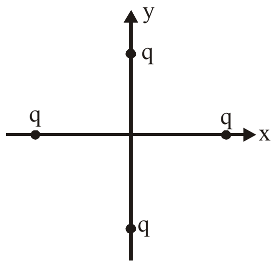


(1) E = 0
(2) $E=1\ kQ/r^2$
(3) $E=2kQ/r^2$
(4) $E=6kQ/r^2$

39. A point charge of 25 μC is located in the XY plane at the point of position vector $\vec{r}_0 = \left(\hat{i}+\hat{j}\right)m$. What is the magnitude of electric field at the point of position vector $\vec{r}_1 = \left(4\hat{i}+5\hat{j}\right)m$?

(1) $900\dfrac{V}{m}$
(2) $\dfrac{9V}{m}$
(3) $90\dfrac{V}{m}$
(4) $9000\dfrac{V}{m}$

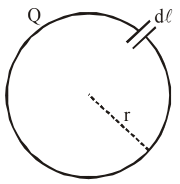
40. Four point charges, each carrying charge q, are at the positions with coordinates of (a,0), (–a,0), (0,a), (0,–a), respectively. The electric field strength at (0, a/2) is



(1) $\frac{1}{4\pi\varepsilon_0}\frac{q}{a^2}$ (2) $\frac{3.84}{4\pi\varepsilon_0}\frac{q}{a^2}$

(3) $\frac{1.84}{4\pi\varepsilon_0}\frac{q}{a^2}$ (4) $\frac{2.84}{4\pi\varepsilon_0}\frac{q}{a^2}$

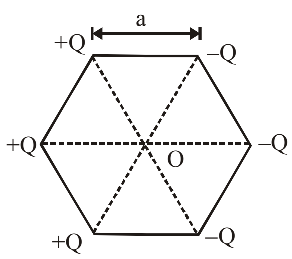
41. A ring of radius "r" has charge Q. It is cut by small length $d\ell$. Find the electric field at the centre :-



(1) Zero (2) $\frac{Qd\ell}{2\pi r^2\varepsilon_0}$

(3) $\frac{Qd\ell}{2\pi r^3\varepsilon_0}$ (4) $\frac{Qd\ell}{8\pi^2\varepsilon_0 r^3}$

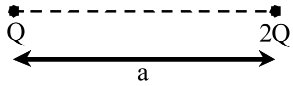
42. Six charges are placed at the vertices of a regular hexagon as shown in the figure. Component of the electric field along the line passing through point O and perpendicular to the plane of the figure at a distance of x (>>a) from O is

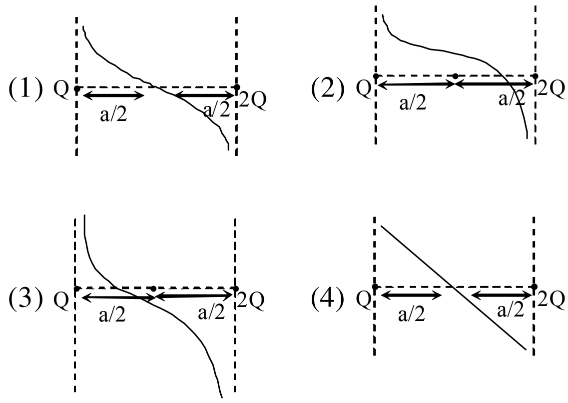


(1) $\frac{Qa}{\pi\varepsilon_0 x^3}$ (2) $\frac{2Qa}{\pi\varepsilon_0 x^3}$

(3) $\frac{\sqrt{3}Qa}{\pi\varepsilon_0 x^3}$ (4) zero

43. Find the variation of electric field on the line joining the two charges - [Take +x axis as +ve direction of $\vec{E}$]





44. A ring carries a linear charge density on one half and the linear charge density of same magnitude but opposite sign on the other half.

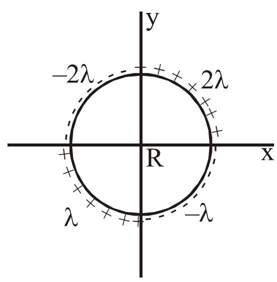
(1) the component of electric field along the axis of ring, at all points on the axis, is non-zero.

(2) the component of electric field along the axis of ring at point on the axis is zero only at the centre.

(3) the resultant field at the centre is zero.

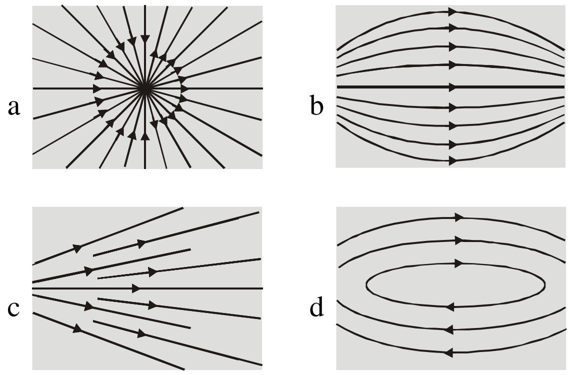
(4) the electric field at all points on the axis of ring is perpendicular to axis.

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



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

46. Consider the four field patterns shown. Assuming there are no charges in the regions shown, which of the patterns represents a possible electrostatic field:



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

47. Mark the **CORRECT** statement :-

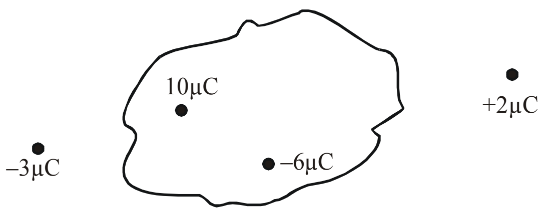
(1) The tangential component of electric field at the surface of a electrostatic conductor is continuous.

(2) The normal component of electric field at the surface of an electrostatic conductor is discontinuous

(3) Work function (which is the minimum work required to remove an electron from inside the conductor) is equal to (–e) ($V_{surface}$ – V_{inside}). Thus work function is zero for an electrostatic conductor.

(4) All free electrons reside on the surface of the conductor

48. In a particular system, number of electric field lines associated by 1C charge is 10^9. If net number of electric field lines passing through the given closed surface is n × 10^3 then find n.



(1) 4 (2) 6 (3) 2.5 (4) 3

49. The electric field at a point is :

(1) always continuous

(2) continuous if there is no charge at that point

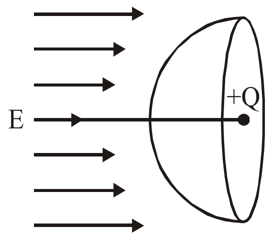
(3) discontinuous if there is a negative charge at that point.

(4) Both (2) and (3)

50. The figure shows a point charge +Q placed at the center of an imaginary hemispherical surface of radius R. A uniform electric field E is applied in the horizontal direction. If the net flux passing through the hemispherical surface is zero then what is the magnitude of the electric field E.

(1) $\frac{Q}{2\pi\varepsilon_0 R^2}$

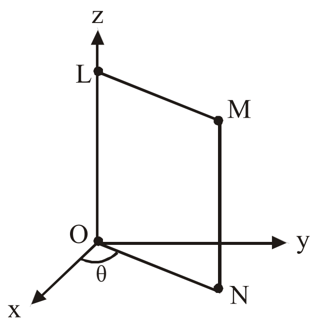
(2) $\frac{Q}{2\varepsilon_0 R^2}$



(3) $\frac{Q}{\pi\varepsilon_0 R^2}$

(4) $\frac{Q}{\varepsilon_0 R^2}$

51. The electric field intensity at all points in space is given by $\vec{E} = \sqrt{3}\hat{i} - \hat{j}$ volts/metre. A square frame LMNO of side 1 metre is shown in figure. The point N lies in x-y plane. The initial angle between line ON and x-axis is θ = 60°.



The magnitude of electric flux through area enclosed in square frame LMNO is -

(1) 0 volt-metre (2) 1 volt-metre

(3) 2 volt-metre (4) 4 volt-metre

52. A body in the form of a right circular cone of dielectric material with base radius R and height h is placed with its base on a horizontal table. A horizontal uniform electric field of magnitude E penetrates the cone. The electric flux that enters the body is

(1) ERh/3 (2) ERh

(3) ERh/6 (4) 2ERh

53. Select incorrect statement :-

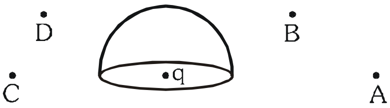
(1) Electrostatics lines of forces cannot be closed

(2) Gauss's law is valid for any arbitrary charge distribution

(3) Electrostatic field is a conservative field

(4) Coulomb's law is valid for cylindrical symmetry of charge

54. Figure shows a charge q placed at the centre of a hollow hemisphere. A second charge Q is placed at one of the positions A, B, C and D. In which position (s) of this second charge, the flux of the electric field through the hemisphere remains unchanged ?



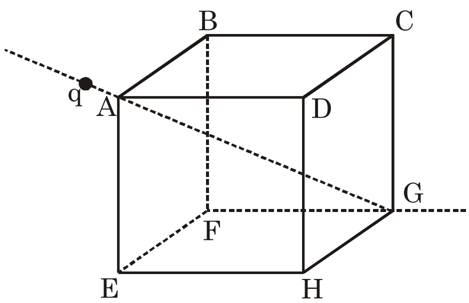
(1) A and C

(2) B and D

(3) A and D

(4) A,B,C and D

55. A charge q is kept just outside a cube on extension of digonal GA. The magnitude of electric flux of face ABCD is :



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

(3) $\frac{q}{24\epsilon_0}$ (4) $\frac{q}{18}\epsilon_0$

56. A point charge +q is kept near infinitely long sheet, the total flux linked with the sheet is :-

(1) $\frac{q}{\epsilon_0}$ (2) $\frac{q}{\sigma\epsilon_0}$ (3) $\frac{q}{2\epsilon_0}$ (4) Zero

57. If $\oint_S \vec{E}.\vec{ds} = 0$ over a surface, then

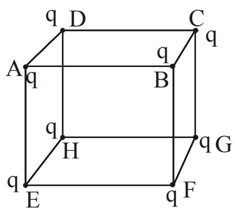
(1) the electric field inside the surface and on it is zero.

(2) the electric field inside the surface is necessarily uniform.

(3) the number of flux lines entering the surface must be equal to the number of flux lines leaving it.

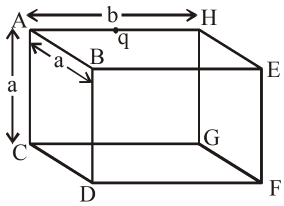
(4) all charges must necessarily be outside the surface.

58. Eight point charges having magnitude q are fixed at vertices of a cube. The electric flux through square surface ABCD of the cube is



(1) $\frac{q}{24\epsilon_0}$ (2) $\frac{q}{12\epsilon_0}$ (3) $\frac{q}{6\epsilon_0}$ (4) $\frac{q}{3\epsilon_0}$

59. A cuboid is of dimension [a × a × b]. Charge q is placed at the centre of edge having length 'b'. If flux through face 'ABCD' is $\frac{q}{32\epsilon_0}$ then select the correct statement(s) :-



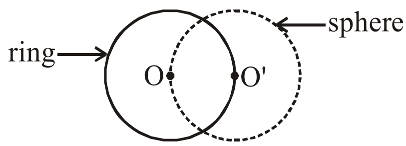
(1) Flux through the entire cuboid is $\frac{q}{4\epsilon_0}$

(2) Flux through the face 'ABEH' is zero.

(3) Flux through the face 'BEFD' is $\frac{3q}{32\epsilon_0}$

(4) All of these

60. A charge Q is distributed uniformly on a ring of radius r. Consider an sphere of equal radius r with its centre at the periphery of the ring. Find the flux of the electric field through the surface of the sphere -

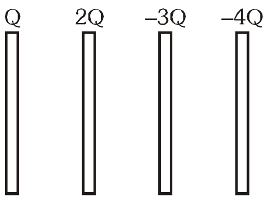


(1) $\frac{Q}{4\epsilon_0}$ (2) $\frac{Q}{6\epsilon_0}$ (3) $\frac{Q}{3\epsilon_0}$ (4) $\frac{Q}{2\epsilon_0}$

61. A hollow charged conductor having surface charge density σ, has a tiny hole cut into its surface. The electric field in the hole is :-

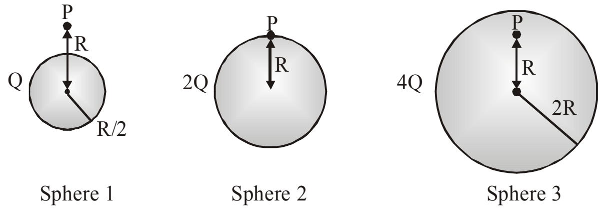
(1) $\frac{\sigma}{\varepsilon_0}$ (2) $\frac{\sigma}{2\varepsilon_0}$ (3) $\frac{\sigma}{4\varepsilon_0}$ (4) Zero

62. Four very large metal plates are given charges as shown. The middle two are then connected through a conducting wire. The charge that will flow through the wire is



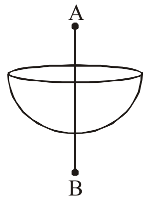
(1) Q (2) 2Q (3) 3Q (4) 5Q

63. Charges Q, 2Q and 4Q are uniformly distributed in three non conducting solid spheres 1, 2 and 3 of radii R/2, R and 2R respectively, as shown in figure. If magnitudes of the electric fields at point P at a distance R from the centre of spheres 1, 2 and 3 are E_1, E_2 and E_3 respectively, then



(1) $E_1 > E_2 > E_3$ (2) $E_3 > E_1 > E_2$
(3) $E_2 > E_1 > E_3$ (4) $E_3 > E_2 > E_1$

64. The diagram shows a uniformly charged hemisphere of radius R. It has volume charge density ρ. If the electric field at a point 2R distance above its centre is E, then what is the electric field at the point which is 2R below its centre?



(1) $\frac{\rho R}{6\varepsilon_0}+E$ (2) $\frac{\rho R}{12\varepsilon_0}-E$

(3) $\frac{-\rho R}{6\varepsilon_0}+E$ (4) $\frac{\rho R}{24\varepsilon_0}+E$

65. A hollow charged spherical conductor has a tiny hole cut into surface. The electric field into hole is (where σ is surface charge density near the hole)

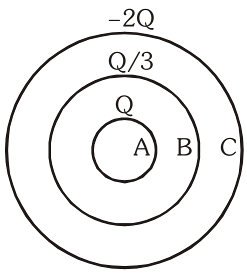
(1) $\frac{\sigma}{2\epsilon_0}$, outward normal direction

(2) $\frac{\sigma}{2\epsilon_0}$, inward normal direction

(3) $\frac{\sigma}{\epsilon_0}$, outward normal direction

(4) $\frac{\sigma}{\epsilon_0}$, inward normal direction

66. Three conducting concentric spherical shells of radius R, 2R and 3R have charges Q, $\frac{Q}{3}$ and – 2Q respectively. The intermediate shell is now grounded. Find the charge flow into the earth.



(1) $\frac{Q}{3}$ (2) $\frac{2Q}{3}$ (3) Q (4) 0

67. An electric charge of 10nC is placed at the point O (4m, 7m, 2m). At the point P (1m, 3m, 2m):–

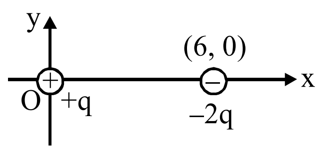
(1) The electric potential is 18 volt.

(2) The electric field has no z–component.

(3) The magnitude of electric field is 3.6 V/m.

(4) All of these

68. The ratio of magnitude of electric field due to +q and –2q at a point between the charges where net potential is zero on x-axis is $\beta : 1$, then β will be.



(1) 2 (2) 4 (3) 0.5 (4) 0.25

69. Four charges 2C, –3C, –4C and 5C respectively are placed at all the corners of a square. Which of the following statements is true for the point of intersection of the diagonals:-

(1) Electric field is zero but electric potential is non-zero

(2) Electric field is non-zero but electric potential is zero.

(3) Both electric field and electric potential are zero

(4) Neither electric field nor electric potential is zero

70. Two point-charges, each with a charge of +1μC, lie some finite distance apart. On which of the segments of an infinite line going through the charges is there a point, a finite distance away from the charges, where the electric potential is zero, assuming that it vanishes at infinity ?

(1) Between the charges only

(2) On either side outside the system

(3) Impossible to tell without knowing the distance between the charges.

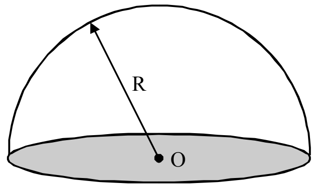
(4) No where

71. Electric potential at the surface of a uniformly charged solid sphere is 4 volt. Find the electric potential (in volt) at the centre of sphere.

(1) 2 volt (2) 6 volt

(3) 4 volt (4) 3 volt

72. Charge Q coulombs is uniformly distributed throughout the volume of a solid hemisphere of radius R metres. Then the potential at centre O of the hemisphere in volts is



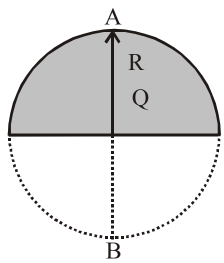
(1) $\frac{1}{4\pi\varepsilon_o}\frac{3Q}{2R}$ (2) $\frac{1}{4\pi\varepsilon_o}\frac{3Q}{4R}$

(3) $\frac{1}{4\pi\varepsilon_o}\frac{Q}{4R}$ (4) $\frac{1}{4\pi\varepsilon_o}\frac{Q}{8R}$

73. A solid sphere of radius R is charged uniformly throughout the volume. At what distance from its surface, is the electric potential 1/4 of the potential at the centre ?

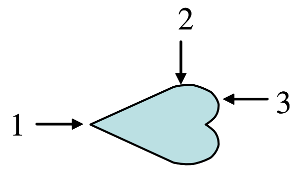
(1) 8R/3 (2) R/3 (3) 5R/3 (4) 2R/3

74. Q charge given to a uniform hemispherical charged distribution of radius 'R'. The potential at two diametrically opposite points are V_A & V_B then $(V_A + V_B)$ is equal to :



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

75. A heart shaped conductor shown below carries net charge Q. Which of the statement, about the electric field E and the surface charge density σ, below is correct?



(1) E strongest and σ smallest at position-1

(2) E strongest and σ highest at position-1

(3) E weakest and σ highest at position-2

(4) E strongest and σ highest at position-3

76. The electric potential inside a charged solid spherical conductor in electrostatic condition:-

(1) is always zero

(2) decreases from its value at the surface to a value of zero at the centre

(3) is constant and equal to its value at the surface

(4) increases from its value at the surface to a higher value at the centre

77. The maximum possible electrostatic potential produced by a spherical conductor of radius R is directly proportional to :-

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

78. Consider a finite insulated, uncharged conductor placed near a finite positively charged conductor. The uncharged body must have a potential :

(1) less than the charged conductor and more than at infinity.

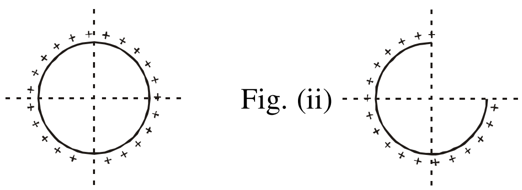
(2) more than the charged conductor and less than at infinity.

(3) more than the charged conductor and more than at infinity.

(4) less than the charged conductor and less than at infinity.

79. Charge Q is spread uniformly over a circular ring of radius R, which gives electrical potential V_1 at its centre. If an arc of length $\frac{\pi R}{2}$ is removed from the ring [as shown in figure (ii)] keeping the net charge Q on the remaining part constant.The relation between new potential V_2 at the centre and V_1 is

Fig. (i) Fig. (ii)



(1) $V_1 > V_2$

(2) $V_2 > V_1$

(3) $V_1 = V_2$

(4) can't determined

80. Consider two conducting sphere of radius R_1 and R_2 with $R_1 > R_2$. If two are at the same potential, There surface charge densities are σ_1 and σ_2 respectively then :-

(1) $\sigma_1 = \sigma_2$ (2) $\sigma_1 < \sigma_2$

(3) $\sigma_1 > \sigma_2$ (4) None

81. Electric potential in a particular region of space is $V = 12x - 3x^2y + 2yz^2$. The electric field at point P (1m, 0, –2m) is :-

(1) 12 unit (2) 13 unit

(3) 5 unit (4) Zero

82. The electric potential due to an infinite sheet of positive charge density σ at a point located at a perpendicular distance Z from the sheet is (Assume V_0 to be the potential at the surface of sheet) :

(1) V_0 (2) $V_0 - \frac{\sigma Z}{\varepsilon_0}$

(3) $V_0 + \frac{\sigma Z}{2\varepsilon_0}$ (4) $V_0 - \frac{\sigma Z}{2\varepsilon_0}$

83. Consider following statement about the relation between electric field and potential.

(A) Electric field is in the direction in which the potential increases steepest

(B) Electric field is in the direction in which the potential decreases steepest

(C) Magnitude of electric field is given by the change in the magnitude of potential per unit displacement normal to the equipotential surface at that point

(D) Magnitude of electric field is given by the change in the magnitude of potential per unit displacement parallel to the equipotential surface at that point

Select correct alternative :-

(1) A and B (2) B and C

(3) A and C (4) All the above

84. An electric field $\left(-30\hat{i}+20\hat{j}\right)\text{Vm}^{-1}$ exists in the space. If potential at the origin is zero, then find the potential at (5m,3m) in volts.

(1) 110 volt (2) 90 volt

(3) 100 volt (4) 95 volt

85. Let V be electric potential and E the magnitude of the electric field. At a given position, which of the following statements is true ?

(1) E is always zero where V is zero

(2) V is always zero where E is zero

(3) E can be zero where V is non-zero

(4) E is always non-zero where V is non-zero

86. Consider a uniform electric field in the $\hat{k}$ direction. The potential is constant :-

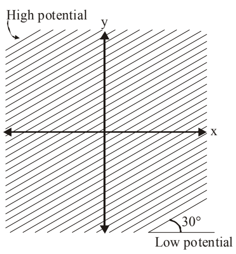
(1) for any x for a given z

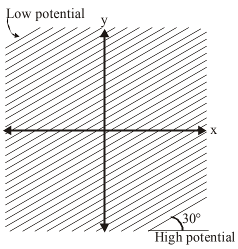
(2) for any y for a given z

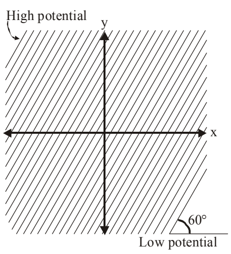
(3) on the x-y plane for a given z

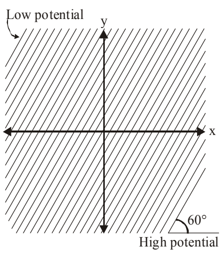
(4) All of these

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

(1) 

(2) 

(3) 

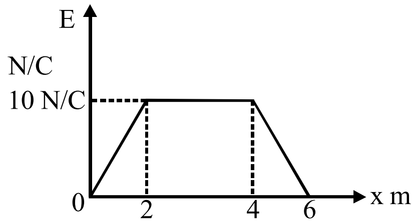
(4) 

88. 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) & point B (1, 3)

(1) 100 V (2) $200\sqrt{2}$ V

(3) 200 V (4) zero

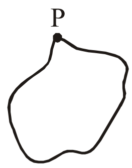
89. Figure shows the variation of electric field intensity with distance x. What is the potential difference between the points at x = 2m and x = 6m from origin ?



(1) 30 V (2) 60 V

(3) 40 V (4) 80 V

90. If we have an irregularly shaped conductor as shown and a charge is given to it, choose the correct statement.



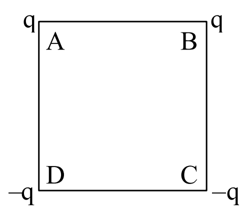
(1) the electric field and electric potential at P is maximum among all points of conductor.

(2) the electric field at P is maximum and electric potential is same at all points of conductor.

(3) the electric field and electric potential at P is same at all points of conductor.

(4) the electric field and electric potential at P is minimum among all points of conductor.

91. Charges are placed on the vertices of a square as shown. Let $\vec{E}$ be the electric field and V the potential at the centre. If the charges on A and B are interchanged with those on D and C respectively, then -



(1) $\vec{E}$ remains unchanged, V changes

(2) Both $\vec{E}$ and V changes

(3) $\vec{E}$ and V remains unchanged

(4) $\vec{E}$ changes, V remains unchanged

92. A spherical conductor A of radius r is placed concentrically inside a conducting shell B of radius R (R > r). A charge Q is given to A, and then A is joined to B by a metal wire. The charge flowing from A to B will be :-

(1) $Q\left(\frac{R}{R+r}\right)$ (2) $Q\left(\frac{r}{R+r}\right)$

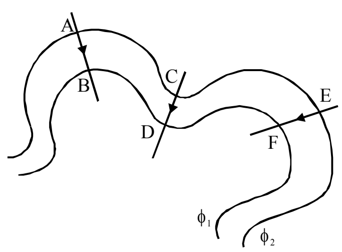
(3) Q (4) 0

93. 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) $\frac{U_2 - U_1}{2q}$

94. In moving from A to B along an electric field line, the electric field does 1.28×10^{-18} J of work on an electron. If ϕ_1, ϕ_2 are equipotential surfaces, then potential difference $V_E - V_D$ is equal to



(1) –8 volt (2) +8 volt

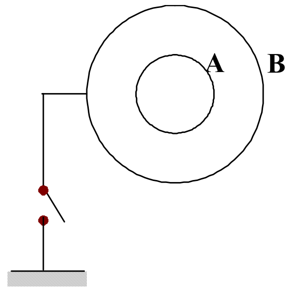
(3) zero (4) 64 volt

95. A spherical shell is uniformly charged by a charge q. A point charge q is at its center. The work of electric force upon the expansion of shell from R to 2R is :-

(1) $\frac{3q^2}{16\pi\varepsilon_o R}$ (2) $\frac{q^2}{8\pi\varepsilon_o R}$

(3) $\frac{q^2}{16\pi\varepsilon_o R}$ (4) $\frac{q^2}{4\pi\varepsilon_o R}$

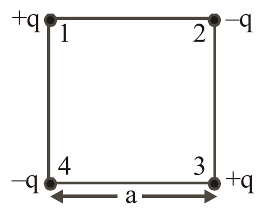
96. Initially the spheres A and B are at potentials V_A and V_B respectively. Now sphere B is earthed by closing the switch. The potential of A become



(1) 0 (2) V_A

(3) $V_A - V_B$ (4) V_B

97. The work done required to put the four charges together at the corners of a square of side a, as shown in the figure is :-



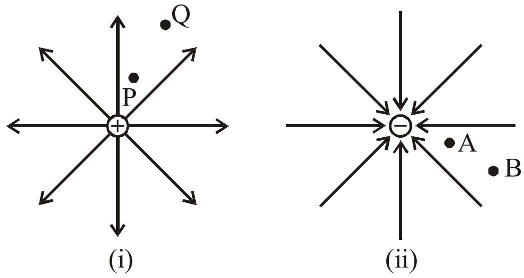
(1) $\frac{1}{4\pi\varepsilon_0}\frac{q^2}{a}$

(2) $\frac{-2.6}{4\pi\varepsilon_0}\frac{q^2}{a}$

(3) $+\frac{2.6}{4\pi\varepsilon_0}\frac{q^2}{a}$

(4) none of these

98. Figures show the field lines of a positive and negative point charge respectively

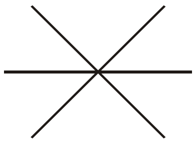


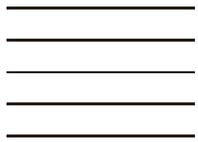
What is the sign of potential energy difference of a small negative charge between points P and Q, B and A :-

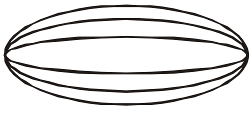
(1) Negative, Negative (2) Positive, Negative

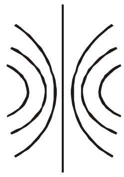
(3) Negative, Positive (4) Positive, Positive

99. Which of the following represents the equipotential lines of a dipole (two equal and opposite charges placed at small separation) ?

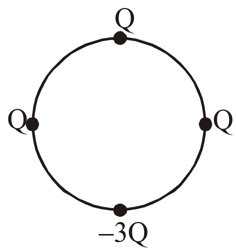
(1) 

(2) 

(3) 

(4) 

100. Find the dipole moment of given configuration if P = QR (where R is the radius of the circle and P is magnitude of dipole moment) :-



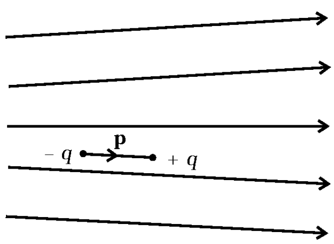
(1) 3P (2) $2\sqrt{2}P$ (3) $3\sqrt{2}P$ (4) 4P

101. An electric dipole is placed at the origin O such that its equator is y-axis. At a point P far away from dipole, the electric field direction is along y-direction. OP makes an angle α with the x-axis such that

(1) $\tan\alpha = \sqrt{3}$ (2) $\tan\alpha = \sqrt{2}$

(3) $\tan\alpha = 1$ (4) $\tan\alpha = \frac{1}{\sqrt{2}}$

102. Figure shows electric field lines in which an electric dipole **p** is placed as shown. Which of the following statements is correct?



(1) The dipole will not experience any force.
(2) The dipole will experience a force towards right.
(3) The dipole will experience a force towards left.
(4) The dipole will experience a force upwards.

103. Two point dipoles of dipole moment $\vec{p}_1$ and $\vec{p}_2$ are at a distance x from each other such that axis of dipoles are same and $\vec{p}_1 \parallel \vec{p}_2$. The force between the dipoles is :-

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

(3) $\frac{1}{4\pi\epsilon_0}\frac{6p_1p_2}{x^4}$ (4) $\frac{1}{4\pi\epsilon_0}\frac{8p_1p_2}{x^4}$

104. The electric potential at a point due to an electric dipole will be-

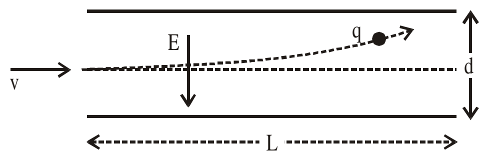
(1) $k\frac{\vec{p}\cdot\vec{r}}{r^3}$ (2) $k\frac{\vec{p}\cdot\vec{r}}{r^2}$

(3) $\frac{k(\vec{p}\times\vec{r})}{r}$ (4) $\frac{k(\vec{p}\times\vec{r})}{r^2}$

105. The maximum possible electrostatic potential produced by a spherical conductor of radius R is directly proportional to :-

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

106. In an ink-jet printer, an ink droplet of mass m is given a negative charge q by a computer-controlled charging unit, and then enters at speed v in the region between two deflecting parallel plates of length L separated by distance d (see figure below). All over this region exists a downward electric field which you can assume to be uniform. Neglecting the gravitational force on the droplet, the maximum charge that it can be given so that it will not hit a plate is most closely approximated by :-



(1) $\frac{mv^2E}{dL^2}$ (2) $\frac{mv^2d}{EL^2}$

(3) $\frac{md}{E(vL)^2}$ (4) $\frac{m(vL)^2}{Ed}$

107. The work done to move a charge slowly along an equipotential surface from A to B

(1) cannot be defined as $-\int_A^B \vec{E}\cdot\overrightarrow{d\ell}$

(2) must be defined as $-\int_A^B \vec{E}\cdot\overrightarrow{d\ell}$

(3) is zero

(4) both (2) and (3)

ANSWER KEY

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	**4**	**1**	**2**	**3**	**1**	**2**	**1**	**3**	**4**	**3**	**4**	**2**	**3**	**4**	**3**	**2**	**3**	**3**	**1**	**4**
Que.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	**2**	**2**	**2**	**1**	**1**	**4**	**2**	**1**	**1**	**1**	**3**	**3**	**1**	**1**	**2**	**3**	**2**	**3**	**4**	**1**
Que.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	**4**	**1**	**3**	**4**	**1**	**2**	**2**	**1**	**4**	**1**	**3**	**2**	**4**	**1**	**3**	**3**	**3**	**3**	**4**	**3**
Que.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Ans.	**2**	**4**	**3**	**2**	**1**	**4**	**4**	**1**	**2**	**4**	**2**	**1**	**3**	**3**	**2**	**3**	**2**	**1**	**3**	**2**
Que.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Ans.	**2**	**4**	**2**	**2**	**3**	**4**	**4**	**4**	**1**	**2**	**4**	**3**	**1**	**1**	**1**	**3**	**2**	**1**	**4**	**4**
Que.	101	102	103	104	105	106	107													
Ans.	**2**	**3**	**3**	**1**	**2**	**2**	**3**													