PHYSICS

BOOKS - CP SINGH PHYSICS (HINGLISH)

ELECTROSTATICS

Example

1. (a) A body is having charge $+4.8 \times 10^{-18} C$. Estimate the number of electrons in excess/shortage.

(b) A body is having charge $3 \times 10^{-12} C$. Determine whether this statement is true/false.

(c) Estimate the number of electrons in $36g$ of water. How much is the total negative charge on these electrons.

(d) Estimate the charge in $26g$ of Na^{+}.

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2. (a) Two protons are placed at some separation in vacuum. Find the ratio of electric and gravitational force acting between them.

(b) Two point charges are placed at separation $3m$ in vacuum. What can be the minimum force between them.

(c) A charge Q is to be divided on two objects. What should be the value of the charges in the objects so that the force between them is maximum ?

(d) Two insulating small spheres are rubbed against each other and placed $1.6cm$ apart. If they attract each other with a force of $0.9N$, how many electrons were transferred from one sphere to the other during rubbing ?

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3. (a) Two identical spheres having positive charges are placed $3m$ apart repel each other with a force $8 \times 10^{-3}N$. Now charges are connected by a metallic wire, they begin to repel each other with a force of $9 \times 10^{-3} N$. Find initial charges on the spheres.

(b) Two identical spheres having charges of opposite sign are placed $3m$ apart attract other with a force $2.4 \times 10^{-3} N$. Now spheres are touched and then placed at original separation repel with a force $10^{-3} N$. Find initial charges on the spheres.

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4. Two point charges are placed at separation d in vacuum and the force between them is F. Now a dielectric slab of thickness $t = d/3$ and dielectric constant K is placed between the charges and the force becomes $9F/25$. Find the value of K.

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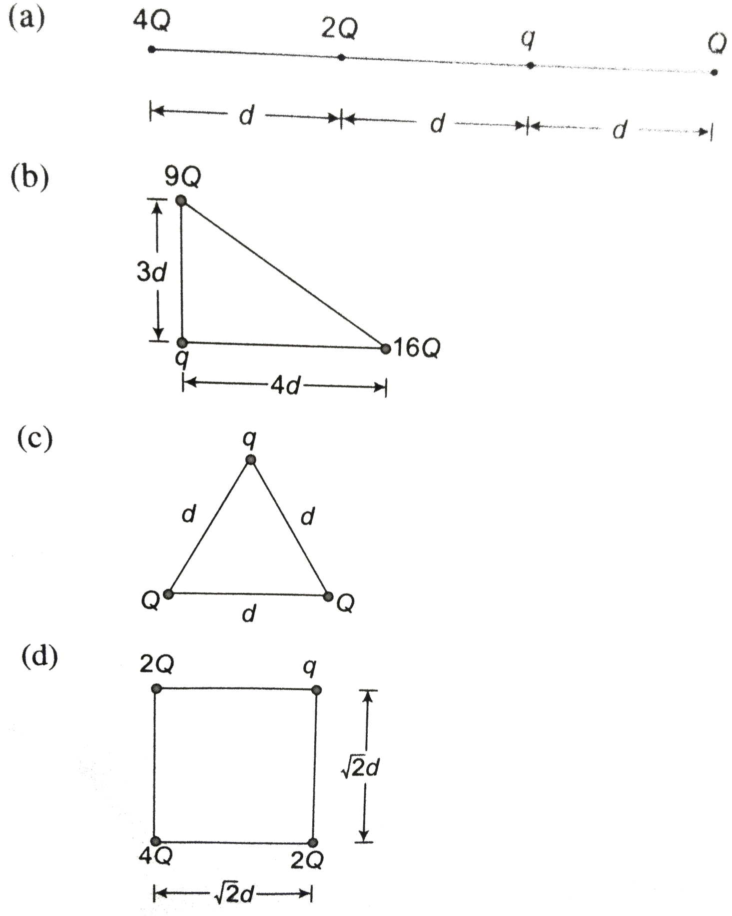
5. Find the net electric force on charge q in the following cases , take $\frac{1}{4\pi \in_0}\frac{Qq}{d^2} = F_0$.



(a)

(e) The point charges $Q, 80Q, 27Q, \ldots, 1000Q$ are placed at $x = d, 2d, 3d, \ldots, 10d$. A point charge q is placed at origin.

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6. (a) Two point charges Q and $16Q$ are fixed at separation d. Where should a third point charge be placed between them so that it experiences no force I.e. in equilibrium ?

(b) In the previous problem , if we replace Q by $-Q$, where should the third charge be placed on the joining the charges so that it is equilibrium ?

(c) Three point charges Q, q and Q are placed at $x = 0, x = d/2$ and $x = d$. Find q in terms of Q so that all charges are in equilibrium.

(d) Two point charges $9Q$ and $25Q$ are placed at separation d. Where should a third charge q be placed between them so that all charges are in equilibrium ? Also find the value of q and its nature.

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7. Two positive point charges , each Q , are fixed at separation d. A third charge q is placed in the middle. Describe the equilibrium of the third charge.

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8. Two points charges , each Q , are fixed at separation $2d$. A charged particle having charge q

and mass m is placed between them.

(a) Now this charged particle is slightly displaced along the line joining the charges , slow that it will execute simple harmonic motion and find the time period of oscillation.

(b) If charge q is negative and it is displaced slightly perpendicular to the line joining the charges , repeat the part (a).

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9. A charged particle of mass m having charge q remains in equilibrium at height d above a fixed charge Q. Now the charged particle is slightly displaced along the line joining the charges, show that it will executes $S.H.M.$ and find the time period of oscillation.

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10. Two equal positive charges , Q , are fixed at points $(0, d)$ and $(0, -d)$ on the y-axis. A charged particle having charge $-q$ and mass m is released from rest at point $(d, 0)$ on the x-axis . Discuss the motion of charged particle.

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11. Two indentical pith balls, each carrying charge q, are suspended from a common point by two strings of equal length l. Find the mass of each ball if the angle between the strings is 2θ in equilibrium.

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12. In the previous problem , if separation between strings is x in equilibrium and angle between strings is small , find q.

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13. Two identical balls , each having a charge q and mass m , are suspended from a common point by two insultating strings each of length L. The balls are held at a separation x and then released. Find

(a) the electric force on each ball

(b) the component of the resultant force on a ball along and perpendicular to string

(c) the tension in the string

(d) the acceleration of one of the balls. Consider the situation only for the instant just after the release.

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14. 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 $0.8gcm^{-3}$, the angle remains the same. If density of the material of the sphere is $1.6gcm^{-3}$, the dielectric constant of the liquid is

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15. (a) Two charged particles , each charge q, are joined by an insultating string of length L and system is kept on smooth surface. Find tension in the string.

(b) A particle having charge Q_0 is placed directly below and at separation d from the bob of simple pendulum at rest. The mass of the bob is m. What charge should be given to bob so that string becomes loose ?

(c) A particle A having charge q and mass m is placed at the bottom of a smooth inclined plane of inclination θ. Where should a block B , having same charge and mass , be placed on the incline so that it may remain in equilibrium ?

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16. A particle A having a charge $10\mu C$ is held fixed on a horizontal surface. A block of mass $80g$ and having charge stays in equilibrium on the surface at a distance $3cm$ from the first charge. The coefficient of friction between the surface and the block is $\mu = 0.5$. Find the range within which the charge on the block may lie.

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17. A small ball of mass m having charge q is suspended by a string of length L. Another identical ball having the same charge is kept at the point of suspension. Determine the minimum horizontal velocity which should be imparted to ball at lowest point so that it can make complete revolution.

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18. Two particles , each having a charge Q, are fixed at $y = d/2$ and $y = -d/2$. Where should a particle of charge q be placed on x-axis from origin so that it experiences maximum force and what is it equal to ? Sketch variation of electric force experienced by qv/sx.

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19. A ring of radius R is having charge Q uniformly distributed. A point charge Q_0 is placed at the centre of the ring. Find tension developed in the ring. If radius of cross - section of the ring is a and Young's modulus of wire is Y, find increase in the radius of ring.

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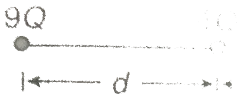
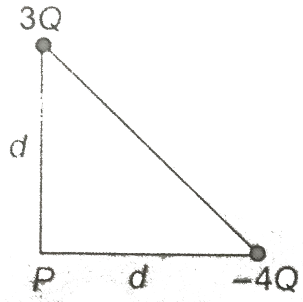
20. Determine electric field at point P or O in the following cases , take $\frac{1}{4\pi \in_0} \cdot \frac{Q}{d^2} = E_0$.

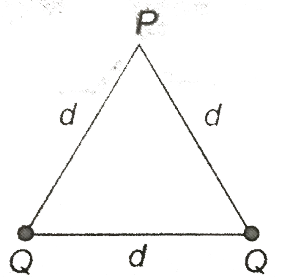
(a)



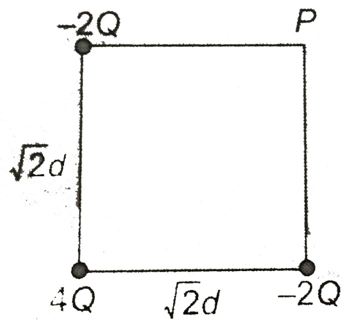
(b)



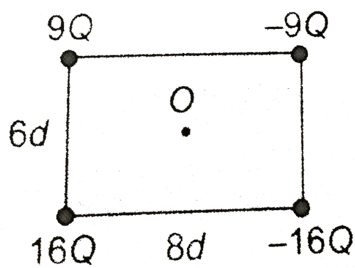
(c)



(d)

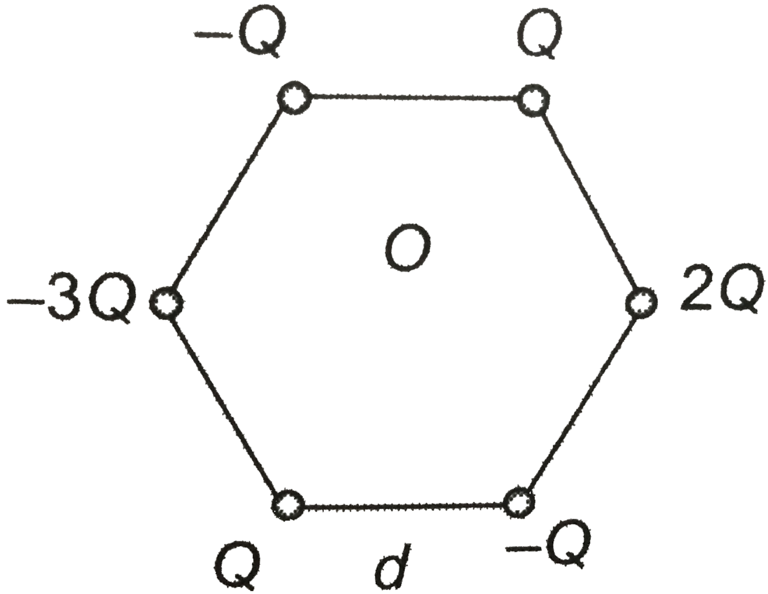


e)



O: centre of rectangle

(a)



(b)

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21. An infinite number of charges each equal to q, are placed along the X-axis at $x = 1, x = 2, x = 4, x = 8$,........ and so on.

(i) find the electric field at a point $x = 0$ due to this set up of charges.

(ii) What will be the electric field if the above setup, the consecutive charges have opposite signs.

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22. (a) Two pont charges $9Q$ and $-25Q$ are fixed at separation d.At what distance from $9Q$, electric field is zero on the line joining the charges ?

(b) A circular ring of radius r carries a total charge Q distributed uniformly over it. A small length dl of wire is removed . Find electric field at center due to the remaining ring.

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23. (a) A point charge $Q = 100\mu C$ is placed at origin. Find electric field vector at point $(6m, 8m)$.

(b) A point charge $Q = 169\mu C$ is placed at $(1m, 2m, 3m)$. Find the electric field vector at the point $(4m, 6m, 15m)$.

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24. (a) A deutron and an α-particle are placed in uniform electric field. Find the ratio of their accelerations.

(b) A charged particle (q, m) is placed in uniform electric field E. Find its kinetic energy after time t.

(c) An electron $(-e, m)$ is given velocity v_0 along a uniform electric field E. After how much time , electron will return to its original position ?

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25. Between two horizontal parallel plates, uniform electric field E directed vertically downward. A charged particle (q, m) remains in equilibrium in vaccum between the plates. Find shortage/excess of electrons in the charged particle .

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26. Two parallel conducting plates , a distance d apart, are held horizontally one above the other in air . Between parallel plates , electric field E is uniform and directed vertically downwards . A spherical ball of radius r, made of a material of density σ falls with constant velocity v. the coefficient of viscosity of air is η and density of air is negligible in comparision of σ. Find electric charge on ball assuming it to be positive.

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27. A charged particle of radius $5 \times 10^{-7} m$ is located in a horizontal electric field of intensity $6.28 \times 10^5 Vm^{-1}$. The surrounding medium has the coefficient of viscosity $\eta = 1.6 \times 10^5 Nsm^{-2}$. The particle starts moving under the effect of electric field and finally attains a uniform horizontal speed of $0.02 ms^{-1}$. Find the number of electrons on it. Assume gravity free space.

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28. A tiny spherical oil drop carrying a net charge q is balanced in still air with a vertical uniform electric

field of strength $\frac{81\pi}{7} \times 10^5 Vm^{-1}$. When the field is switched off, the drop is observed to fall with terminal velocity $2 \times 10^{-3} ms^{-1}$. Given $g = 9.8 ms^{-2}$, viscoisty of the air $= 1.8 \times 10^{-5} Nsm^{-2}$ and the denisty of oil $= 900 kgm^{-3}$, the magnitude of q is

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29. The distance between charged parallel plates is d. An electron -proton is released somewhere in the gap between the plates and it is found that the proton reaches the negative plate at the same time as electron reaches the positive plate. At consider only electric force. The mass of electron is m_e and mass of proton is m_p.The electric field between plates is E.

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30. An electric field E is produced between two parallel plates having a separation d as shown.

(a) With what minimum speed should an electron be projected from the lower plate in the direction of field so that it may reach the upper plate ?

(b) Suppose the electron is projected from the lower plate with the speed calculated in part (a). The direction of projection makes an angle of 60° with the field. Find the maximum height reached by the electron.

(c) After how much time , the electron again strikes the lower plate ?

(d) Horizontal distance travelled by the electron in time calculated in part (c).

Charge on electron : e ,mass of electron : m, consider only electric force.

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31. An electron (e, m) is projected into a uniform electric field E vertically downward between parallel plates at separation d, with velocity v_0. The electron enters the electric field at a point midway between the plates. Find

(a) the magnitude of electric field if electron emerges from the electric field just at the edge of upper plate.

(b) the direction of the velocity of electron as it emerges from the electric field.

(c) the equation of trajectory followed by electron.

The length of plates is L and consider only electric force.

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32. A ball having charge q and mass m is suspended from a string of length L between two parallel plates where a vertical electric field E is established . Find the time period of simple pendulum if electric field is directed (a) downward and (b) upward.

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33. The simple pendulum of the previous problem is placed in uniform electric field E, directed horizontally. Find the angle made by string with vertical in equilibrium and tension in the string . Now the ball is slightly displaced and it exceutes simple harmonic motion, find its time period of oscillation.

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34. A ball of mass m having a charge q is released from rest in a region where a horizontal electric field E exists.

(a) Find the resultant force acting on the ball.

(b) Find the trajectory followed by the ball.

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35. A block having mass $'m'$ and charge q is resting on a frictionless plane at distance L from the wall as shown in fig.Discuss the motion of the block when a uniform electric field E is applied horizontally towards the wall assuming that collision of the block with the wall is perfectly elastic.

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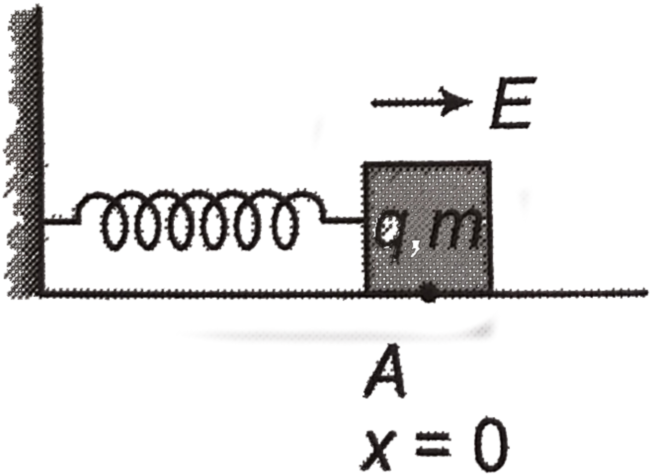
36. A block of mass m having charge q is attached to a spring of spring constant k. This arrangement is placed in uniform electric field E on smooth horizontal surface as shown in the figure. Initially spring in unstretched. Find the extension of spring in equilibrium position and maximum extension of spring.



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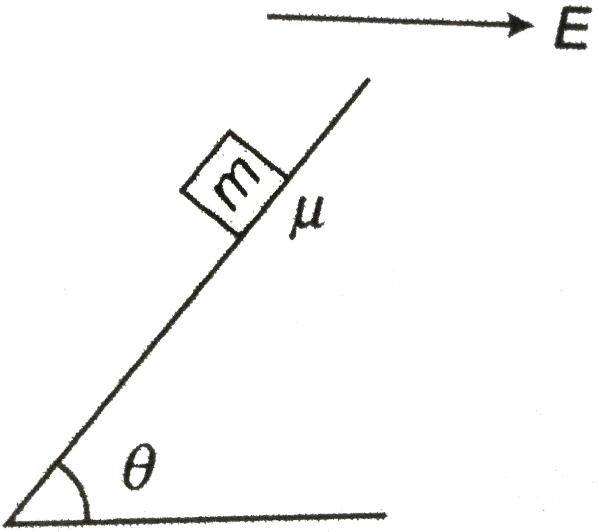
37. An inclined plane of inclination θ is placed in uniform horizontal electric field E as shown. A block of mass m having charge q is sliding down on the plane with constant velocity . If coefficient of friction is μ , find charge q in terms of given quantities .



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38. A charged particle (q, m) is released from origin in an electric field $E = \alpha - \beta x$ where α and β are constants and x is distance from origin. Find the velocity of particle in terms of x and maximum displacement of the particle.

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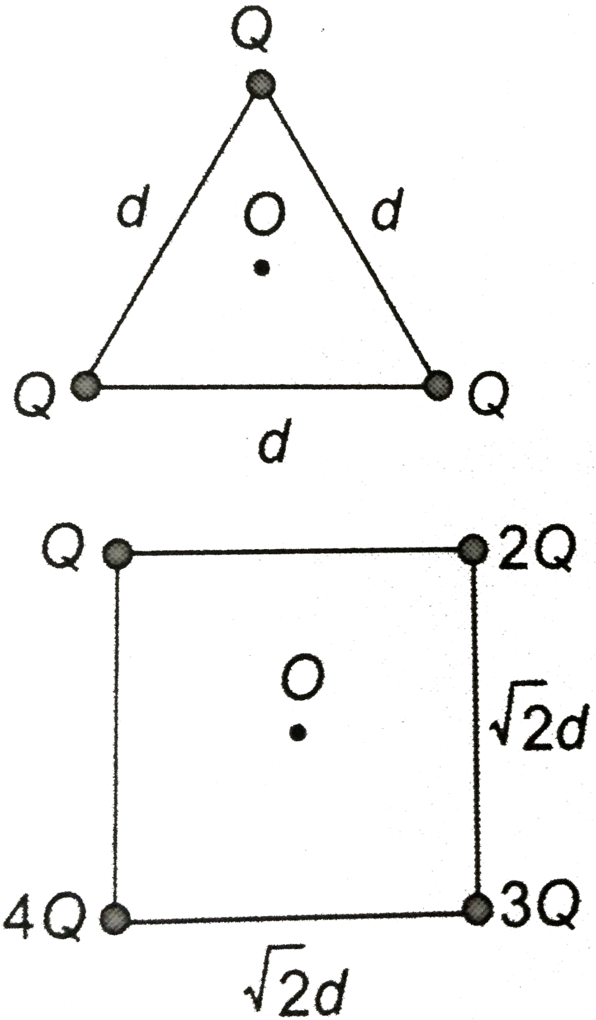
39. Find electric potential at center O.



(a)

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40. (a) The charges each Q are placed at $x - d, 2d, 4d, \ldots \infty$. Find electric potential at origin O.

(b) A charge $+Q$ is placed at each of the points $x = d, x = 3d, x = 5d, \ldots\ldots, \infty$ on the x-axis , and a charge $-Q$ is placed at each of the points $x = 2d, x = 4d, x = 6d, \ldots, \infty$.Find the electric potential at the origin O.

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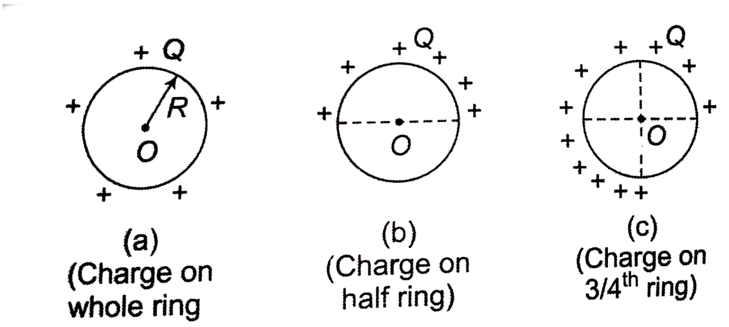
41. A charge Q is distributed uniformly on a ring of radius R as shown in the following diagrams. Find the electric potential at the center O of the ring.

(a) 

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42. A charge Q is uniformly on a ring of radius R. Find the electric potential on the axis of ring at distance x from the centre of the ring. Sketch variation of potential with respect to x.

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43. Two identical thin ring, each of radius R meters, are coaxially placed a distance R metres apart. If Q_1 coulomb, and Q_2 coulomb, are repectively 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

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44. Two fixed charges $-2Q$ and Q are located at the points with coordinates (-3 a, 0) and (+3 a, 0) respectively in the $X-Y$ plane .

All the points in the $X - Y$ plane where the electric potential due to the two charges is zero , line on a .

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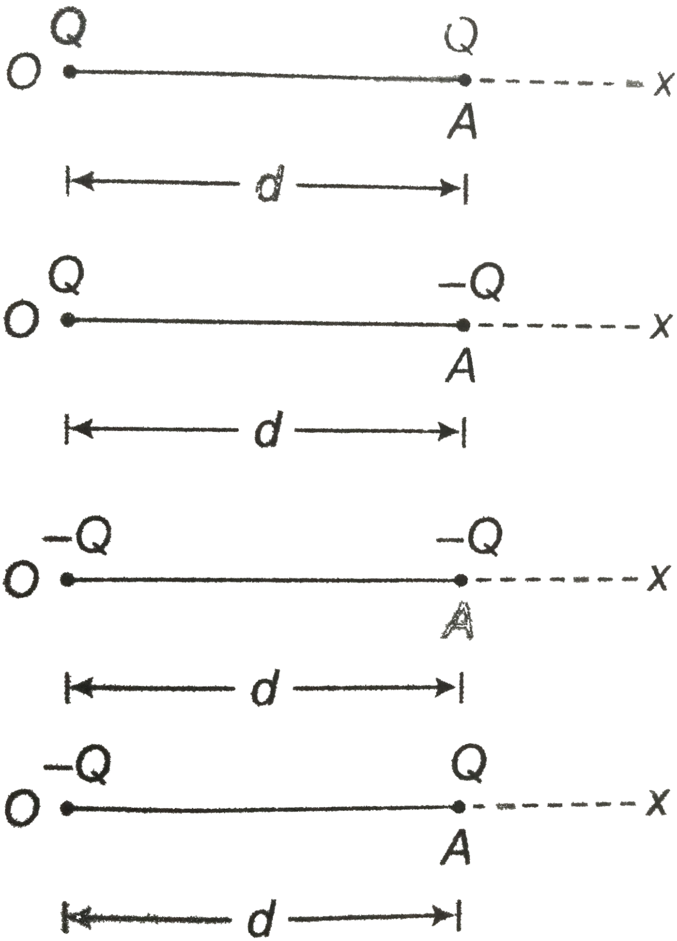
45. Sketch the variation of electric circle potential on the x-axis with respect to x for $x = -\infty$ to

$x = +\infty$ in the following cases.



(a)

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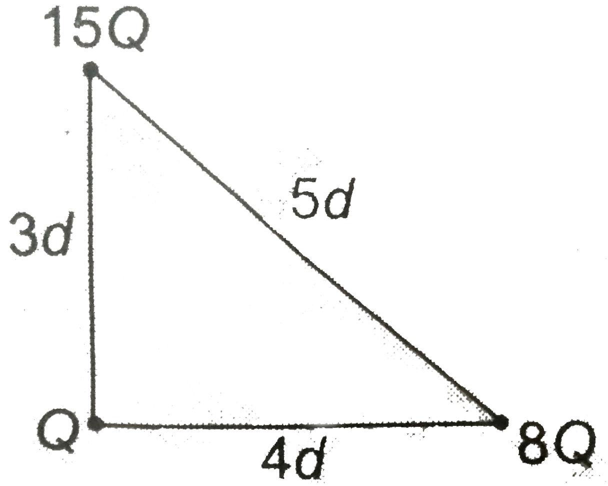
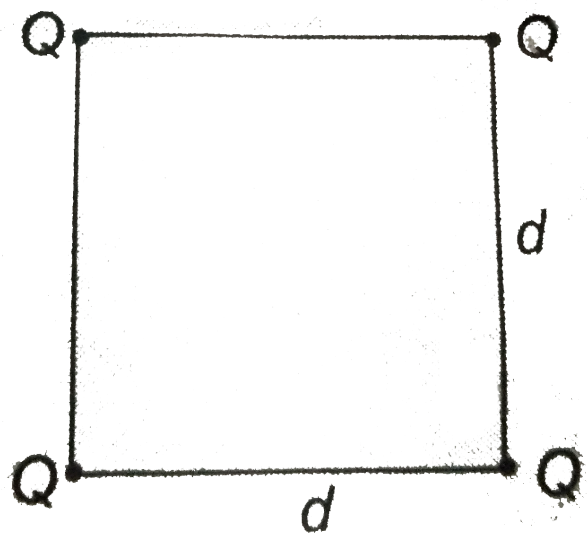
46. Find the electric potential energy of the system of charges.





(a)

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47. Three points charges of $1C, 2C$ and $3C$ are placed at the corners of an equilateral triangle of side 100 cm. Find the work done to move these charges to the corners of a similar equilateral triangle of side 50 cm.

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48. Three charges 0.1 coulomb each are placed on the corners of an equilateral triangle of side $1m$. If the energy is supplied to this system at the rate of

$1kW$ how much time would be required to move one to the charges on to the midpoint of the line joining the two ?

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49. Two equal point charges are fixed at $x = -a$ and $x = +a$ on the x-axis. Another point charge Q is placed at the origin. The change in the electrical potential energy of Q, when it is displaced by a small distance x along the x-axis, is approximately proportional to

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50. Three point charges q, 2q and 8q are to be placed

on a

. 9cm long straight line. Find the

. positions where the charges shouldbe placed such

that the potential energy

. of this sysrem is minimum. In this situation, what is

the

. electric field at the charge q due to the other two

charges?

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51. An α-particle with kinetic energy K is heading towards a stationary nucleus of atomic number Z. Find the distance of the closest approach.

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52. A charged particle (q, m) is moving directly towards fixed positive charge Q. When it is at distance d from Q, it has speed v_0. At what distance Q will be particle come momentarily to rest ? Is the acceleration constant during motion ?

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53. Two point charges each $50\mu C$ are fixed on y-axis at $y = +4m$ and $y = -4m$. Another charged particle having charge $-50\mu C$ and mass $20g$ is moving along the positive x-axis. When it is at $x = -3m$, its speed is $20m/\sec$. Find the speed of charged particle when it reaches to origin. Also, find distance of charged particle from origin, when its kinetic energy becomes zero.

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54. A circular ring of radius R with uniform positive charge density λ per unit length is located in the y-z plane with its centre at the origin O. A particle of mass m and positive charge q is projected from the point P $\left(R\sqrt{3}, 0, 0\right)$ on the positive x-axis directly towards O, with an initial speed v. Find the smallest (non-zero) value of the speed v such that the particle does not return to P.

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55. (a) Two protons are placed at separation d on a smooth surface. Find the speed of each proton when separation between them is doubled.

(b) An α-particle and a proton are placed at a separation d on a smooth surface.Find the speed of each when separation between them becomes infinite. (m: mass of proton , e: charge of proton.)

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56. 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 .

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57. A block of mass $5kg$ having charge q is attached to a spring of constant $K = 10^4 N / m$. A charge $-q$ is placed below the block at separation $0.5m$. If the maximum elongation of spring is $0.5m$. If the maximum elongation of spring is $0.1m$, find q. Assume the initial elongation of spring is zero.

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58. Eight point charges , each q , are placed on the vertices of a cube of side a. Find the potential energy of the system of charges.

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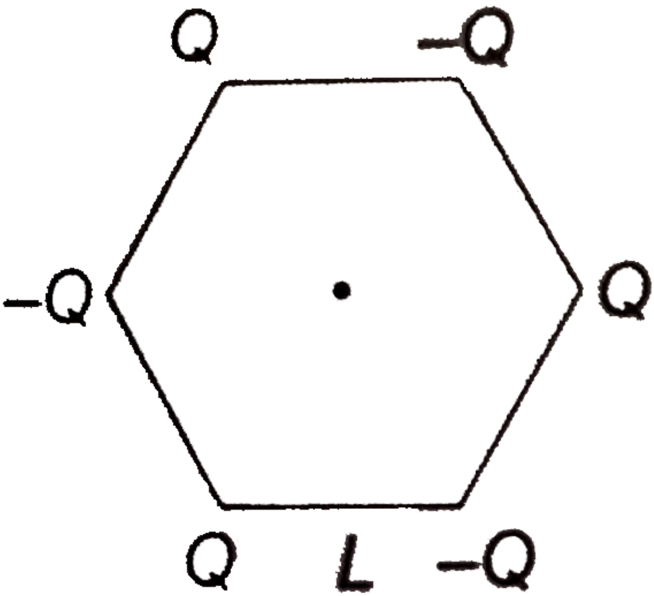
59. The point charges are placed on the vertices of regular hexagon of side L as shown. Find the potential energy of the system of charges.



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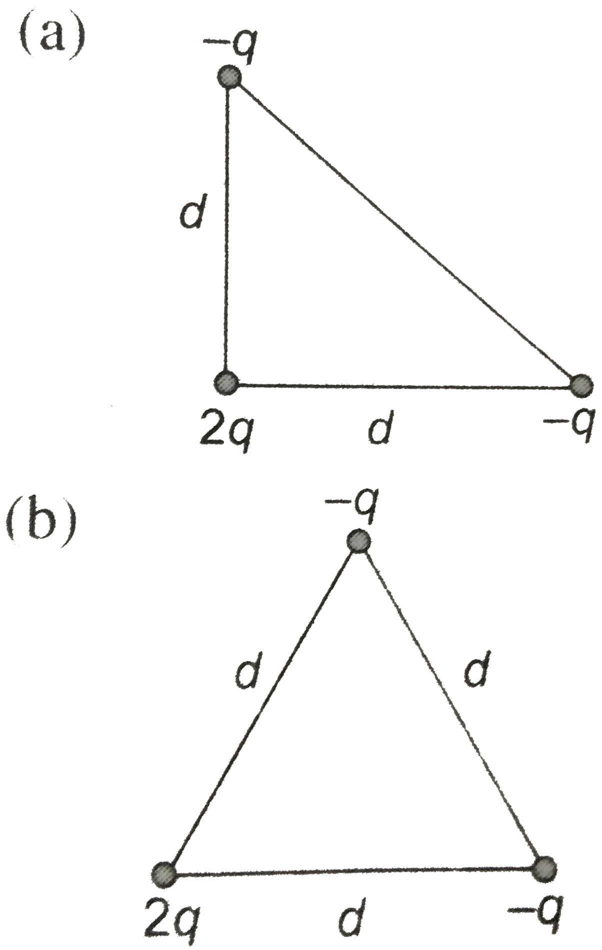
60. Three charges are placed as shown . Find dipole moment of the arrangements .



(a)

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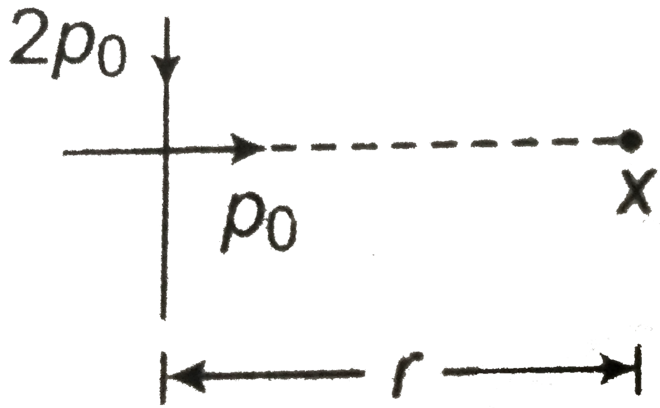
61. Two short dipoles are placed perpendicularly as shown. Find electric field and potential at charge distance r.



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62. An electric dipole is placed at the origin O and is directed along the x-axis. At a point P, far away from the dipole, the electric field is parallel to y-axis. OP makes an angle θ with the x-axis then

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63. show an electric dipole formed by two

. particles fixed at the ends of a light rod of length l. The

. mass of each particle is m and the charges are -q and

. +q . The system is placed in such a way that the dipole

. axis is parallel to a uniform electric field E that exist

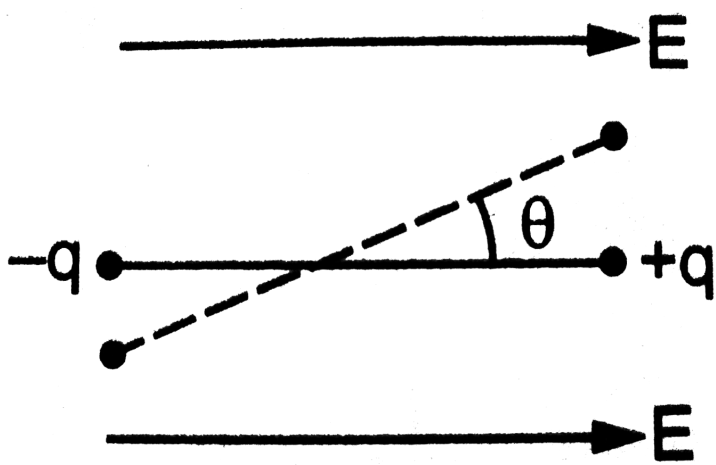
. in the region. The dipole is slightly rotated abut its

. centre and released. Show that for small angular

. desplacement, the motin is anguler sumple

harmonic

. and find its time period.



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64. A closed cylinder is placed in uniform electric field.Find electric flux passing through cylinder.

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65. The electric field in a region is given by $\overrightarrow{E} = \frac{E_0}{a} x \hat{i}$. Find the electric flux passing through a cubical volume bounded by the surfaces $x = 0, x = a, y = 0, y = a, z = 0$ and $z = a$.

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66. A point charge Q is placed at one corner of a cube. Find flux passing through

(a) cube

(b) each face of cube containing the charge

(c) each face of cube not containing the charge

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67. A hemispherical body of radius R is placed in a uniform electric field E. What is the flux linked with the curved surface if, the field is (a) parallel to the base, (b) perpendicular to the base.

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68. A charge q_0 is distributed uniformly on a ring of radius R. A sphere of equal radius R constructed with its centre on the circumference of the ring. Find the electric flux through the surface of the sphere.

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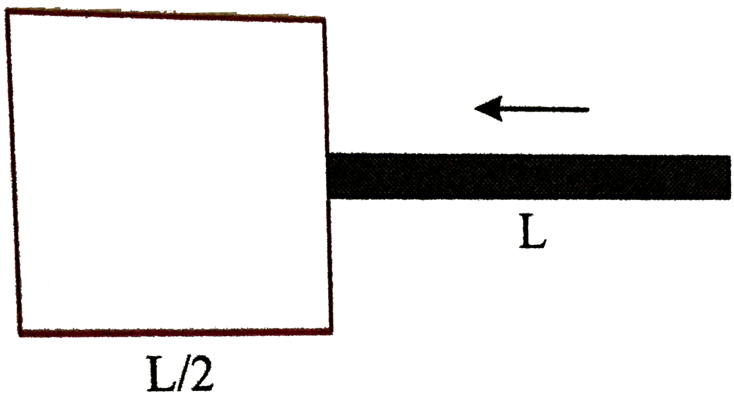
69. The figure shows an imaginary cube of length $L/2$ and a uniformly charged rod of length L touching the centre of the centre of the right face of the cube normally.At time $t=0$ the rod starts moving to the left slowly at a constant speed v .The electric flux (F) through the cube is plotted against time (t) .The correct graph showing the variation of flux with time is



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70. A long cylindrical wire carries a positive charge of linear density λ. An electron $(-e, m)$ revolves around it in a circular path under the influence of the attractive electrostatic force. Find the speed of the electron.

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71. Two large conducting plates are placed parallel to each other with a separation d. An electron $(-e, m)$ starting from rest near one of the plates reaches the other plate in time t_0. Find the surface density on the inner surface.

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72. A Charge Q is distributed uniformly within the material of a hollow sphere of inner and outer radii r_1 and r_2 (figure 30-E4). Find the electric field at a point P a distance x away from the centre for $r_1 < x < r_2$. Draw a rough graph showing the electric field as a function of x for $0 < x < 2r_2$. (figure).

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73. A charge Q is distributed over two concentric hollow spheres of radii r and $R(> r)$ such that the surface charge densities are equal. Find the potential at the common centre.

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74. Three concentric spherical metallic shells A, B and C of radii a, b and c (a lt b ltc) have surface charge densities $\sigma, -\sigma$ and σ respectively.

`(i) Find the potential of the three shells A, B and C.

(ii) If the shells A and C are at the same potential, obtain the relation between the radii a, b and c.

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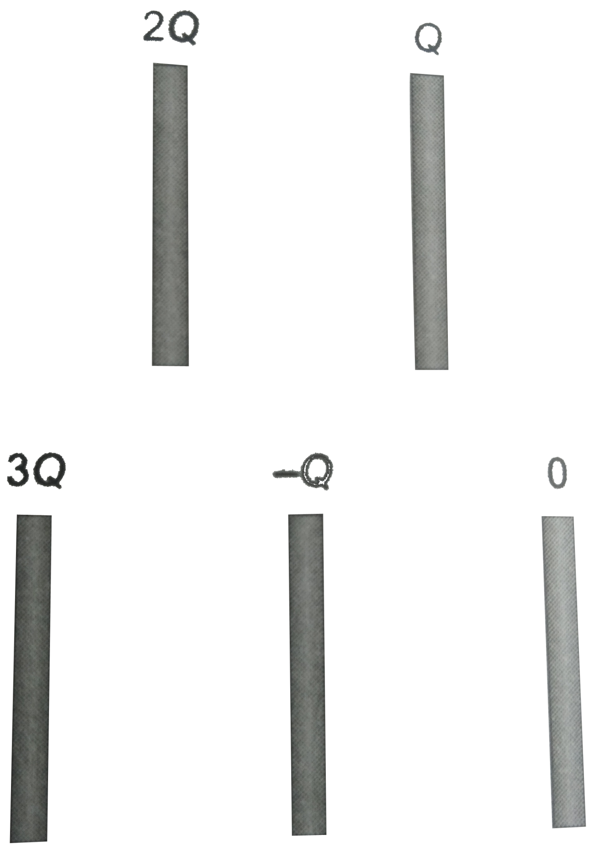
75. Some isolated metal plates with large surface areas are kept parallel to each other and total charges on each plate are as shown. Find the charge appearing on the surfaces of plates.



(a)

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76. A conducting sphere carrying charge Q is surrounded by a spherical conducting shell.

a. What is the net charge on the inner surface of the shell?

b. Another charge q is placed outside the shell. Now, what is the net charge on the inner surface of the shell?

c. If q is moved to a position between the shell and the sphere, what is the net charge on the inner surface of the shell?

d. Are your answer valid if the sphere and shell are not concentric?

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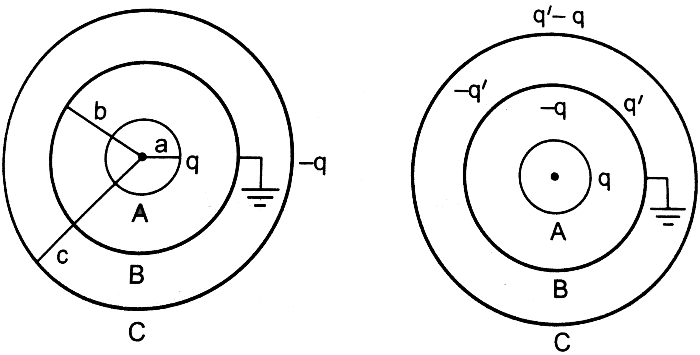
77. Figure shows three concentric thin spherical shells A, B and C of radii a, b and c respectively. The shells A and C are given charges q and -q respectively and the shell B is earthed. Find the charges appearing on the surfaces of B and C.



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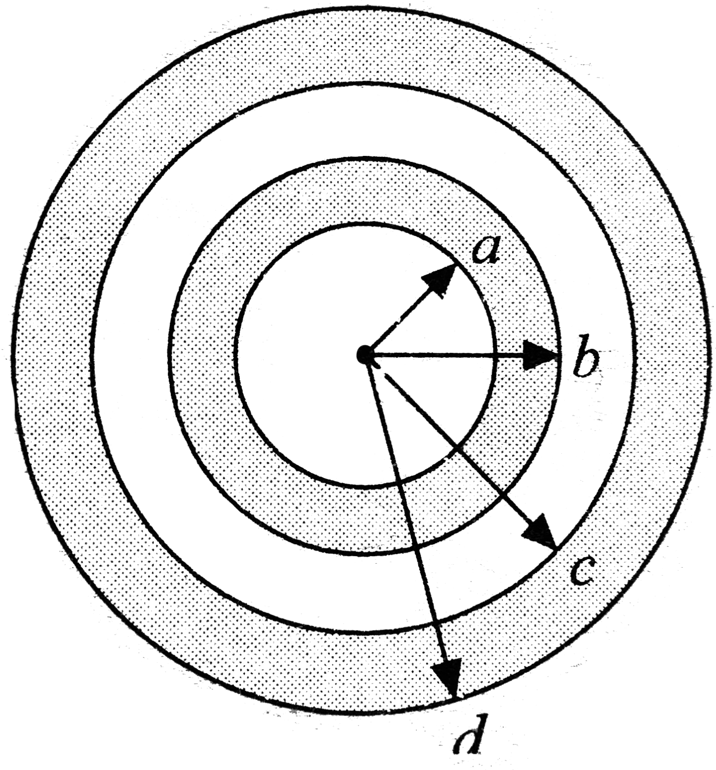
78. A small conducting spherical shell with inner radius a and outer radius b is concentric with a larger conducting spherical shell with inner radius c and outer radius d (as shown in Fig . 2.121). The inner shell has a total charge $+2q$, and the outer shell has a total charge $+4q$. Calculate the electric field in terms of q and the distance r from the common center of the two shells for



$b < r < c$

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79. Consider two concentric spherical metal shells of radii r_1 and $r_2 (r_2 > r_1)$. Find the charge on the inner shell and charge distribution.

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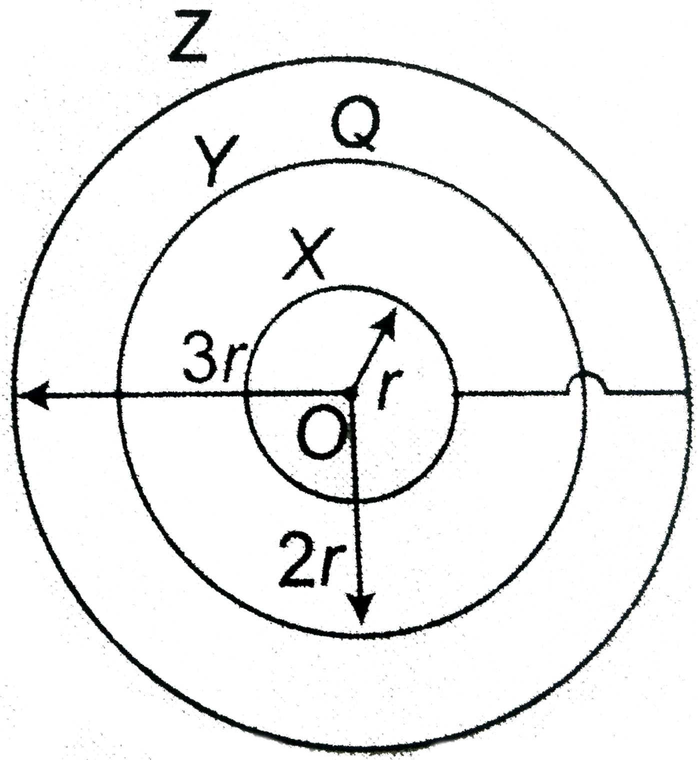
80. The figure shows three concentric , conducting ,spherical shells X, Y and Z with radii r, $2r$ and $3r$ respectively . X and Z are connected by a conducting wire and Y is uniformly charged to charge Q. Find:

(a) charges on shells X and Z,

(b) potentials of $X$and Y.



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81. A thin spherical conducting shell of radius r_1 carries a charge Q. Concentric with it is another thin metallic spherical shell of radius $r_2 (r_2 > r_1)$. Calculate electric field at distance r when (i) $r < r_1$, (ii) $r_1 < r < r_2$ and (iii) $r > r_2$.

What will be the field in above cases if outer shell (a) is given charge q and (b) is earthed ?

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82. A solid metallic sphere of radius R having charge $+3Q$ is surrounded by a hollow spherical shell of radius $2R$ and having a charge $-Q$.

(a) Find electric field at distance r from centre of solid sphere $[R < r < 2R]$.

(b) Find potential difference between sphere and shell.

(c) Find distribution of charge if

(i) inner sphere is earthed

(ii) inner sphere and shell are connected by a metallic wire.

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83. Two non-conducting sphere of radius R have charge Q uniformly distributed. The centres of sphere are $x = 0$ and $x = 3R$. Find the magnitude and direction of the net electric field on the X-axis

(i) $x = 0$

(ii) $x = \frac{R}{2}$

(iii) $x = \frac{3R}{2}$

(iv) $x = 4R$

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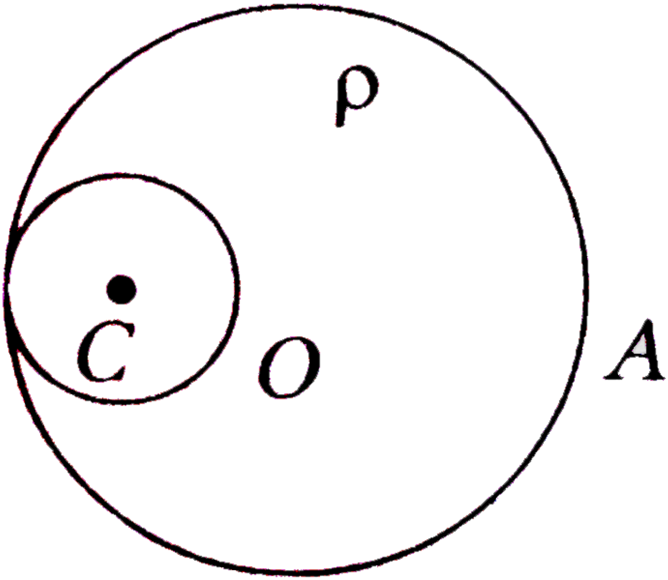
84. A non-conducting sphere of radius R has a spherical cavity of radius $R/2$ as shown. The solid part of the sphere has a uniform volume charge density ρ. Find the magnitude and direction of electric field at point (a) O and (b) A.



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85. An electric field of $20 N / C$ exists along the x-axis in space. Calculate the potential difference $V_B - V_A$ where the points A and B are given by

a. $A = (0, 0), B = (4m, 2m)$

b. $A = (4m, 2m), B = (6m, 5m)$

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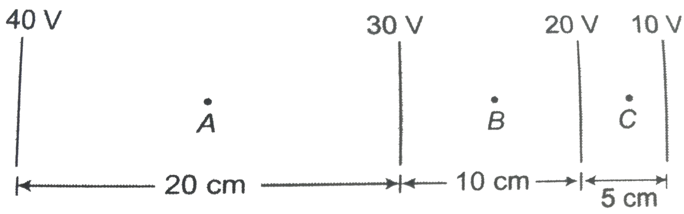
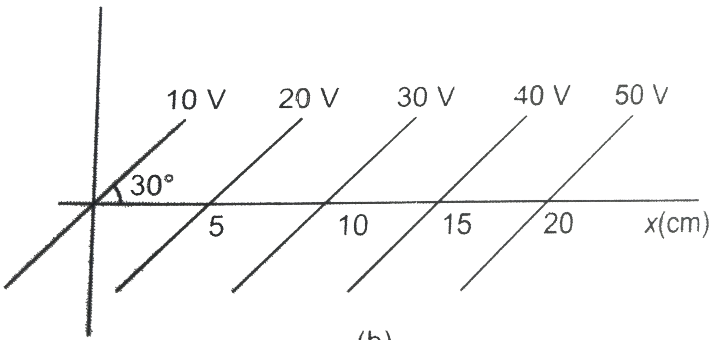
86. Some equipotential surfaces are shown in the figure . Determine electric field at points A, B, C in

(a) and in (b).



(a)



(b)

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87. Determine the electric field strength vector if the potential of this field depends upon x - and y -

coordinates as :

(i) $V = a(x^2 - y^2)$

(ii) $V = axy$.

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88. A ring of radius a contains a charge q distributed. uniformly ober its length. Find the electric field at a point. on the axis of the ring at a distance x from the centre.

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89. An electric field $E = \left(20\hat{i} + 30\hat{j}\right)$ N/C exists in the space. If thepotential at the origin is taken be zero, find the potential at $(2m, 2m)$.

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90. An electric field $\overrightarrow{E} = \overrightarrow{i20 + \overrightarrow{j} 30NC^{-1}}$ exists in the space. If the potential at the origin is taken to be zero find the potential at (2m, 2m).

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91. An electric field $\overrightarrow{E} = \overrightarrow{i20 + \overrightarrow{j}30NC^{-1}}$ exists in the space. If the potential at the origin is taken to be zero find the potential at (2m, 2m).

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92. Find the potential difference V_{AB} between $A(0, 0, 0)$ and $B(1m, 1m, 1m)$ in an electric field :

(i) $\overrightarrow{E} = \left(y\hat{i} + x\hat{j}\right)Vm^{-1}$

(ii) $\overrightarrow{E} = \left(3x^2y\hat{i} + x^3\hat{j}\right)Vm^{-1}$.

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93. If electric field is

(a) $\overrightarrow{E} = 2axy\hat{i} + a\left(x^2 - y^2\right)\hat{j}$

(b) $\overrightarrow{E} = ay\hat{i} + (ax + bz)\hat{j} + by\hat{k}\Big)$

Find potential.

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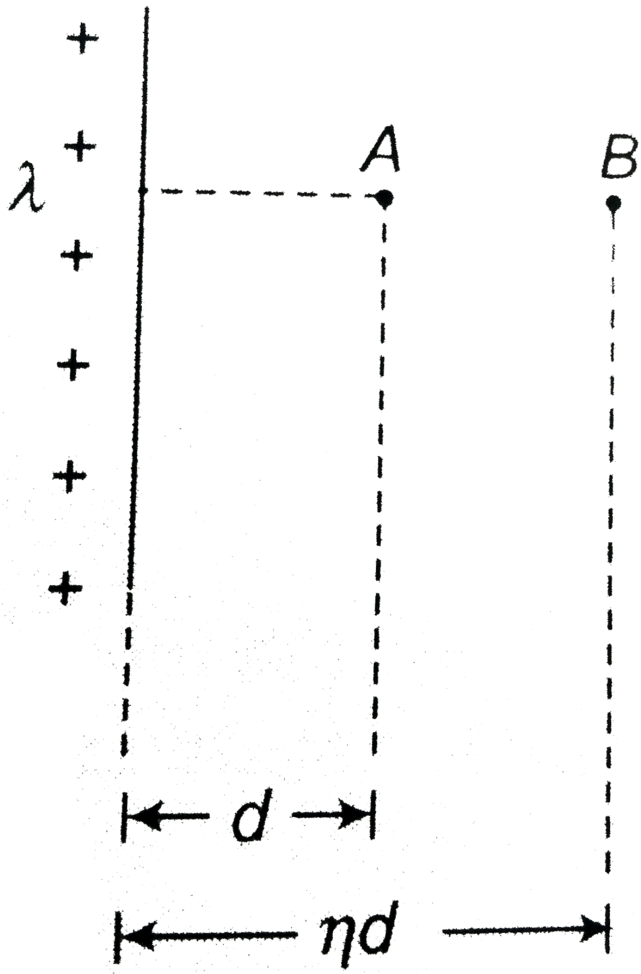
94. There is infinitely long straight thread carrying a charge with linear density λ.Calculate the potential difference A and B.



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95. A charge q is uniformly distributed over the volume of a shpere of radius R. Assuming the permittively to be equal to unity throughout, find the potential

(a) at the centre of the sphere,

(b) inside the sphere as a function of the distance r from its centre.

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96. A rod of length L lies along the x-axis with its left end at the origin. It has a non-uniform charge density $\lambda = \alpha x$, where a is a positive constant.

(a) What are the units of α?

(b) Calculate the electric potential at point A where $x = -d$.

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97. A rod of length L lies along the x-axis with its left end at the origin. It has a non-uniform charge density $\lambda = \alpha x$, where a is a positive constant.

(a) What are the units of α?

(b) Calculate the electric potential at point A where $x = -d$.

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98. A quarter ring of radius R is having uniform charge density λ. Find the electric field and potential at the centre of the ring.

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99. A quarter ring of radius R is having uniform charge density λ. Find the electric field and potential at the centre of the ring.

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100. The volume charge density inside of sphere of radius R is given by $\rho = \rho_0\left(1 - \frac{r}{R}\right)$,where ρ_0 is constant and r distance from centre.

(a) Find total charge Q inside sphere.

Electric field outside sphere at distance r from centre.

(b) Electric field outside sphere at distance r from centre.

(c) Electric field inside sphere at distance r from centre.

(d) At what distance from centre electric field is maximum and its value?

(e) Sketch E versus r graph.

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101. A charge Q is uniformly distributed inside a non-conducting sphere of radius R. Find the electric potential energy stored in the system.

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102. A charge Q is uniformly distributed inside a non-conducting sphere of radius R. Find the electric potential energy stored in the system.

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103. A cube of edge a is placed at some distance from a long plane sheet of charge having surface density σ. Find the electric energy stored in the cube.

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104. A charge Q is uniformly distributed on a ring of radius R. Find the electric potential on the axis of ring at distance x from the centre of the ring. Sketch variation of potential with respect to x.

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105. A point charge q is located at the centre fo a thin ring of radius R with uniformly distributed charge $-q$, find the magnitude of the electric field strength vectro at the point lying on the axis of the ring at a distance x from its centre, if $x > > R$.

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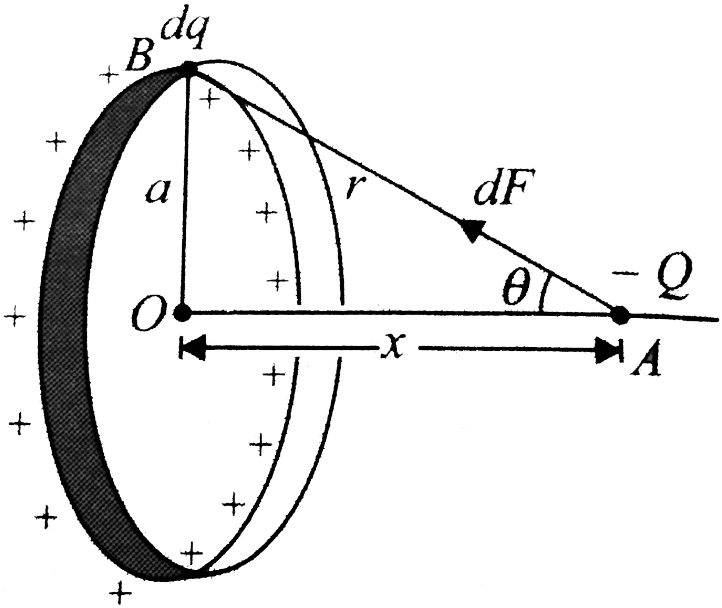
106. A thin fixed ring of radius a has a positive charge q uniformly distributed over it.A particle of mass m having a negative charge Q, is placed on the axis at a distance of $x(x < < a)$ form the center of the ring. Show that the motion of the negatively charged

particle is approximately simple harmonic. Calculate the time period of oscillation.



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107. A very thin round plate of radius R carrying a uniform surface charge density σ is located in vacumm. Find the electric field potentail and strength along the plate's axis as a function of a distance l from its centre. Investigation the obtained expression of $l \rightarrow 0$ and $l > > R$.

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Exercises

1. Which of the following is correct regarding electric charge ?

(i) If a body is having positivr charge i.e. shortage of electrons

(ii) If a body is having negative charge i.e. excess of electrons

(iii) Minimum possible charge $= \pm 1.6 \times 10^{-19} C$

(iv) Charge is quantised i.e. $Q = \pm ne$,

where $n = 1, 2, 3, 4....$

A. (i) and (ii)

B. (ii) and (iii)

C. (i) ,(ii) and (iii)

D. All

Answer: 4

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2. When 10^{14} electrons are removed from a neutral metal sphere , the charge on it becomes

A. $16\mu C$

B. $-16\mu C$

C. $32\mu C$

D. $-32\mu C$

Answer: 1

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3. The ratio of the electric force between two electrons to the gravitational force between them is of the order of

A. 10^{42}

B. 10^{40}

C. 10^{36}

D. 10^{32}

Answer: 1

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4. Find the ratio of the magnitude of the electric force to the grativational force acting between two protons.

A. 10^{40}

B. 10^{38}

C. 10^{36}

D. 10^{34}

Answer: 3

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5. Two insultating small spheres are rubbed against each other and placed $96cm$ apart. If they attract each other with a force of $0.1N$, how many electrons were transferred from one sphere to the other during rubbing ?

A. 10^{11}

B. 2×10^{13}

C. 3×10^{11}

D. 4×10^{11}

Answer: 2

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6. Two particles having charge Q_1 and Q_2 , when kept at a certain distance exert a force F on each other . If the distance between the two particles is reduced to half and the charge on each particle is doubled , the force between the particles would be

A. $2F$

B. $4F$

C. $8F$

D. $16F$

Answer: 4

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7. Two point charge $+2C$ and $+6C$ repel each other with a force of $12N$. If a charge of $-2C$ is given to each other of these charges , the force will now be

A. zero

B. $8N$ (attractive)

C. $8N$ (repulsive)

D. none

Answer: 1

8. Two identical metals balls with charges $+2Q$ and $-Q$ are separated by some distance and exert a force F on each other . They are joined by a conducting wire , which is then removed. The force between them will now be

A. F

B. $\frac{F}{2}$

C. $\frac{F}{4}$

D. $\frac{F}{8}$

Answer: 4

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9. Two positive point charges are $3m$ apart their combined charge is $20\mu C$. If the force between them is $0.075N$, the charges are

A. $10\mu C, 10\mu C$

B. $15\mu C, 5\mu C$

C. $12\mu C, 8\mu C$

D. $14\mu C, 6\mu C$

Answer: 2

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10. Charge Q is divided into two parts which are then kept some distance apart . The force between them will be maximum if the two parts are

A. $\frac{Q}{2}$ and $\frac{Q}{2}$

B. $\frac{Q}{2}$ and $\frac{3Q}{4}$

C. $\frac{Q}{2}$ and $\frac{2Q}{3}$

D. e and $(Q - e)$

Answer: 1

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11. Force of attraction between two point charges Q and $-Q$ separated by $d metre is F_e$. When these charges are placed on two identical spheres of radius $R = 0.3d$ whose centres are $d metre$ apart , the force of attraction between them is

A. greater than F_e

B. equal to F_e

C. less than F_e

D. none of these

Answer: 1

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12. Two charges are at a distance d apart. If a copper plate (conducting medium) of thickness $d/2$ is placed between them , the effictive force will be

A. $2F$

B. $F/2$

C. 0

D. $\sqrt{2}F$

Answer: 3

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13. Five balls numbered 1,2,3,4,and 5 are suspended using separated threads. The balls (1,2),(2,4) and (4,1) show electrostatic attraction while balls (2,3) and (4,5) show repulsion. Therefore, ball 1 must be

A. positively charged

B. negatively charged

C. neutral

D. made of metal

Answer: 3

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14. Equal charges q are placed at the four corners $A, B, C, D$of a square of length a. The magnitude of the force on the charge at B will be

A. $\dfrac{3q^2}{4\pi\varepsilon_0 a^2}$

B. $\dfrac{4q^2}{4\pi\varepsilon_0 a^2}$

C. $\left(\dfrac{1+2\sqrt{2}}{2}\right)\dfrac{q^2}{4\pi\varepsilon_0 a^2}$

D. $\left(\sqrt{2}+\dfrac{1}{\sqrt{2}}\right)\dfrac{q^2}{4\pi\varepsilon_0 a^2}$

Answer: 3

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15. Two spherical conductors B and C having equal radii and cayying equal charges on them repel each other with a force F when kept apart at some distance. A third spherical conductor having same radius as that B but uncharged is brought in contact with B, then brought in contact with C and finally removed away from both. The new force of repulsion between B and C is

A. $F/4$

B. $3F/4$

C. $F/8$

D. $3F/8$

Answer: 4

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

A. $\dfrac{4\pi \in_0 Fd^2}{q^2}$

B. $\dfrac{4\pi \in_0 Fd^2}{2}$

C. $\sqrt{\dfrac{4\pi \in_0 Fe^2}{d^2}}$

D. $\sqrt{\frac{4\pi \in_0 Fd^2}{e^2}}$

Answer: 4

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17. Two point charges $+4q$ and $+q$ are placed at a distance L apart. A third charge Q is so placed that all the three charges are in equilibrium. Then location. And magnitude of the third charge will be

A. $Q = \frac{4q}{9}, x = \frac{d}{3}$

B. $Q = \frac{4q}{9}, x = \frac{d}{4}$

C. $Q = -\frac{4q}{9}, x = \frac{d}{3}$

D. $Q = -\frac{4q}{9}, x = \frac{d}{4}$

Answer: 3

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18. Two point charges $q_1 = +2C$ and $q_2 = -1C$ are separated by a distance d. The position on the line joining the two charges where a third charge $q = +1C$ will be in equilibrium is at a distance

A. $\frac{d}{\sqrt{2}}$ from q_1 and q_2

B. $\frac{d}{\sqrt{2}}$ from q_1 away from q_2

C. $\frac{d}{\sqrt{2}-1}$ from q_2 between q_1 and q_2

D. $\frac{d}{\sqrt{2}-1}$ from q_2 away from q_1

Answer: 4

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19. A charge q is placed at the centre of the line joining two equal charges Q. The system of the three charges will be in equilibrium if q is equal to:

A. $-\frac{q}{2}$

B. $-\frac{q}{4}$

C. $+\frac{q}{4}$

D. $+\frac{q}{2}$

Answer: 2

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20. In the previous question , if $e =$ electronic charge , the minimum magnitude of q is

A. e

B. $2e$

C. $4e$

D. none of these

Answer: 3

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21. Three charge q, Q and $-4q$ are placed in a straight line , line of length Lat points distant $0, L/2$ and L respectively from one end. In order to make the net force on q zero, the charge Q must be equal to

A. $-q$

B. $-2q$

C. $-\frac{q}{2}$

D. q

Answer: 1

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22. Three identical charges are fixed at the corners of an equilateral triangle . If the force between any two charges is F, then the net electric force on each will be

A. $\sqrt{2}F$

B. $2F$

C. $\sqrt{3}F$

D. $3F$

Answer: 3

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23. Three charges each of value q are placed at the corners of an equilateral triangle. A fourth charge Q is placed at the centre of the triangle. If $Q = -q$:

A. the charges will move towards the centre

B. the charges will move away from the centre

C. the charges will remain stationary

D. the charges may move in any direction

Answer: 1

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24. In the above problem , the value of Q for which charges will remain stationary is

A. $q\sqrt{3}$

B. $\frac{q}{\sqrt{3}}$

C. $-\frac{q}{\sqrt{3}}$

D. $-q\sqrt{3}$

Answer: 3

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25. A charge Q is place 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:

A. $\frac{1}{2\sqrt{2}}$

B. $\sqrt{2}$

C. $\frac{1}{\sqrt{2}}$

D. $-2\sqrt{2}$

Answer: 4

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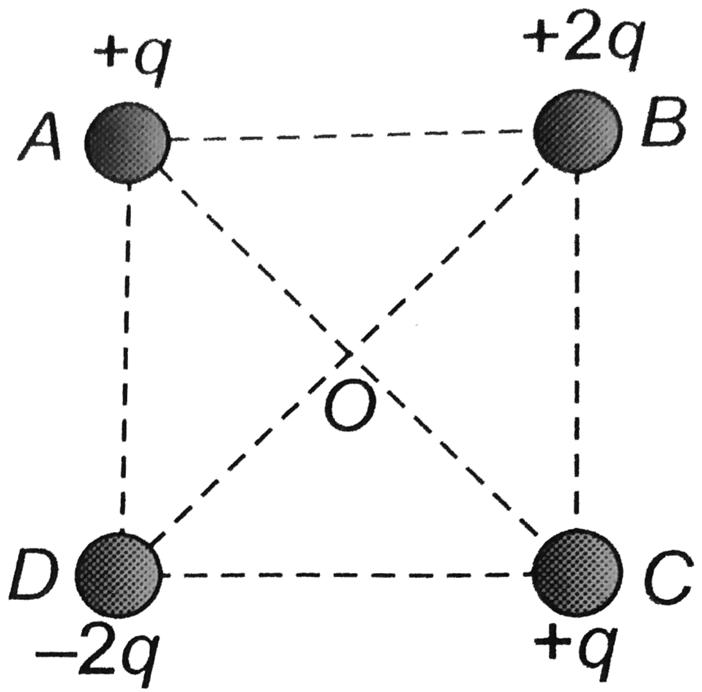
26. Four charges are arranged at the corners of a square $ABCD$, as shown in the adjoining figure, The force on a positive charge kept at the centre O is



A. zero

B. along the diagonal AC

C. along the diagonal BD

D. perpendicular to side AB

Answer: 3

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27. Four identical charges i.e. q is placed at the corners of a square of side a. The charge Q that must be placed at the centre of the square such that the whole system of charges in equilibrium is

A. $\frac{q}{4}$

B. $\frac{q}{4}[2\sqrt{2}+1]$

C. $-\frac{q}{4}[2\sqrt{2}+1]$

D. $-\frac{q}{4}[3\sqrt{3}+1]$

Answer: 3

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28. Two particles , each of mass m and carrying charge Q , are separated by some distance. If they are in equilibrium under mutual gravitational and electrostatic force then $Q/m(\in C/kg)$ is of the order of

A. 10^{-5}

B. 10^{-10}

C. 10^{-15}

D. 10^{-20}

Answer: 2

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29. In the previous question , the equilibrium is

A. stable

B. unstable

C. neutral

D. none

Answer: 3

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30. Consider two identical charges placed a distance $2d$ apart on the x-axis.The equilibrium of a positive test charge placed at the point O midway between them may be

(i) neutral

(ii) stable for displacement along the x-axis

(iii) stable for displacement along the y-axis

(iv) unstable for displacement along the x-axis

A. $(i), (ii), (iii)$

B. $(i), (iii), (iv)$

C. $(i), (ii), (iv)$

D. $(ii), (iii), (iv)$

Answer: 4

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31. Point charges $+4q, \ -q$ are kept on the x-axis at points $x = 0, x = a$ and $X = 2a$ respectively, then

A. only $-q$ is in stable equilibrium

B. none of the charges are in equilibrium

C. all the charges are unstable equilibrium

D. all the charges are in stable equilibrium

Answer: 2

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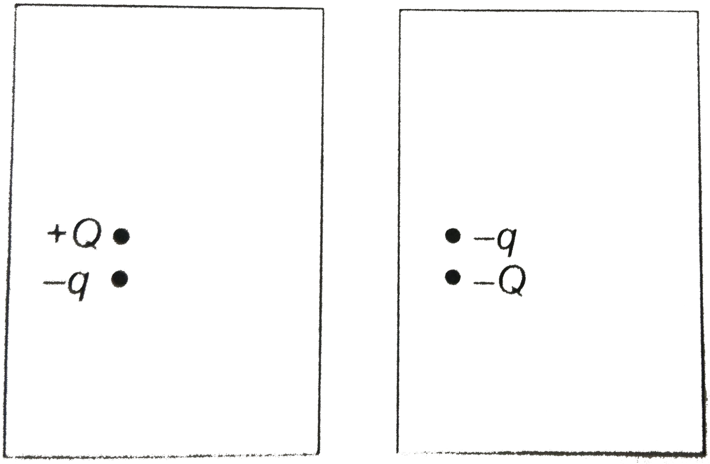
32. In the following diagrams a particle with small charge $-q$ is free to move up or down , but not sideways near a larger fixed charge Q.The small charge is in equilibrium because in the positions shown ,the electrical upward force is equal to the weight of the particle .Which statement os true?



(A) (B)

A. In fig.$(A), \ -q$ is in stable equilibrium

B. In fig.$(A), \ -q$ is in neutral equilibrium

C. In fig.$(B), \ -q$ is in stable equilibrium

D. Neither in fig.A nor in B, $-q$ is in stable equilibrium

Answer: 3

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33. Three point charges are placed at the corner of an equilateral triangle. Assuming only electrostatic forces are acting.

A. The system will be in equilibrium if the charges have the same magnitude but not all have same sign.

B. The system will be in equilibrium if the charges have different magnitudes and not all have the same sign

C. The system will be in equilibrium if the charges rotate about the centre of the triangle

D. The system can never be in equilibrium

Answer: 4

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34. Two points charges Q_1 and Q_2 placed at separation d in vacuum and force acting between them is F. Now a dielectric slab of thickness $d/2$ and dielectric constant $K = 4$ is placed between them. The new force between the charges will be

A. $\frac{4F}{9}$

B. $\frac{2F}{9}$

C. $\frac{F}{9}$

D. $\frac{5F}{9}$

Answer: 1

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35. Two identical simple pendulums, A and B are suspended from the same point. The bobs are given positive charges, with A having more charge than B making angles θ_1 and θ_2 with the vertical respectively. Which of the following is correct?

A. $\theta_1 > \theta_2$

B. $\theta_1 < \theta_2$

C. $\theta_1 = \theta_2$

D. The tension in $A > B$

Answer: 3

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36. Two small balls having equal poistive charges Q(coulomb) on each are suspended by two insulating strings of equal length L(metre) from a hook fixed to a stand. The whole set up is taken in a satellite into space where there is no gravity (state of weightlessness). The angle between the two strings is................and the tenison in each string is....................newtons.

A. 0°

B. 90°

C. 180°

D. $0^\circ < \theta < 180^\circ$

Answer: 3

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37. In previous question , the tension in each string is

A. 0

B. $\frac{1}{4\pi\varepsilon_0}\cdot\frac{Q^2}{L^2}$

C. $\frac{1}{4\pi\varepsilon_0}\cdot\frac{Q^2}{2L^2}$

D. $\frac{1}{4\pi\varepsilon_0}\cdot\frac{Q^2}{4L^2}$

Answer: 4

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38. Two identical charges $+Q$ are kept fixed some distance apart.A small particles P with charge q is placed midway between them . If P is given a small displacement Δ ,it will undergo simple harmonic motion if

(i) q is positive and Δ is along the line joining the charges

(ii) q is positive and Δ is perpendicular to the line joining the charges

(iii) q is negative and Δ is perpendicular to the line joining the charges

(iv) q is positive and Δ is along the line joining the charges

A. $(i), (ii)$

B. $(i), (iii)$

C. $(ii), (iii)$

D. $(i), (iv)$

Answer: 2

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39. Two point charges $q_1 = 4\mu C$ and $q_2 = 9\mu C$ are placed $20cm$ apart. The electric field due to them will be zero on the line joining them at distamce of

A. $8cm$ from q_1

B. $8cm$ from q_2

C. $\frac{80}{13}cm$ from q_1

D. $\frac{80}{13}cm$ from q_2

Answer: 1

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40. Three charges ,each of $+4\mu C$,are placed at the corners A, B, C of a square $ABCD$ of side $1m$.The electric field at the centre O of a square $ABCD$ of side $1m$.The electric field at the centre O of the square is

A. $7.2 \times 10^4 N/C$ towards D

B. $7.2 \times 10^4 N/C$ towards B

C. $3.6 \times 10^4 N/C$ towards A

D. $7.2 \times 10^4 N/C$ towards C

Answer: 1

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41. Four particles each having a charge q, are placed on the four vertices of a regular pentagon. The distance of each corner from the centre is a. Find the electric field at the centre of the pentagon.

A. $\dfrac{q}{4\pi\varepsilon_0 a^2}$

B. $\dfrac{2q}{4\pi\varepsilon_0 a^2}$

C. $\dfrac{3q}{4\pi\varepsilon_0 a^2}$

D. $\dfrac{4q}{4\pi\varepsilon_0 a^2}$

Answer: 1

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42. In a regular polygon of n sides, each corner is at a distance r from the centre. Identical charges each of magnitude q are placed at corners. The field at the centre is

A. $k\left(\frac{Q}{r^2}\right)$

B. $(n-1)k\left(\frac{Q}{r^2}\right)$

C. $\left(\frac{n}{n-1}\right)k\left(\frac{Q}{r^2}\right)$

D. $\left(\frac{n-1}{n}\right)k\left(\frac{Q}{r^2}\right)$

Answer: 1

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43. A wire is bent in the form of a regular hexagon and a total charge q is distributed uniformly on it.

What is the electric field at the centre? You may answer this part without making any numerical calculations.

A. $\frac{q}{4\pi\varepsilon_0 a^2}$

B. zero

C. $\frac{3q}{4\pi\varepsilon_0 a^2}$

D. $\frac{4q}{4\pi\varepsilon_0 a^2}$

Answer: 2

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44. A circular wire-loop of radius a carries a total charge Q distributed uniformly over its length . A small length dL of the wire is cut off. Find the electric field at the centre due to remaining wire.

A. $\frac{QdL}{8\pi\varepsilon_0 a^3}$

B. $\frac{QdL}{4\pi\varepsilon_0 a^3}$

C. $\frac{QdL}{2\pi\varepsilon_0 a^3}$

D. $\frac{QdL}{\pi\varepsilon_0 a^3}$

Answer: 1

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45. A point charge is brought in an electric field. The electric field at a nearby point

(i) will increase if the charge is $+ve$

(ii) will decrease if the charge is $-ve$

(iii) may increase if the charge is $+ve$

(iv) may decrease if the charge is $-ve$

A. (i), (ii)

B. (ii), (iii)

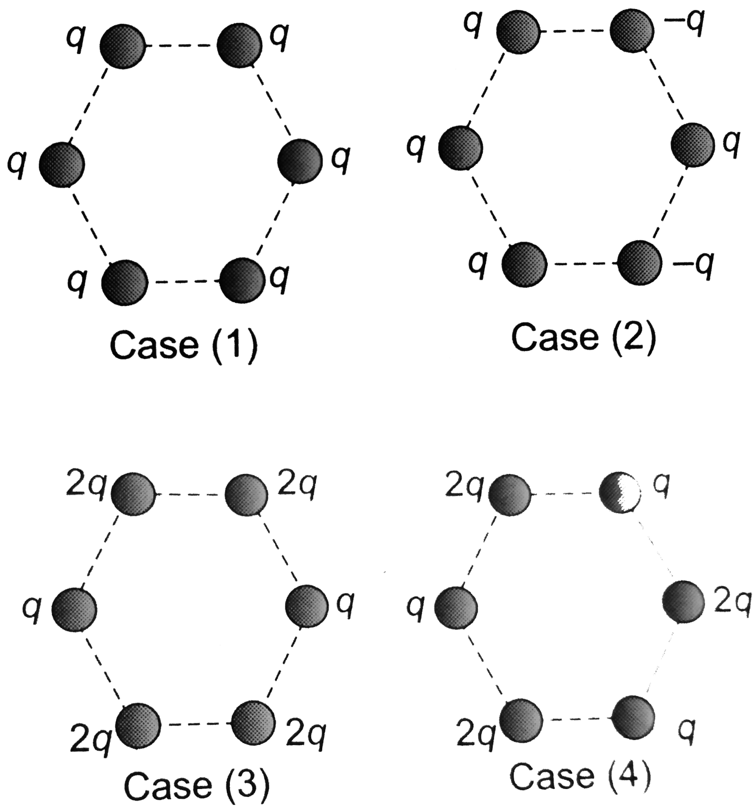
C. (i), (iv)

D. (iii), (iv)

Answer: 4

Watch Video Solution

46. Figure below show regular hexagons with charges at the vertices. In which of the following cases the electric field at the centre is not zero



A. 1

B. 2

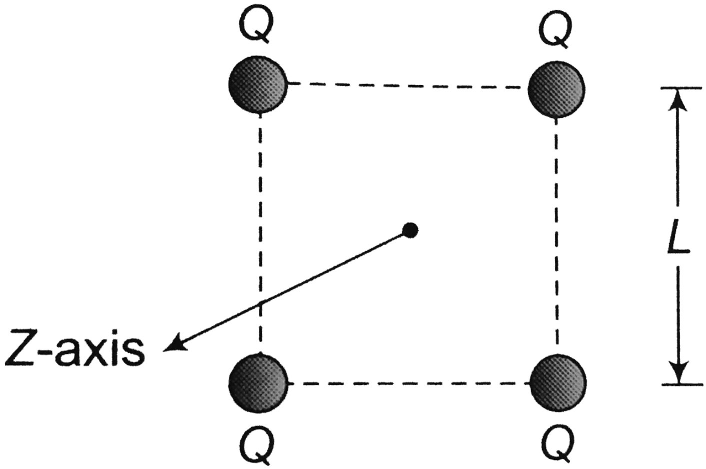
C. 3

D. 4

Answer: 6

Watch Video Solution

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



A. $-ve$ charge oscillates along the Z-axis

B. it moves away from the frame

C. it moves slowly towards the frame and stays in the plane of the frame

D. it passes through the frame only once

Answer: 1

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48. A proton and an electron are placed in a uniform electric field.

A. The electric forces acting on them will be equal

B. The magnitudes of the forces will be equal

C. Their accelerations will be equal

D. The magnitudes of their accelerations will be equal

Answer: 2

Watch Video Solution

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

A. $\frac{2E^2t^2}{mq}$

B. $\frac{Et^2m}{2t^2}$

C. $\frac{E^2q^2t^2}{2m}$

D. $\frac{Eqm}{2t}$

Answer: 3

Watch Video Solution

50. A particle of mass m and charge q is thrown at a speed u against a uniform electric field E. How much distance will it travel before coming to momentary rest?

A. $\frac{2mu^2}{qE}$

B. $\frac{mu^2}{qE}$

C. $\frac{mu^2}{2qE}$

D. $\frac{mu^2}{2qE}$

Answer: 4

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51. 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 of t_2 / t_1 is nearly equal to

A. 1

B. $\sqrt{\frac{m_e}{m_p}}$

C. $\sqrt{\frac{m_p}{m_e}}$

D. 1836

Answer: 3

Watch Video Solution

52. The magnitude of the electric field required to just balance in air a $2 \times 10^{-4} kg$ liquid drop carrying a charge of $10 \times 10^{-2} \mu C$ is

A. $10^4 N/C$

B. $2 \times 10^4 N/C$

C. $4 \times 10^4 N/C$

D. $5 \times 10^4 N/C$

Answer: 2

Watch Video Solution

53. A deuteron and an α-particle are placed in an electric field.The forces acting on them are F_1 and F_2 and their accelerations are a_1 and a_2 respectively.

(i) $F_1 = F_2$

(ii) $F_1 \neq F_2$

(iii) $a_1 = a_2$

(iv) $a_1 \neq a_2$

A. $(i), (ii)$

B. $(ii), (iii)$

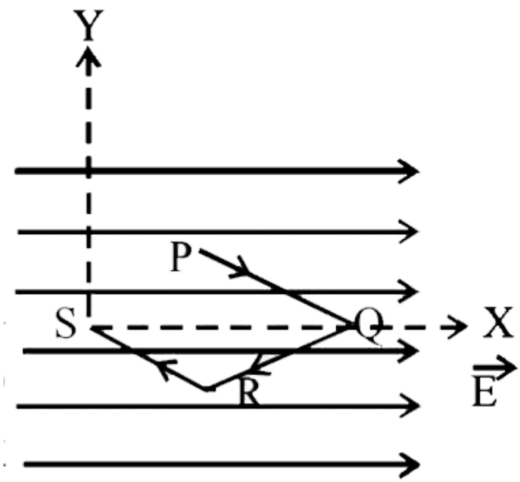
C. $(ii), (iv)$

D. $(i), (iv)$

Answer: 2

Watch Video Solution

54. A point charge q moves from point P to pont S along the path PQRS (fig.) in a uniform electric field E pointing parallel to the poistive direction of the X-axis. The coordinates of the points P, Q, R and S are(a, b, O), (2a, O, O)(a, -b,$\underline{O}$) and `(O, O, O) respectively. The work done by the field in the above process is given by the expresison............



A. qaE

B. $-qaE$

C. $q\left[\sqrt{a}^2 + b^2\right]E$

D. $3qE\sqrt{(a^2 + b^2)}$

Answer: 2

Watch Video Solution

55. A pith ball carrying a charge of $3 \times 10^{-10} C$ is suspended by an insulated thread of length $50cm$ .When a uniform electric filed is applied in a horizontal direction , the ball is found to deflect by $2cm$ from the vertical. If the mass of the ball is $0.5gm$, the intensity of the electric field is :

A. $6.6 \times 10^5 N / C$

B. $3.3 \times 10^5 N / C$

C. $9.9 \times 10^5 N/C$

D. $1.1 \times 10^5 N/C$

Answer: 1

Watch Video Solution

56. A particle of mass m and charge q is thrown in the vertical direction with a velocity v_0 in a uniform horizontal electric field E. Assuming the gravity force to be negligible ,the equation of the path followed by the particle will be

A. parabola ,$x = \left(\frac{qE}{2mv_0^2}\right)y^2$

B. hyperbola , $x = \frac{qE}{2mv_0^2 y}$

C. straight line ,$x = \frac{qEy}{2mv_0^2}$

D. none of the above

Answer: 1

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57. A block of mass m containing a net positive charge q is placed on a smooth horizontal table which terminates in a vertical wall as shown in figure(29-E2). The distance of the bolck from the wall is d. A horizontal electric field E to towards right is switched on. Assuming elastic collisions find the time period of the resulting oscillatory motion. Is it a simple harmonic motion?

A. $\sqrt{\dfrac{4md}{QE}}$

B. $\sqrt{\dfrac{md}{8QE}}$

C. $\sqrt{\dfrac{8md}{QE}}$

D. $\sqrt{\dfrac{md}{4QE}}$

Answer: 3

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58. A small metallic bob of mass m of a simple pendulum of length l is suspended from a silk threas between two parallel charged plates.The electric field intensity E act vertically downwards . If bob is given a charge $+q$,time period of oscillation

(i) $T = 2\pi\sqrt{\frac{l}{\left(g - \frac{qE}{m}\right)}}$, if the lower plate is charged positively

(ii) $T = 2\pi\sqrt{\frac{l}{\left(g - \frac{qE}{m}\right)}}$,if the lower plate is charged negatively

(iii) $T = 2\pi\sqrt{\frac{l}{\left(g + \frac{qE}{m}\right)}}$,if the lower plate is charged positively

(iv) $T = 2\pi\sqrt{\frac{l}{\left(g + \frac{qE}{m}\right)}}$, if the lower plate is charged negatively

A. (i), (ii)

B. (i), (iii)

C. (i), (iv)

D. all

Answer: C

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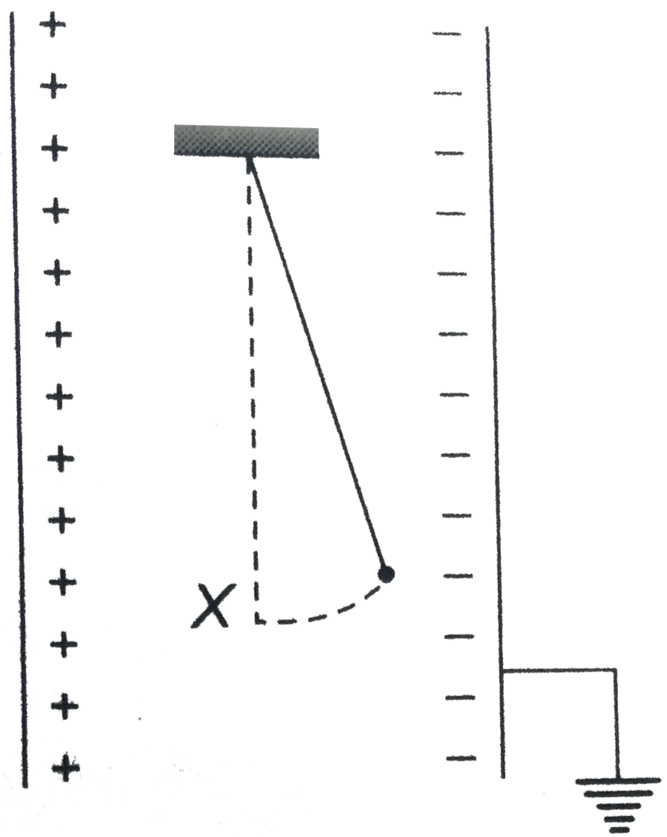
59. A simple pendulum has a length l, mass of bob m. The bob is given a charge q.The pendulum is suspended between the vertical plates of charged parallel plate capacitor. If E is the field strength between the plates ,then time period $T =$



A. $2\pi\sqrt{\frac{l}{g}}$

B. $2\pi\sqrt{\left\{\frac{l}{g+\frac{qE}{m}}\right\}}$

C. $2\pi\sqrt{\left\{\frac{l}{g-\frac{qE}{m}}\right\}}$

D. $2\pi\sqrt{\frac{l}{\left(g^2+\left(\frac{qE}{m}\right)^2\right)^{1/2}}}$

Answer: 4

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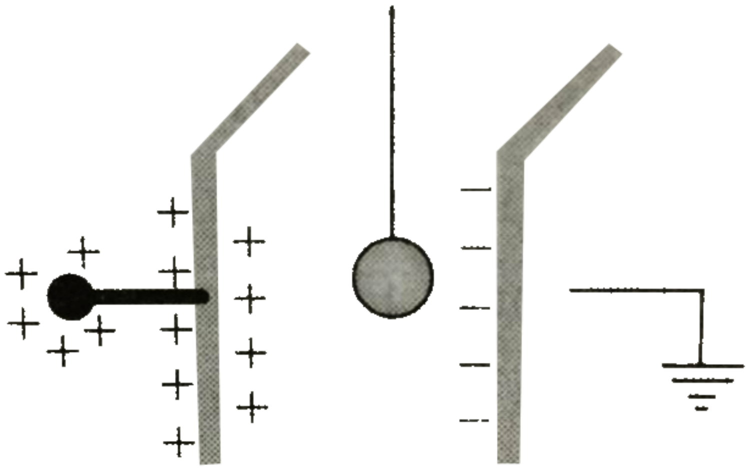
60. A table tennis ball covered with a conducting paint is suspended by a silk thread so that it hangs between tow metal plates. One plate is earthed, when the other plate is connected to a high voltage generator, what will happen to the ball.



A. is attached to the high voltage

B. hangs without moving

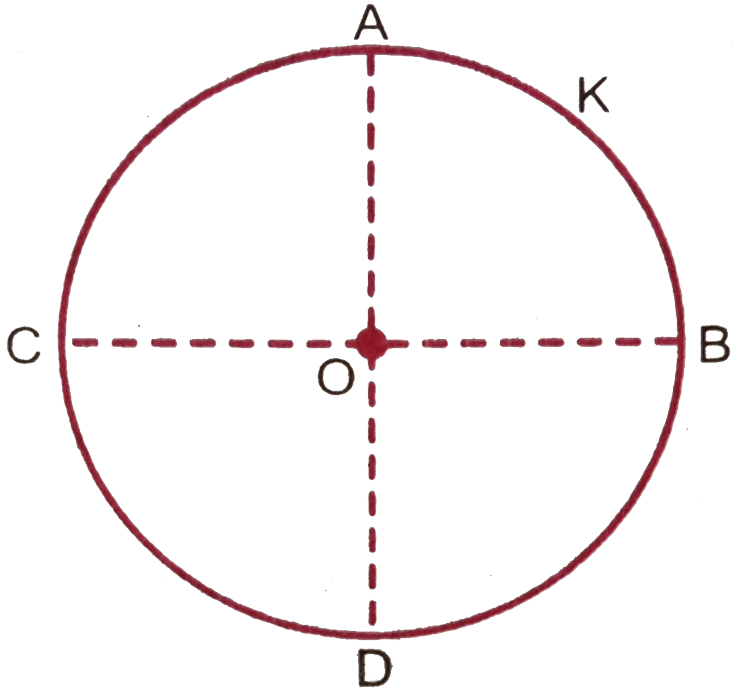
C. swings backward and forward hitting the plates

D. is repelled to the earthed plate and stays there

Answer: 3

Watch Video Solution

61. A thin conducting ring of radius R is given a charge $+Q$, Fig. The electric field at the center O of the ring due to the charge on the part AKB of the ring is E. The electric field at the center due to the charge on part $ACDB$ of the ring is



A. E along KO

B. $3E$ along OK

C. $3E$ along KO

D. E along OK

Answer: 4

Watch Video Solution

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

A. becomes zero

B. increase

C. decrease

D. remain same

Answer: 3

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63. Three is an electric field E in the x - direction. If the work done by the electric field in moving a charge of $0.2C$ through a distance of $2m$ along a line making an angle 60° with the x- axis is $4J$, then what is the value of E ?

A. $\sqrt{3}N/C$

B. $4N/C$

C. $5N/C$

D. None of these

Answer: 4

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64. Two large vertical and parallel metal plates having a separation of 1cm are connected to a DC voltage source of potential difference X. A proton is released at rest midway between the two plates. It is found to move at 45° to the vertical JUST after release. Then X is nearly

A. $1 \times 10^{-5} V$

B. $1 \times 10^{-7} V$

C. $1 \times 10^{-9} V$

D. $1 \times 10^{-10} V$

Answer: 3

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65. A and B are two points in an electric field . If the work done in carrying $4.0C$ of electric charge from A to B is $16.0J$, the potential difference between A and B is

A. zero

B. $2.0V$

C. $4.0V$

D. $16.0V$

Answer: 3

Watch Video Solution

66. A particle of mass 'm' and charge 'q' is accelerated through a potential difference of V volt, its energy will be

A. QV

B. mQV

C. $\frac{MQ}{V}$

D. $\frac{m}{QV}$

Answer: 1

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67. Two charges $4 \times 10^{-8}C$ and $-6 \times 10^{-8}C$ are at points A and B respectively ,$50cm$ apart . The electrical potential due to them is zero on the line AB at a distance from A equal to

A. $10cm$

B. $20cm$

C. $30cm$

D. $40cm$

Answer: 2

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68. Two positive charges of magnitude $4C$ and $6C$ are placed $10cm$ apart . The electric potential at a distance of $10cm$ from the middle point on the right bisector of the line,joining the two charges is

A. $5 \times 10^{11} V$

B. $4 \times 10^9 V$

C. $8 \times 10^{11} V$

D. $5 \times 10^9 V$

Answer: 3

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

A. $Q = -q$

B. $Q = -\frac{1}{q}$

C. $Q = q$

D. $Q = \frac{1}{q}$

Answer: 1

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70. In an hydrogen atom, the electron revolves around the nucles in an orbit of radius $0.53 \times 10^{-10} m$. Then the electrical potential produced by the nucleus at the position of the electron is

A. $-13.6V$

B. $-27.2V$

C. $27.2V$

D. $13.6V$

Answer: 3

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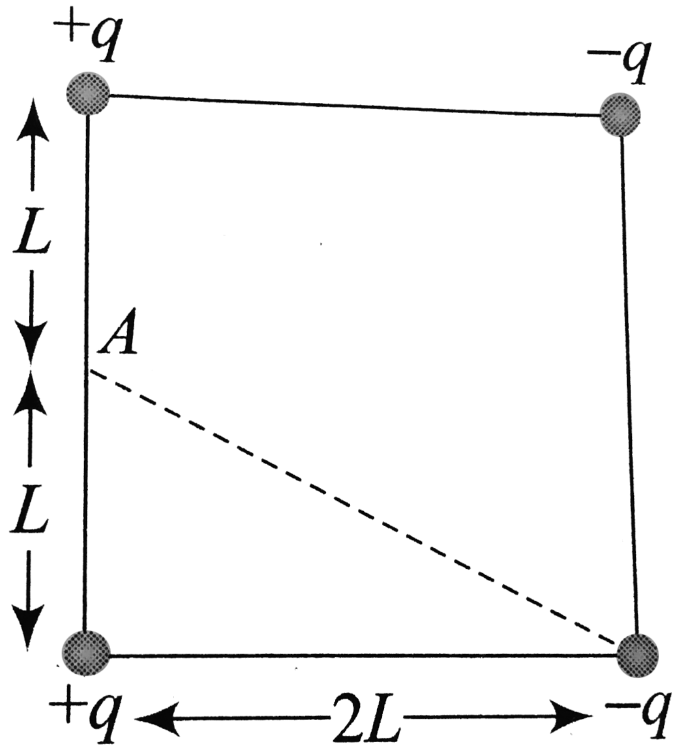
71. Four electric charges $+q$, $+q$, $-q$ and $-q$ are placed at the corners of a square of side 2L (see figure). The electric potential at point A, mid-way between the two charges $+q$ and $+q$, is



A. zero

B. $\frac{1}{4\pi\varepsilon_0}\frac{2q}{L}(1+\sqrt{5})$

C. $\frac{1}{4\pi\varepsilon_0}\frac{2q}{L}\left(1+\frac{1}{\sqrt{5}}\right)$

D. $\frac{1}{4\pi\varepsilon_0}\frac{2q}{L}\left(1-\frac{1}{\sqrt{5}}\right)$

Answer: 4

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72. A bullet of mass $2gm$ is having a charge of $2\mu c$. Through what potential difference must it be accelerated, starting from rest, to acquire a speed of $10m/s$

A. $5kV$

B. $50kV$

C. $5V$

D. $50V$

Answer: 2

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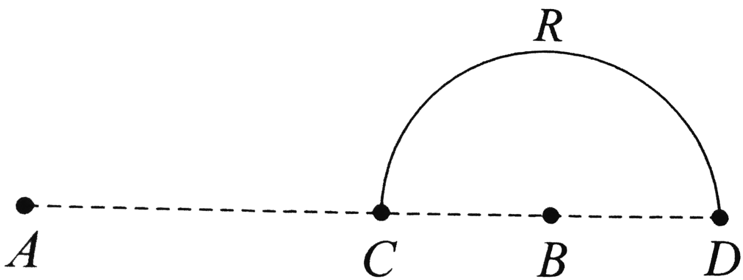
73. Charges $+q$ and $-q$ are placed at points A and B respectively which are a distance $2L$ apart, C is the midpoint between A and B. The work done in moving a charge $+Q$ along the semicircle CRD is



A. $\frac{qQ}{4\pi\varepsilon_0 L}$

B. $\frac{qQ}{2\pi\varepsilon_0 L}$

C. $\frac{qQ}{6\pi\varepsilon_0 L}$

D. $-\frac{qQ}{6\pi\varepsilon L}$

Answer: 4

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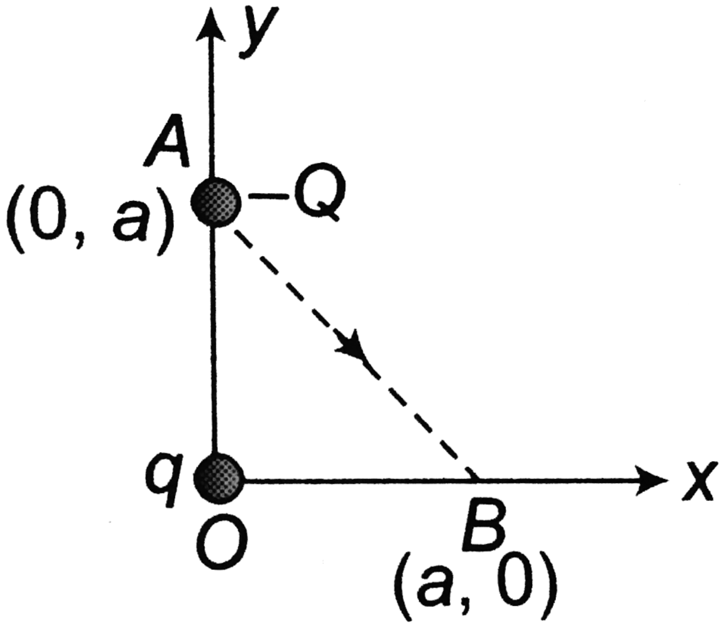
74. As per this diagram a point charge $+q$ is placed at the origin O. Work done in taking another point charge $-Q$ from the point $A(0, a)$ to another point

$B(a, 0)$ along the staight path AB is:



A. zero

B. $\left(\frac{-qQ}{4\pi\varepsilon_0 a^2}\right)\sqrt{2}a$

C. $\left(\frac{-qQ}{4\pi\varepsilon_0 a^2}\right)\frac{a}{\sqrt{2}}$

D. $\left(\frac{qQ}{4\pi\varepsilon_0 a^2}\right)\sqrt{2}a$

Answer: 1

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75. A charge $+q$ is fixed at each of the points $x = x_0$, $x = 3x_0$, $x = 5x_0$,............$x = \infty$ on the x axis, and a charge $-q$ is fixed at each of the points $x = 2x_0$, $x = 4x_0$, $x = 6x_0$, ...$x = \infty$. Here x_0 is a positive constant. Take the electric potential at a point due to a charge Q at a distance r from it to be $Q/(4\pi\varepsilon_0 r)$ .Then, the potential at the origin due to the above system of

A. 0

B. $\frac{q1n2}{8\pi\varepsilon_0 x_0}$

C. ∞

D. $\frac{q1n2}{4\pi\varepsilon_0 x_0}$

Answer: 4

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76. A charge Q is uniformly distributed only on the fourths portion of a ring of radius R. The elctric potential at centre of ring is

A. $\frac{3Q}{4\pi\varepsilon_0 R}$

B. $\dfrac{Q}{4\pi\varepsilon_0 R}$

C. $\dfrac{3Q}{2\pi\varepsilon_0 R}$

D. $\dfrac{6Q}{4\pi\varepsilon_0 R}$

Answer: B

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77. A ring of radius a contains a charge q distributed. uniformly ober its length. Find the electric field at a point. on the axis of the ring at a distance x from the centre.

A. $\dfrac{1}{4\pi\varepsilon_0}\cdot\dfrac{4Q}{\sqrt{R^2+x^2}}$

B. $\frac{1}{4\pi\varepsilon_0} \cdot \frac{2Q}{\sqrt{R^2 + x^2}}$

C. $\frac{1}{4\pi\varepsilon_0} \cdot \frac{3Q}{\sqrt{R^2 + x^2}}$

D. $\frac{1}{4\pi\varepsilon_0} \cdot \frac{Q}{\sqrt{R^2 + x^2}}$

Answer: 4

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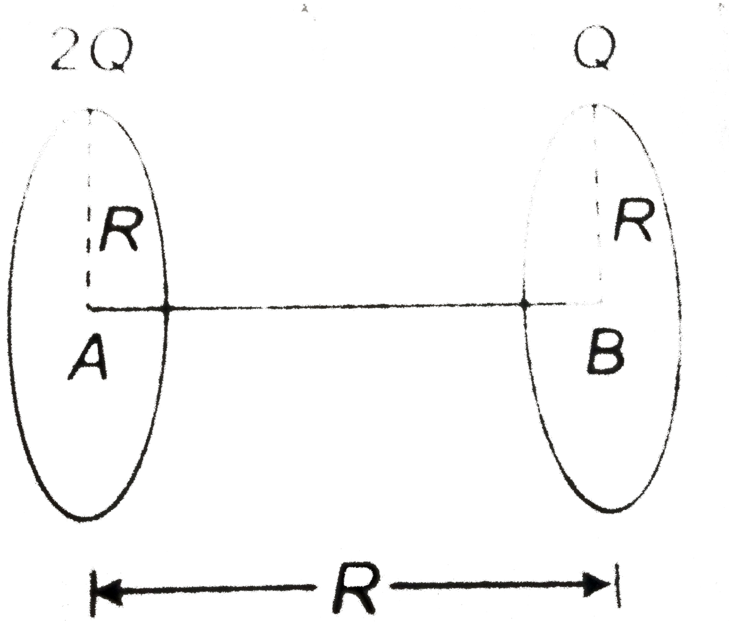
78. In the following arrangement



A. $V_A = \dfrac{Q\left(2\sqrt{2}-1\right)}{4\pi \in_0 \sqrt{2}R}$

B. $V_B = \dfrac{Q\left(\sqrt{2}-1\right)}{4\pi\varepsilon_0 R}$

C. $W.\ D.$ in moving a charge $+q$ from B to A

$$W_{BA} = \frac{qQ\left(3\sqrt{2}-3\right)}{4\sqrt{2}\pi\varepsilon_0 R}$$

D. all options are correct

Answer: 4

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79. Two identical thin ring, each of radius R meters, are coaxially placed a distance R metres apart. If Q_1 coulomb, and Q_2 coulomb, are repectively 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. $\dfrac{q(Q_1 - Q_2)\left(\sqrt{2} - 1\right)}{4\sqrt{2}\pi\varepsilon_0 R}$

C. $\dfrac{q(Q_1 - Q_2)\left(\sqrt{2} - 1\right)}{4\sqrt{2}\pi\varepsilon_0 R}$

D. $\dfrac{q\sqrt{2}(Q_1 + Q_2)}{4\pi\varepsilon_0 R}$

Answer: 2

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80. Two fixed charges $-2Q$ and Q are located at the points with coordinates (-3 a, 0) and (+3 a, 0) respectively in the $X - Y$ plane .

All the points in the $X - Y$ plane where the electric potential due to the two charges is zero , line on a .

A. straight line

B. ellipse

C. circle

D. parabola

Answer: 3

Watch Video Solution

81. The work done in carrying a charge Q_1 once round a circle of radius R with a charge Q_2 at the centre is

A. $\dfrac{Q_1Q_2}{4\pi \in_0 R^2}$

B. zero

C. $\dfrac{Q_1Q_2}{4\pi \in_0 R}$

D. infinite

Answer: 2

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82. Two equal positive charges are kept at points A and B. The electric potential at the points between A and B (exculding these points) is studid while moving from A to b. The potential

A. continuously increases

B. continuously decreases

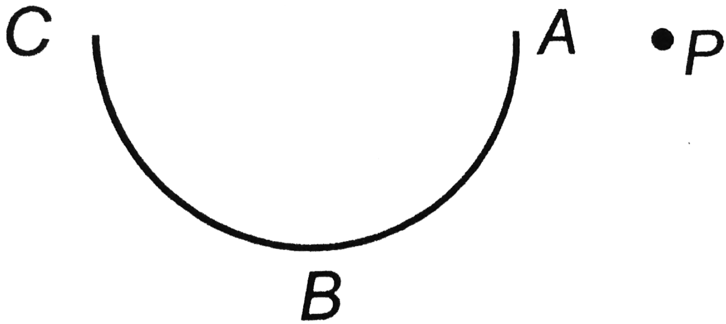
C. increases then decreases

D. decreases then increases

Answer: 4

Watch Video Solution

83. In the following diagram the work done in moving a point charge from point P to point A, B and C is respectively as W_A, W_B and W_C, then



A. $W_A < W_B < W_C$

B. $W_A > W_B > W_C$

C. $W_A = W_B = W_C$

D. None of these

Answer: 3

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84. Two equal charges q are placed at a distance of $2a$ and a third charge $-2a$ is placed at the midpoint. The potential energy of the system is

A. $\frac{q^2}{8\pi\varepsilon_0 a}$

B. $\frac{6q^2}{8\pi\varepsilon_0 a}$

C. $-\frac{7q^2}{8\pi\varepsilon_0 a}$

D. $\frac{9q^2}{8\pi\varepsilon_0 a}$

Answer: 3

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85. Charges $+q, \ -q, \ +q$ and $-q$ are placed at the corners A, B, C and D respectively of a square of side a. The potential energy of the system is $1/4\pi\varepsilon_0$ times

A. $\left(\frac{q^2}{a}\right)(-4+\sqrt{2})$

B. $\left(\frac{q^2}{2a}\right)(-4+\sqrt{2})$

C. $\left(\frac{4q^2}{a}\right)$

D. $-\left(\frac{4\sqrt{2}q^2}{a}\right)$

Answer: 1

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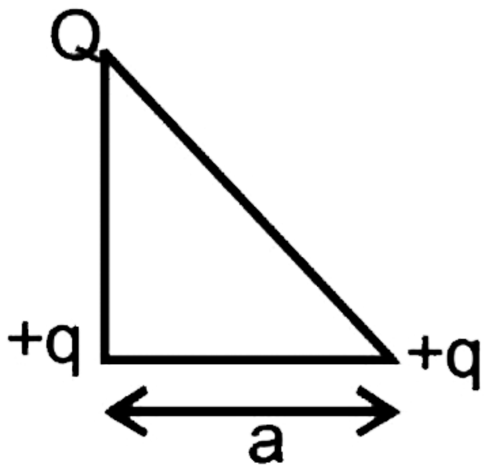
86. Three charges Q, $+q$ and $+q$ are placed at the vertices of a right-angled isosceles triangle as shown. The net electrostatic energy of the configuration is zero if Q is equal to



A. $\frac{-q}{1+\sqrt{2}}$

B. $\frac{-2q}{2+\sqrt{2}}$

C. $-2q$

D. $+q$

Answer: B

Watch Video Solution

87. Three points charges of $1C, 2C$ and $3C$ are placed at the corners of an equilateral triangle of side 100 cm. Find the work done to move these charges to the corners of a similar equilateral triangle of side 50 cm.

A. $3.3 \times 10^{10} J$

B. $6.6 \times 10^{10} J$

C. $9.9 \times 10^{10} J$

D. zero

Answer: 3

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88. If identical charges $(-q)$ are placed at each corner of a cube of side b, then electric potential energy of charge $(+q)$ which is palced at centre of the cube will be

A. $\dfrac{8\sqrt{2}q^2}{4\pi\varepsilon_0 b}$

B. $\dfrac{-8\sqrt{2}q^2}{\pi\varepsilon_0 b}$

C. $\dfrac{-4\sqrt{2}q^2}{\pi\varepsilon_0 b}$

D. $\dfrac{-4q^2}{\sqrt{3}\pi\varepsilon_0 b}$

Answer: 4

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89. Four equal charges Q are placed at the four corners of a square of each side is 'a'. Work done in removing a charge $-Q$ from its centre to infinity is

A. 0

B. $\dfrac{\sqrt{2}Q^2}{4\pi\varepsilon_0 a}$

C. $\dfrac{\sqrt{2}Q^2}{\pi\varepsilon_0 a}$

D. $\dfrac{Q^2}{2\pi\varepsilon_0 a}$

Answer: 2

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90. Identify the WRONG statement.

A. The electrical potential energy of a system of two protons shall increase if the separation between the two is decreased

B. The electrical potential energy of a proton , electron system will increase if the separation between the two is decreased

C. The electrical potential energy of a proton electron system will increase if the separation between the two is increased

D. The electrical potential energy of system of two electrons shall increase if the separation between the two is decreased

Answer: 2

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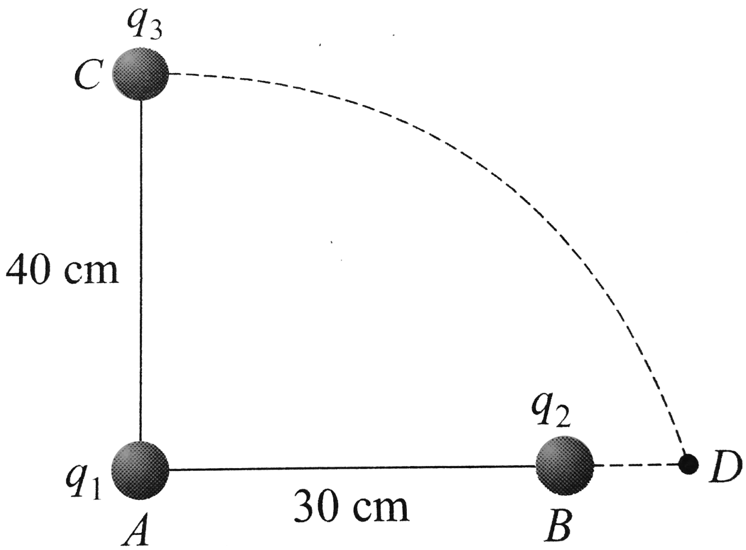
91. Two charges q_1 and q_2 are placed $30cm$ apart, as shown in the figure. A third charge q_3 is moved along the arc of a circle of radius $40cm$ from C to D. The change in the potential energy o fthe system is $\frac{q_3}{4\pi\varepsilon_0}k.$, where k is



A. $8q_2$

B. $8q_1$

C. $6q_2$

D. $8q_1$

Answer: 1

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92. Four charges $+q, +q, -q,$ and $-q$ are placed, respectively, at the corners $A, B, C,$ and D of a square of side a, arranged in the given order. E and F are the midpoints of sides BC and CD, respectively, O is the center of square.

The work done in carrying a charge e from O to E is.

A. zero

B. $\dfrac{3qQ}{4\pi \in_0 a}$

C. $\dfrac{3qQ}{8\pi \in_0 a}$

D. $\dfrac{qQ}{4\pi \in_0 a}$

Answer: 1

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93. Poistive and negative point charges of equal magnitude are kept at $\left(0, 0, \frac{a}{2}\right)$ and $\left(0, 0, \frac{-a}{2}\right)$

respectively. The work done by the electric field when another poistive point charge is moved from $(-a, 0, 0)$ to $(0, a, 0)$ is

A. positive

B. negatively charged

C. zero

D. depends on the path connecting the initial and final positions

Answer: 1

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94. A proton and α-particle are placed at separation d on a smooth surface . The ratio of their speed when separation becomes infinite will be

A. $4:1$

B. $2:1$

C. $1:4$

D. $1:2$

Answer: 1

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95. A particle A of mass m and charge Q moves directly towards a fixed particle B, which has charge Q. The speed of A is a v when it is far away from B. The minimum separtion between the particles is not proportional to

A. Q^2

B. $\frac{1}{v^2}$

C. $\frac{1}{v}$

D. $\frac{1}{m}$

Answer: 3

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96. Charges $2q$ and $8q$ are placed at the end points A and B repsectively of a $9cm$ long straight line. A third charge q is placed at a point $C of AB$ such that the potential energy of the system is minimum . The distance of C from A is

A. $2cm$

B. $3cm$

C. $4cm$

D. $5cm$

Answer: 2

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97. When the separation between two charges is increased, the electric potential energy of the charges

A. increases

B. decreases

C. remains the same

D. may increase or decrease

Answer: 4

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98. If a positive charge is shifted from a low - potential region to a high- potential region, the electric potential energy

A. increases

B. decreases

C. remains the same

D. may increase or decrease

Answer: 1

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99. An infinite number of charges each equal to q, are placed along the X-axis at $x = 1, x = 2, x = 4, x = 8$,........ and so on.

(i) find the electric field at a point $x = 0$ due to this set up of charges.

(ii) What will be the electric field if the above setup, the consecutive charges have opposite signs.

A. $2q, 4q$

B. $\frac{2q}{3}, 4q$

C. $\frac{2q}{3}, \frac{4q}{3}$

D. $2q, \frac{4q}{3}$

Answer: 4

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100. An infinite number of charges each equal to q, are placed along the X-axis at $x = 1, x = 2, x = 4, x = 8$,......... and so on.

(i) find the electric field at a point $x = 0$ due to this set up of charges.

(ii) What will be the electric field if the above setup, the consecutive charges have opposite signs.

A. $\frac{2q}{3}, 4q$

B. $\frac{2q}{5}, \frac{4q}{5}$

C. $\frac{2q}{3}, \frac{4q}{5}$

D. $\frac{2q}{5}, \frac{4q}{7}$

Answer: 3

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101. Three charges $2q, \ -q, \ \text{and} \ \ -q$ are located at the vertices of an equilateral triangle. At the center of the triangle,

A. field is zero but potential is non -zero

B. field is non -zero but potential is zero

C. both , field and potential are zero

D. both field and potential are non-zero

Answer: B

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102. A cube of side b has a charge q at each of its vertices. Determine the potential and electric field due to this charge array at the center of the cube.

A. $\dfrac{2q}{\sqrt{3}\pi \in_0 b}$,zero

B. $\dfrac{4q}{\sqrt{3}\pi \in_0 b}$,zero

C. $\dfrac{5q}{\sqrt{3}\pi \in_0 b}$,zero

D. $\dfrac{7q}{\sqrt{3}\pi \in_0 b}$,zero

Answer: 2

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103. Four identical charges are placed at the points $(1, 0, 0)$, $(0, 1, 0)$, $(-1, 0, 0)$, and $(0, -1, 0)$. Then,

A. (i), (ii)

B. (i), (iii)

C. (ii), (iii)

D. $(ii), (iv)$

Answer: 4

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104. Four charges , all of the same magnitude , are placed at the four corners of a square . At the centre of the square , the potential is V and the field is E. By suitable choice of the signs of the four charges ,which of the following can be obtained?

(i) $V = 0, E = 0$

(ii) $V = 0, E \neq 0$

(iii) $V \neq 0, E = 0$

(iv) $V \neq 0, E \neq 0$

A. $(i), (ii)$

B. $(i), (iii)$

C. $(ii), (iii)$

D. all

Answer: D

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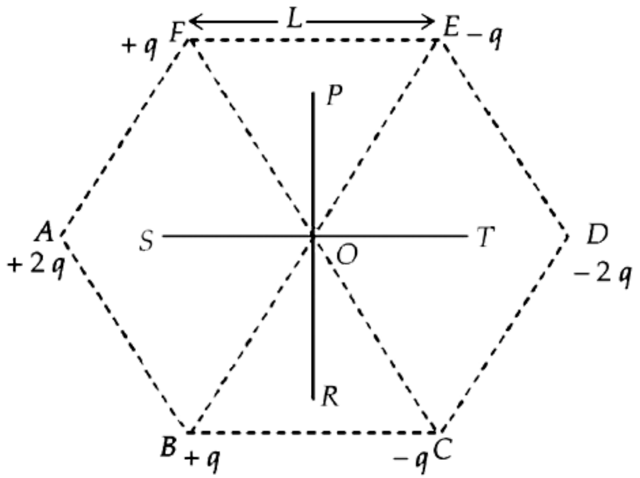
105. Six point charges are kept at the vertices of a regular hexagon of side L and centre O, as shown in the figure. Given that $K=\frac{1}{4\pi\varepsilon_0}\frac{q}{L^2}$, which of the following statements(s) is (are) correct?



A. The electric field at $Ois6K$ along OD

B. The potential at O is zero

C. The potential at all points on the line PR is

same

D. The potential at all points on the line ST is same

Answer: 4

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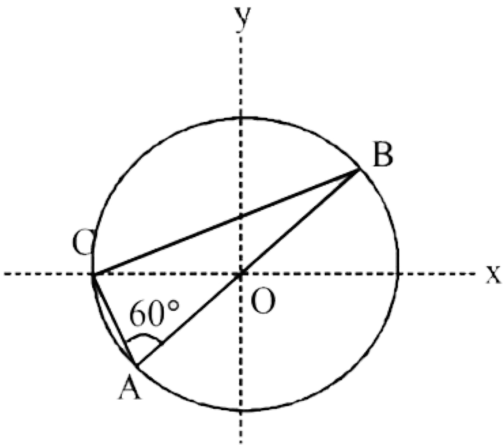
106. Conisder a system of three charges $q/3$, $q/3$ and $-2q/3$ placed at point A, B and C, respectively, as shown in the figure. Take O to be centre of the circle of radius R and angle $CAB = 60^\circ$



A. The electric field at point $O is \frac{q}{8\pi\varepsilon_0 R^2}$ directed along the negative x-axis

B. The potential energy of the system is zero

C. The magnitude of the force between the charges at C and $B is \frac{q^2}{54\pi\varepsilon_0 R^2}$

D. The potential at point O is $\frac{q}{12\pi\varepsilon_0 R}$

Answer: 3

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107. Which of the following is correct regarding electric lines of force ?

(i) Electric lines of force diverge from $+ve$ and converge at a $-ve$ charge

(ii) Electric lines of force never cross each other , otherwise there will be two directions of electric field at a point of intersection which is not possible

(iii) Closer are the electric lines of forces , stronger is the field , and further apart lines of force ,weaker is electric field

(iv) The electric lines of forces are parallel for a uniform electric field

A. $(i), (ii)$

B. $(ii), (iii)$

C. $(ii), (iv)$

D. all

Answer: 4

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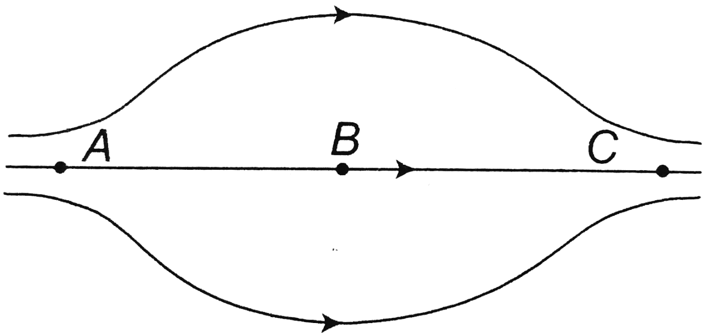
108. The figure shows some of the electric field lines corresponding to an electric field. The figure suggests



A. $E_A > E_B > E_C$

B. $E_A = E_B = E_C$

C. $E_A = E_C > E_B$

D. $E_A = E_C < E_B$

Answer: 3

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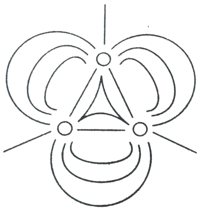
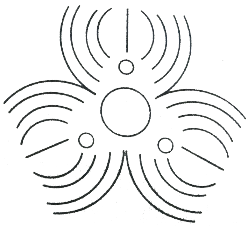
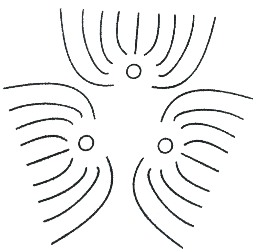
109. Three poistive charges of equal value q are placed at the vertices of an equilateral triangle. The resulting lines of force should be sketched as in

(1) 

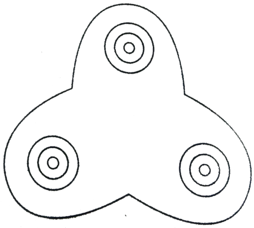
A.



B.



C.

D. 

Answer: 3

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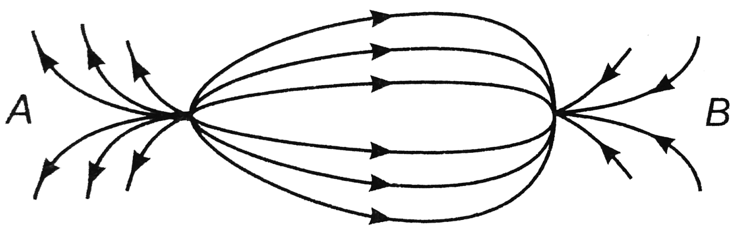
110. The spatial distribution of the electric field due to charges (A, B) is shown in figure. Which of the following statements is correct?



A. A is $+ve$ and $B - ve$ and $|A| > |B|$

B. A is $-ve$ and $B + ve$, $|A| > |B|$

C. Both are $+ve$ but $A > B$

D. Both are $-ve$ but $A > B$

Answer: 1

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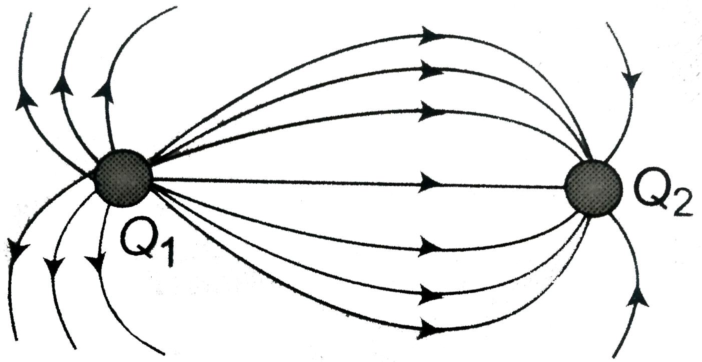
111. A few electric field lines for a system of two charges Q_1 and Q_2 fixed at two different points on the x-axis are shown in the figure. These lines suggest that

(i) $|Q_1| > |Q_2|$

(ii) $|Q_1| < |Q_2|$

(iii) At a finite distance to the left of Q_1 the electric field is zero

(iv) At a finite distance to the right of Q_2 the electric field is zero



A. (i), (iii)

B. (i), (iv)

C. (ii), (iii)

D. $(ii), (iv)$

Answer: 2

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112. Electric lines of force about negative point charge are

A. circular ,anticlockwise

B. circular ,clockwise

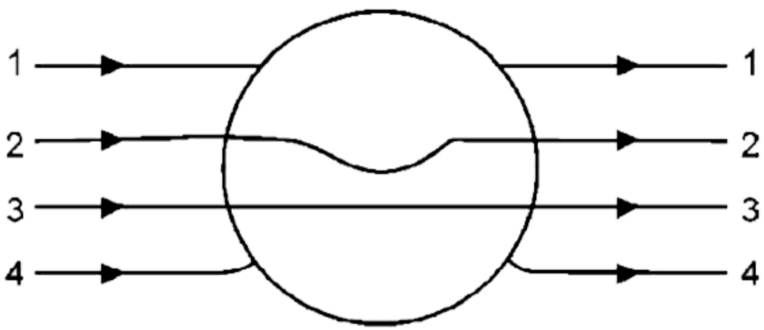
C. radial ,inward

D. radial , outward

Answer: 3

Watch Video Solution

113. A metallic solid sphere is placed in a uniform electric fied. The lines of force follow the path(s) shown in Figure as



A. 1

B. 2

C. 3

D. 4

Answer: 4

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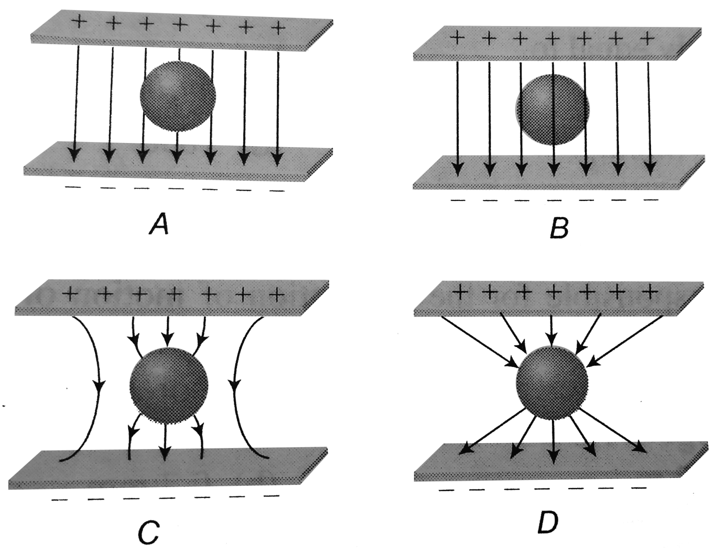
114. An uncharged sphere of metal is placed in between two charged plates as shown. The lines of force look like



A. A

B. B

C. C

D. D

Answer: 3

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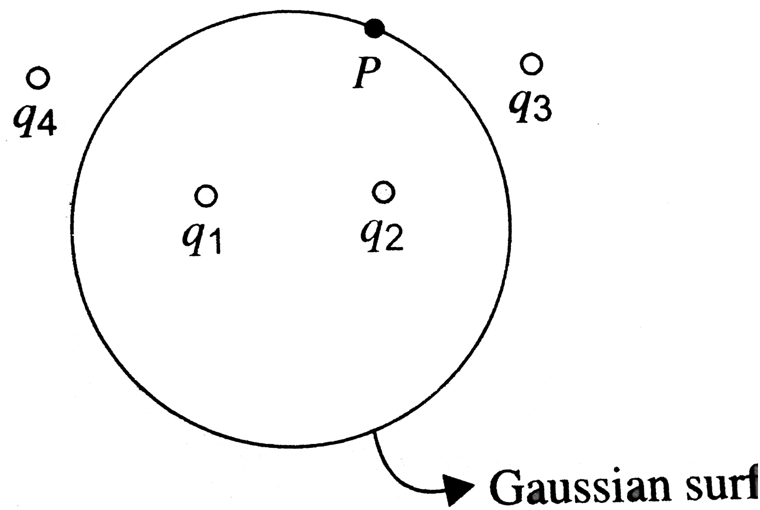
115. Consider the Gaussian surface that surrounds parts of the charge distribution shown in figure. Then the contribution to the electric field at point P arises from charges



A. q_1 and q_2 only

B. q_3 and q_2 only

C. q_1, q_2, q_3 and q_4

D. none of the above

Answer: 3

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116. A cylinder of radius R and length l is placed in a uniform electric field E parallel to the axis of the cylinder. The total flux over the curved surface of the cylinder is

A. $2\pi R^2 E$

B. $\pi R^2 / E$

C. $\left(\pi R^2 / \pi R\right) / E$

D. zero

Answer: 4

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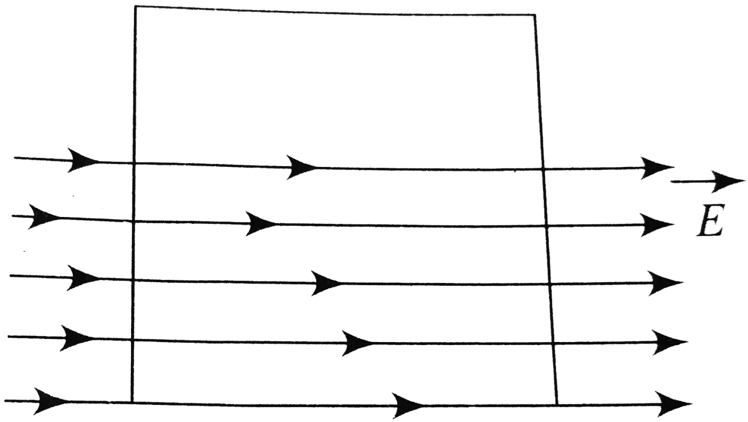
117. A square surface of side Lm is in the plane of the paper. A uniform electric field $\overrightarrow{E}(V/m)$, also in the plane of the paper, is limited only to the lower half of the square surface (see figure). The electric flux in SI

units associated with the surface is:



A. zero

B. EL^2

C. $EL^2 / (2\varepsilon_0)$

D. $EL^2 / 2$

Answer: 1

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118. An electric charge is placed at the centre of a cube of side a.The electric flux

(i) through one of its faces $\frac{q}{6 \in_0}$

through one of its faces $\frac{q}{3 \in_0}$

(iii) through all of its faces $\frac{q}{\in_0}$

(iv) through one of its faces $\frac{q}{2 \in_0}$

A. $(i),(ii)$

B. $(ii),(iii)$

C. $(ii),(iv)$

D. $(i),(iii)$

Answer: 4

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119. What is the number of electric lines lines of force that radiate outwards from one coulomb of charge in vacumm ?

A. 1.11×10^{11}

B. 1.11×10^{-10}

C. 1.1×10^{19}

D. 1

Answer: 1

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120. A long strikes with a charge of λ per unit length passes through an imaginary cube of edge a. The maximum flux of the electric field through the cube will be

A. $\dfrac{\lambda a}{\varepsilon_0}$

B. $\sqrt{\dfrac{\lambda a}{\varepsilon_0}}$

C. $\dfrac{6\lambda a^2}{\varepsilon_0}$

D. $\dfrac{\sqrt{3}\lambda a}{\varepsilon_0}$

Answer: 4

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121. Electric charge are distributed in a small vouume. The flux of the electric field through a spherical surface of rasius 10cm surrounding the total charge is 25 V m. The flux over a concentric sphere of radius 20 cm will be

A. $25V - m$

B. $50V - m$

C. $100V - m$

D. $200V - m$

Answer: 1

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

A. $\frac{q}{\pi\varepsilon_0}$

B. $\frac{q}{6\varepsilon_0}$

C. $\frac{q}{\varepsilon_0}$

D. zero

Answer: 2

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123. A charge $Q$is placed at the mouth of a conical flask. The flux of the electric field through the flask is

A. zero

B. $\frac{Q}{\varepsilon_0}$

C. $\frac{Q}{2\varepsilon_0}$

D. $< \frac{Q}{2\varepsilon_0}$

Answer: 3

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124. A charge q is placed at the centre of a cube of side l what is the electric flux passing through two opposite faces of the cube ?

A. zero

B. $\frac{q}{8\varepsilon_0}$

C. $\frac{q}{6\varepsilon_0}$

D. $\frac{q}{6\varepsilon_0}$

Answer: 2

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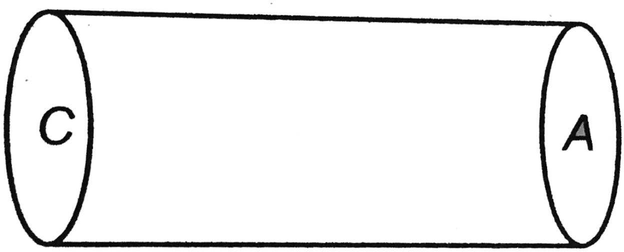
125. A hollow cylinder has a charge qC within it. If ϕ is the electric flux in unit of voltmeter associated with the curved surface B the flux linked with the plance surface A in unit of voltmeter will be



A. $\frac{1}{2}\left(\frac{q}{\in_0}-\phi\right)$

B. $\frac{q}{2 \in_0}$

C. $\frac{\phi}{3}$

D. $\frac{q}{\in_0} - \phi$

Answer: 1

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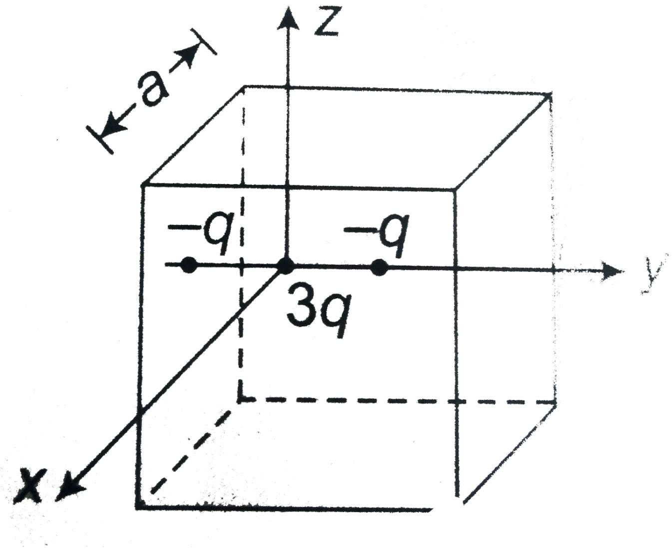
126. A cubical region of side a has its centre at the origin. It encloses three point charges , $-q$ at $(0, -a/4, 0), +3qat(0, 0, 0)$ and $-q$ at $(0, +a/4, 0)$.

Choose the correct option (s)



(i) The net electric flux crossing the plane $x = +\frac{q}{2}$ is equal to the net electric flux crossing the plane $x = -\frac{a}{2}$

(ii) The net electric flux crossing the plane $y = +\frac{a}{2}$ is more than the net electric flux crossing the plane $y = -\frac{a}{2}$

(iii) The net electric flux crossing the entire region is $\frac{q}{\varepsilon_0}$

(iv) The net electric flux crossing the plane $z = +\frac{a}{2}$

is equal to the net electric flux crossing the plane

$x = + \frac{a}{2}$

A. (i), (ii)

B. (i), (iii)

C. (i), (iii), (iv)

D. (ii), (iii), (iv)

Answer: 3

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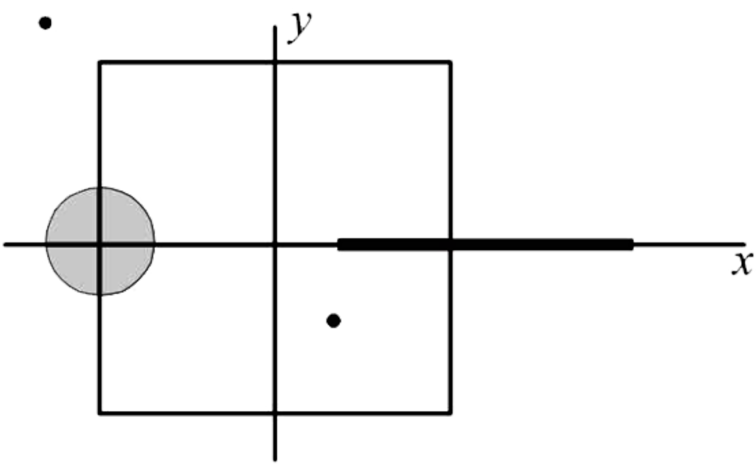
127. A disc of radius $a/4$ having a uniformly distributed charge $6C$ is placed in the x-y plane with its centre at $(-a/2, 0, 0)$. A rod of length a carrying a uniformly distributed charge 8C is placed on the x-axis from $x = a/4$ to $x = 5a/4$. Two point charges $-7C$ and $3C$ are placed at $(a/4, -a/4, 0)$ and $(-3a/4, 3a/4, 0)$, respectively. Conisder a cubical surface formed by isx surfaces $x = \pm a/2$, $y = \pm a/2$, $z = \pm a/2$. The electric flux through this cubical surface is



A. $\dfrac{-2C}{\varepsilon_0}$

B. $\frac{2C}{\varepsilon_0}$

C. $\frac{10C}{\varepsilon_0}$

D. $\frac{12C}{\varepsilon_0}$

Answer: 1

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128. Mark the correct option:

A. Gauss's law is valid only for symmetrical charge distributions

B. Gauss's law is valid only for charge placed in vacuum

C. The electric field calculaed by Gauss's law is the field due the charges inside the Gaussian surface

D. The flux of the electric field through closed surface due to all the charges is equal to the flux due to the charges enclosed by the surface

Answer: 4

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129. If the flux of the electric field through a closed surface is zero ,

(i) the electric field must be zero everywhere on the surface

(ii) the electric field may be zero everywhere on the surface

(iii) the charge inside the surface must be zero

(iv) the charge in the vicinity of the surface must be zero

A. (i), (ii)

B. (ii), (iii)

C. (ii), (iv)

D. (i), (iii)

Answer: 2

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130. Charges Q_1 and Q_2 lie 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 O_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 $E = 0$ but $\phi \neq 0$

D. If $Q_1 \neq 0$ and $Q_2 \neq 0$ then $E = 0$ ut $\phi \neq 0$

Answer: 4

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131. Choose the correct option

A. A charged particle in an electric field always experiences a force either it is at rest or in motion and the direction of force is that of field if it is $+ve$,and opposite to the field if $-ve$

B. (i) For an external point (i.e., $r > R$) , a solid or hollow , conducting or non-conducting charged sphere behaves as if whole of its charge is concentrated at its centre.

(ii) In case of a hollow or solid conducting sphere for an internal point (i.e.,$r < R$) , intensity $\overrightarrow{E}$ everywhere is dame and equal to zero

C. In case of spherical volume distribution of charge intensity an internal point $(r < R)$ will be due to the charge obtained in the sphere of radius r

D. All options are correct

Answer: 4

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132. All charge on a conductor must reside on its outer surface.' This statement is true

A. in all cases

B. for spherical conductors only (both solid and hollow)

C. for hollow spherical conductors only

D. for conductors which do not have any sharp points or corners

Answer: 1

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133. The electric field intensity on the surface of a charged conductor is

A. zero

B. directed normally to the surface

C. directed tangentially to the surface

D. directed along 45° to the surface

Answer: 2

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134. A and B are two spherical conductors of the same extent and size. A is solid and B is hollow. Both are charged to the same potential . If the charges on A and B are Q_A and Q_B respectively, then

A. Q_A is less than Q_B

B. Q_A is greater than Q_B but not double

C. $Q_A = Q_B$

D. $Q_A = 2Q_B$

Answer: 3

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135. The electric field at a distance r from a long wire having charge per unit length λ is

A. $k\left(\frac{\lambda}{r^2}\right)$

B. $k\left(\frac{\lambda}{r}\right)$

C. $k\left(\frac{\lambda}{2r}\right)$

D. $k\left(\frac{2\lambda}{r}\right)$

Answer: 4

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136. The electric intensity due to a uniformly charged infinite cylinder of radius R, at a distance $r(>R)$, from its axis is proportional to

A. r^2

B. r^3

C. r^{-1}

D. r^{-2}

Answer: 3

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137. A charge moves with a speed v in a circular path of radius r around a long uniformly charged conductor.

A. $v \propto r$

B. $v \propto \frac{1}{r}$

C. $v \propto \frac{1}{\sqrt{r}}$

D. $v \propto r^0$

Answer: 4

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138. In the previous question , if the conductor has a charge per unit length λ , the particle has mass m and charge q then (choose the correct option)

A. $v \propto \sqrt{q}$

B. $v \propto \sqrt{\lambda}$

C. $v \propto \sqrt{m}$

D. $v \propto \frac{1}{\sqrt{m}}$

Answer: 3

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139. Two large parallel plane sheets have uniform charge densities $+\sigma$ and $-\sigma$. Determine the electric field (i) between the sheets, and (ii) outside the sheets.

A. $\frac{\sigma}{2\varepsilon_0}$

B. $\frac{\sigma}{\varepsilon_0}$

C. $\frac{2\sigma}{\varepsilon_0}$

D. zero

Answer: 2

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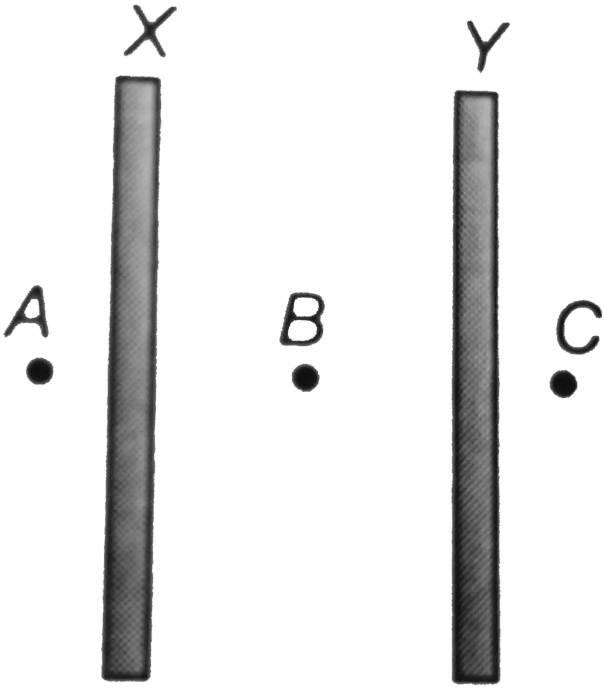
140. X and Y are large, parallel conducting plates close to each other. Each face has an area A. X is given a charge Q. Y is without any charge. Points

A, B and C are as shown in the figure.



A. (i), (iii), (iv)

B. (ii), (iii)

C. (ii), (iv)

D. (i), (iii)

Answer: 1

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141. If the earth's surface is treated as a conducting surface with some charge , then the order of magnitude of the charge per unit area $\sigma \text{in} C / m^2$, so that a proton remains suspended in space near the earh's surface will be

A. $\frac{\varepsilon_0 e}{mg}$

B. $\frac{\varepsilon_0 mg}{e}$

C. $\frac{mge}{\varepsilon_0}$

D. $\frac{mg}{e\varepsilon_0}$

Answer: 2

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142. A large flat metal surface has a uniform charge density $+\sigma$. An electron of mass m and charge u and returns to it at point B. Disregard gravity . The maximum value of AB is

A. $\frac{2u^2m\varepsilon_0}{\sigma e}$

B. $\frac{u^2e\varepsilon_0}{m\sigma}$

C. $\frac{u^2e}{\varepsilon_0 m\sigma}$

D. $\dfrac{u^2\sigma e}{\varepsilon_e m}$

Answer: 1

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143. A simple pendulum of length l has a bob of mass m , with a charge q on it. A vertical sheet of charge , with the vertical . Its time period of oscillation is T in this position

(i) $\tan\theta = \dfrac{\sigma q}{2\varepsilon_0 mg}$

(ii) $\tan\theta = \dfrac{\sigma q}{\varepsilon_0 mg}$

(iii) $T < 2\pi\sqrt{\frac{l}{g}}$

(iv) $T > 2\pi\left(\frac{l}{g}\right)$

A. $(i), (ii)$

B. $(i), (iii)$

C. $(ii), (iii)$

D. $(ii), (iv)$

Answer: 2

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144. A simple pendulum of time period T is suspended above a large horizontal metal sheet with uniformly distributed positive charge. If the bob is given some negative charge , its time period of oscillation will be

A. $> T$

B. $< T$

C. T

D. proportional to its amplitude

Answer: 1

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145. A spring - block system undergoes vertical oscillation above a large horizontal metal sheet with uniform positive charge. The time period of the oscillation will be is given a charge Q , its time period of oscillation will be

A. T

B. $> T$

C. $< T$

D. $> T$ if Q is $+ve$ and $< T$ if Q is $-ve$

Answer: 1

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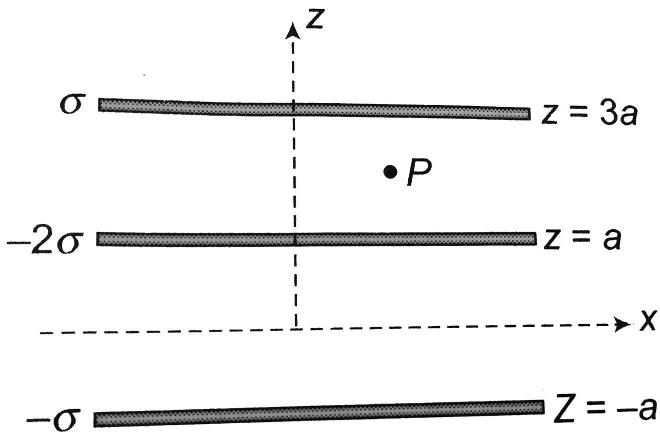
146. Three infinitely long charge sheets are placed as shown in figure. The electric field at point P is



A. $\dfrac{2\sigma}{\varepsilon_0}\hat{k}$

B. $-\dfrac{2\sigma}{\varepsilon_0}\hat{k}$

C. $\dfrac{4\sigma}{\varepsilon_0}\hat{k}$

D. $-\frac{4\sigma}{\varepsilon_0}\hat{k}$

Answer: 2

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147. A hollow insulated conducting sphere is given a positive charge of $10\mu C$. What will be the electric field at the centre of the sphere it is radius is 2 metres ?

A. zero

B. $5\mu Cm^{-2}$

C. $20\mu Cm^{-2}$

D. $8\mu Cm^{-2}$

Answer: 1

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148. The electric field at a distance $3R/2$ from the centre of a charge conducting spherical shell of radius R is E. The electric field at a distance $R/2$ from the centre of the sphere is

A. Zero

B. E

C. $\frac{E}{2}$

D. $\frac{E}{3}$

Answer: 1

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149. An insulated sphere of radius R has a uniform volume charge density λ. The electric field at a point A, which is at distance r from its center is given by $(R > r)$

A. $\frac{\rho R}{3\varepsilon_0}$

B. $\frac{\rho r}{\varepsilon_0}$

C. $\frac{\rho r}{3\varepsilon_0}$

D. $\frac{3\rho r}{\varepsilon_0}$

Answer: 3

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150. Three concentric metallic spherical shells of radii R, 2R, 3R, are given charges Q_1, Q_2, Q_3, respectively. It is found that the surface charge denisties on the outer surfaces of the shells are equal. Then, the ratio of the charges given to the shells, $Q_1 : Q_2 : Q_3$, is

A. $1 : 2 : 3$

B. $1 : 3 : 5$

C. $1:4:9$

D. $1:8:18$

Answer: 2

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151. A non-conducting solid sphere of radius R is uniformly charged. The magnitude of the electric filed due to the sphere at a distance r from its centre

A. increases as r increases for $r < R$

B. decreases as r increases for $0 < r < \infty$

C. decreases as r increases for $R < r < \infty$

D. is displacement at $r = R$

Answer: 2

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152. A solid sphere of radius R_1 and volume charge density $\rho = \frac{\rho_0}{r}$ is enclosed by a hollow sphere of radius R_2 with negative surface charge density σ, such that the total charge in the system is zero . ρ_0 is positive constant and r is the distance from the centre of the sphere . The ratio R_2 / R_1 is

A. $\frac{\sigma}{\rho_0}$

B. $\sqrt{\frac{2\sigma}{\rho_0}}$

C. $\sqrt{\frac{\rho_0}{2\sigma}}$

D. $\frac{\rho_0}{\sigma}$

Answer: 3

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153. Three concentric spherical metallic spheres A, B and C of radii a, b and $c(a < b < c)$ have surface charge densities $\sigma, \ -\sigma$ and σ respectively.

A. The potential of shell A:

$$V_A = \frac{\sigma}{\varepsilon_0}(a + b + c)$$

B. The potential of shell B:

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

C. The potential of shell C:

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

D. All options are correct

Answer: 4

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154. In the previous problem , if the shells A and C are at the same potential , then

A. $a+b=c$

B. $a=b+c$

C. $a-b=c$

D. $a=b-c$

Answer: 1

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155. Three concentric spherical shells have radii a, b and $c(a < b < c)$ and have surface charge densities $\sigma, -sigam$ and σ respectively. If V_A, V_B and V_C denote the potentials of the three shells, then for $c = q + b$, we have

A. $V_C = V_A \neq V_B$

B. $V_C = V_B \neq V_A$

C. $V_C \neq V_A \neq V_B$

D. $V_C = V_B = V_A$

Answer: 1

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156. A solid sphere of radius R has charge q uniformly distributed over its volume. The distance from it surfce at which the electrostatic potential is equal to half of the potential at the centre is

A. R

B. $\frac{R}{2}$

C. $\frac{R}{3}$

D. $2R$

Answer: 3

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157. A small conducting sphere of radius r is lying concentrically inside a bigger hollow conducting sphere of radius R. The bigger and smaller spheres are charged with Q and $q(Q > q)$ and are insulated from each other. The potential difference between the spheres will be

A. $\frac{1}{4\pi\varepsilon_0}\left(\frac{q}{r}-\frac{Q}{R}\right)$

B. $\frac{1}{4\pi\varepsilon_0}\left(\frac{Q}{R}+\frac{q}{r}\right)$

C. $\frac{1}{4\pi\varepsilon_0}\left(\frac{q}{r}-\frac{q}{R}\right)$

D. $\frac{1}{4\pi\varepsilon_0}\left(\frac{q}{R}-\frac{Q}{r}\right)$

Answer: 3

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158. A charge Q is distributed over two concentric hollow spheres of radii r and $R(> r)$ such that the surface charge densities are equal. Find the potential at the common centre.

A. $Q\left(\frac{r+R}{r^2+R^2}\right)$

B. $\frac{Q}{2}\left(\frac{r+R}{r^2+R^2}\right)$

C. $2Q\left(\frac{r+R}{r^2+R^2}\right)$

D. Zero

Answer: 1

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159. The concentric, thin metallic spheres of radii r_1 and $r_2 (r_1 > r_2)$ carry charges q_1 and q_2 respectively. Then the electric potential at distance $r(r_2 < r < r_1)$ will be $\frac{1}{4\pi\varepsilon_0}$ times

A. $k\left(\frac{Q_1 + Q_2}{r}\right)$

B. $k\left(\frac{Q_1}{r} + \frac{Q_2}{R_2}\right)$

C. $k\left(\frac{Q_2}{r} + \frac{Q_1}{r}\right)$

D. $k\left(\frac{Q_1}{R_1} + \frac{Q_2}{r}\right)$

Answer: 4

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160. A spherical metal shell A of radius R_A and a solid metal sphere B of radius $R_B(< R_A)$ are kept far apart and each is given charge $'+Q'$. Now they are connected by a thin metal wire. Then

A. $(i), (ii)$

B. $(i), (ii), (iii)$

C. $(i), (ii), (iv)$

D. All

Answer: 4

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161. n small drops of same size are charged to V volts each .If they coalesce to from a single large drop, then its potential will be -

A. $\frac{V}{n}$

B. Vn

C. $Vn^{1/3}$

D. $Vn^{2/3}$

Answer: 4

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162. A long, hollow conducting cylinder is kept coaxially inisde another long, hollow conducting cylinder of larger radius. Both the cylinders are initially electrically neutral.

A. A potential difference appears between the two cylinders when a charge density is given to the inner cylinder

B. A potential difference appears between the two cylinders when a charge density is given to the outer cylinder.

C. No potential difference appears between the two cylinders when a uniform line charge is kept along the axis of the cylinders

D. No potential difference appears between the two cylinders when same charge density is given to both the cylinders

Answer: 2

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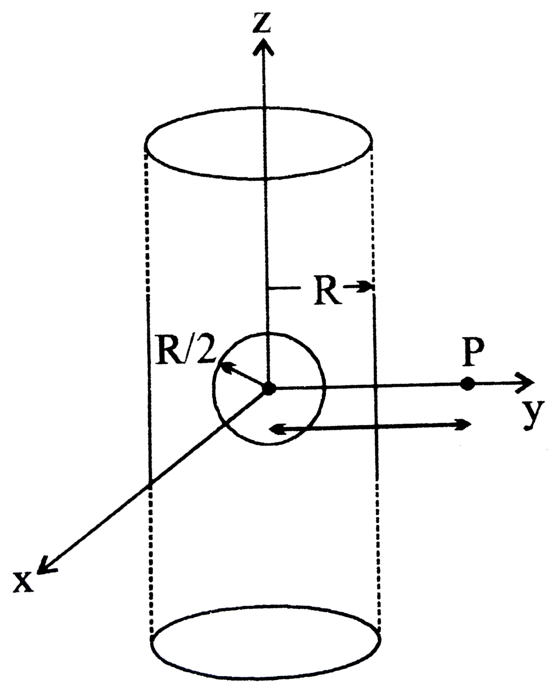
163. An infinitely long solid cylinder of radius R has a uniform volume charge density ρ. It has a spherical cavity of radius $R/2$ with its centre on the axis of cylinder, as shown in the figure. The magnitude of the electric field at the point P, which is at a distance $2R$ form the axis of the cylinder, is given by the expression $\frac{23rR}{16ke_0}$. The value of k is .



A. 2

B. 4

C. 6

D. 8

Answer: 3

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164. The electric field strength due to a ring of radius R at a distance x from its centre on the axis of ring carrying charge Q is given by

$$E = \frac{1}{4\pi\varepsilon_0}\frac{Qx}{\left(R^2 + x^2\right)^{3/2}}$$

At what distance from the centre will the electric field be maximum ?

A. $x = R$

B. $x = \frac{R}{2}$

C. $x = \pm \frac{R}{\sqrt{2}}$

D. $x = \sqrt{2}R$

Answer: 3

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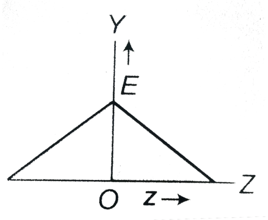
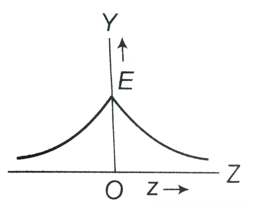
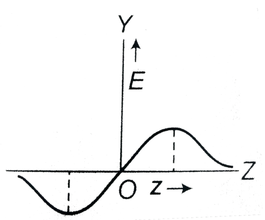
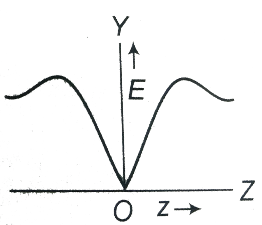
165. A circular ring carries a uniformly distributed positive charge and lies in the xy plane with center at the origin of the cooredinate system. If at a point (0,0,z) the electric field is E, then which of the following graphs is correct?

A. 

B. 

C. 

D. 

Answer: 3

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166. A ring of radius R carries a charge $+q$. A test charge $-q_0$ is released on its axis at a distance $\sqrt{3}R$ from its centre. How much kinetic energy will be acquired by the test charge when it reaches at the centre of the ring ?

A. $\frac{1}{4\pi\varepsilon_0}\left(\frac{qq_0}{R}\right)$

B. $\frac{1}{4\pi\varepsilon_0}\left(\frac{qq_0}{2R}\right)$

C. $\frac{1}{4\pi\varepsilon_0}\left(\frac{qq_0}{\sqrt{3}R}\right)$

D. $\frac{1}{4\pi\varepsilon_0}\left(\frac{qq_0}{3R}\right)$

Answer: 2

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167. In the above question , the nature of motion of the test charge is

A. simple harmonic

B. oscillatory and periodic

C. oscillatory and non-periodic

D. non-oscillatory and non-periodic

Answer: 2

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168. A positively charged thin metal ring of radius R is fixed in the xy plane with its centre at the origin O. A negatively charged particle P is released from rest at the point $(0, 0, z_0)$ where $z_0 > 0$. Then the motion of P is

A. periodic , for all value of z_0 satisfying $0 < z_0 < \infty$

B. simple harmonic , for all value of z_0 satisfying $0 < z_0 \leq R$

C. approximately simple harmonic ,provided $z_0 < \ < R$

D. such that P crosses O and continues to move along the negative z-axis towards $z = \ - \infty$

Answer: 2

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169. A given charge is situated at a certain distance from an electric dipole in the end-on position experiences a force F If the distance of the charge is doubled, the force acting on the charge will be

A. $2F$

B. $\frac{F}{2}$

C. $\frac{F}{4}$

D. $\frac{F}{8}$

Answer: 4

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170. A and B are two points on the axis and the perpendicular bisector, respectively, of and electric dipole. A and B are far away from the dipole and at equal distance from it. The fields at A and B are $\overrightarrow{E}_A$ and $\overrightarrow{E}_B$. Then

A. $\overrightarrow{E}_A = \overrightarrow{E}_B$

B. $\overrightarrow{E}_A = 2\overrightarrow{E}_B$

C. $\overrightarrow{E}_A = -2\overrightarrow{E}_B$

D. $\left|\overrightarrow{E}_B\right| = \frac{1}{2}\left|\overrightarrow{E}_A\right|, \overrightarrow{E}_B \perp^{ar} \overrightarrow{E}_A$

Answer: 3

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171. An electric dipole is kept in non-unifrom electric field. It experiences

A. a force and a torque

B. a force but not a torque

C. a torque but not a force

D. neither a force nor a torque

Answer: 1

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172. An electric dipole is placed along x-axis with its centre at origin:

A. θ

B. α

C. $\theta + \alpha$

D. $\theta + 2\alpha$

Answer: 3

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173. An electric dipole is placed at the origin O and is directed along the x-axis. At a point P, far away from the dipole, the electric field is parallel to y-axis. OP makes an angle θ with the x-axis then

A. $\tan\theta = \sqrt{3}$

B. $\tan\theta = \sqrt{2}$

C. $\theta = 45^\circ$

D. $\tan\theta = \frac{1}{\sqrt{2}}$

Answer: 2

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174. The point charges $+q, \ -2q$ and $+q$ are placed at point $(x=0, y=a, z=0)$, $(x=0, y=0, z=0)$ and $(x=a, y=0, z=0)$, repectively. The magnitude and direction of the electric dipole moment vector of this charge assembly are

A. $\sqrt{2}qa$ along $+y$ direction

B. $\sqrt{2}qa$ along the line joining points $(x=0, y=0, z=0)$ and $(x=a, y=a, z=0)$

C. qa along the line joining points $(x=0, y=0, z=0)$ and

$(x = a, y = a, z = 0)$

D. $\sqrt{2}qa$ along $+x$ direction

Answer: 2

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175. An electric dipole moment p is placed in an electric field of intensity $'E'$. The dipole acquires a position such that the axis of the dipole makes an angle θ with the direction of the field. Assuming that the potential energy of the dipole to be zero when $\theta = 90^{\circ}$, the torque and the potential energy of the dipole will respectively be

A. $pE\sin\theta, \ -pE\cos\theta$

B. $pE\sin\theta, \ -2pE\cos\theta$

C. $pE\sin\theta, 2pE\cos\theta$

D. $pE\cos\theta, \ -pE\cos\theta$

Answer: 1

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176. An electric dipole is put in north-south direction in sphere filled with water. Which statement is correct

A. Electric flux is coming towards sphere

B. Electric flux is coming out of sphere

C. Electric flux entering into sphere and leaving the sphere is same

D. Water does not permit electric flux to enter into sphere

Answer: 3

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177. An electric dipole of moment $\overrightarrow{p}$ is placed normal to the lines of force of electric intensity $\overrightarrow{E}$, then the work done in deflecting it through an angle of 180° is

A. Pe

B. $+2pE$

C. $-2pE$

D. Zero

Answer: 4

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

A. $2q. E$ and minimum

B. $q. E$ and $p. E$

C. zero and minimum

D. $q. E$ and maximum

Answer: 3

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179. Two short dipoles , each of dipole moment P are placed at a large separation r. The force between them

A. is proportional to product of dipole momenta

B. is inversely proportional to r^4

C. the force is attractive , if direction of dipole momenta are same , repulsive if opposite

D. all options are correct

Answer: 4

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180. The electric field at the origin is along the positive x-axis. A small circle is drawn with the centre at the origin cutting the axes at points A, B, C and D having coordinates (a,0), (0,a), (-a,0),(0,-a) respectively. Out of the points on the periphery of the circle, the potential is minimum at

A. A

B. B

C. C

D. D

Answer: 1

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181. Which of the following is correct regarding equipotential surface ?

A. Equipotential surfaces can never cross each other otherwise potential at a point will have two values which is absurd

B. Equitential surfaces are always perpendicular to lines of force

C. If a charge is moved from one point to the other over an equipotential surface, work done will be zero as

$$W_{AB} = -U_{AB} = Q(V_B - V_A = 0(as(V_B = V_A)$$

D. All options are correct

Answer: 4

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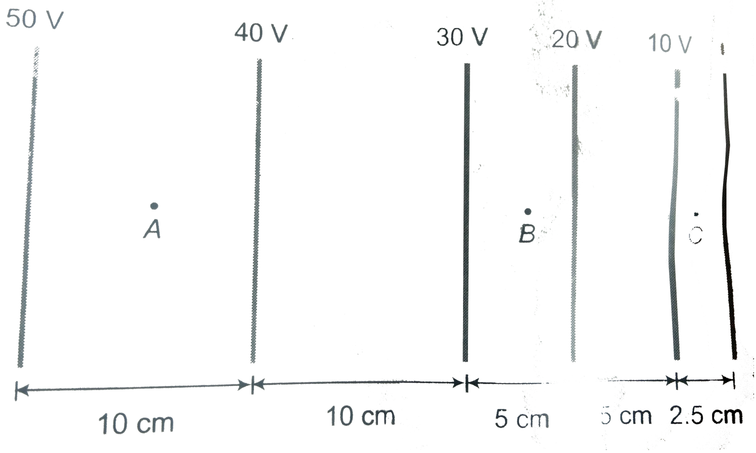
182. In the following figure, equipotential lines are shown



A. $E_A = 1V / cm$

B. $E_B = 2V / cm$

C. $E_C = 4V / cm$

D. All options are correct

Answer: 4

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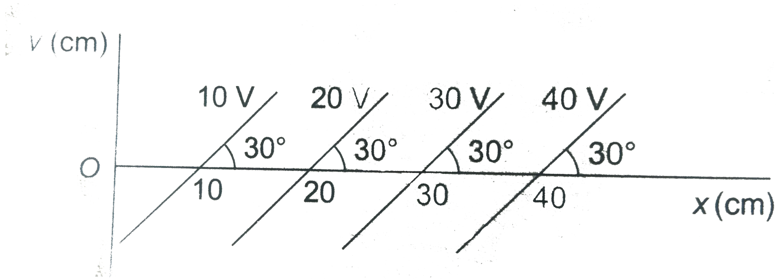
183. Some equipotential surfaces are shown in figure . The magnitude and direction of electric field is



A. $2V / cm$ at angle 120° with $+ve$ x-axis in anticlockwise direction

B. $2V / cm$ at angle 120° with $+ve$ x-axis in clockwise direction

C. $1V / cm$ at angle 150° with $+ve$ x-axis in anticlockwise direction

D. $1V / cm$ at an angle 120° with $+ve$ x-axis in clockwise direction

Answer: 1

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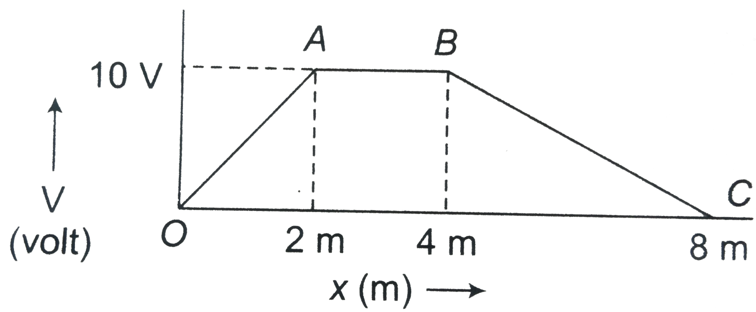
184. In the following graph , the magnitude of maximum electric field is



A. $5V / m$

B. $2.5V/m$

C. $1.25V/m$

D. $10V/m$

Answer: 1

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185. The electric field and the electric potential at a point are E and V respectively.

A. $(i), (iii)$

B. $(ii), (iii)$

C. All

D. None

Answer: 4

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186. In a uniform electric field ,

A. all points are at the same potential

B. no two points can have the same potential

C. pairs of points separate by the same distance must have the same difference in potential

D. none of these

Answer: 4

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187. In a uniform electric field , equipotential surface must

(i) be plane surfaces

(ii) be normal to the direction to the filed

(iii) be spaced such that surfaces having equal difference in potential are separated by equal distances

(iv) have decreasing potentials in the direction of field

A. $(i), (iii)$

B. $(ii), (iii)$

C. $(i), (ii), (iii)$

D. All

Answer: 4

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

A. $-8i$

B. $8i$

C. $-16i$

D. $8\sqrt{5}i$

Answer: A

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189. The electirc potential at a point (x, y, z) is given

by

$$V = -x^2y - xz^3 + 4$$

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

A. $\overrightarrow{E} = \hat{i}\left(2xy + z^3\right) + \hat{j}x^2 + \hat{k}3xz^2$

B. $\overrightarrow{E} = \hat{i}2xy + \hat{j}\left(x^2 + y^2\right) + \hat{k}\left(3xy - y^2\right)$

C. $\overrightarrow{E} = \hat{i}z^3 + \hat{j}xyz + \hat{k}z^2$

D. $\overrightarrow{E} = \hat{i}\left(2xy - z^2\right) + \hat{j}xy^2 + \hat{k}3z^2x$

Answer: 1

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190. An electric field $E = \left(20\hat{i} + 30\hat{j}\right)$ N/C exists in the space. If thepotential at the origin is taken be zero, find the potential at $(2m, 2m)$.

A. $-50V$

B. $100V$

C. $-100V$

D. $200V$

Answer: 3

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191. Electric potential is given by

$V = 6x - 8xy^2 - 8y + 6yz - 4z^2$

Then electric force acting on $2C$ point charge placed on origin will be

A. $2N$

B. $6N$

C. $8N$

D. $20N$

Answer: 4

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192. Two points are at distance a and $b(a < b)$ from a long string of charge per unit length λ. The potential difference between th epoints is proportional to

A. $\frac{b}{a}$

B. $\frac{b^2}{a^2}$

C. $\sqrt{\frac{b}{a}}$

D. $\frac{\ln(b)}{a}$

Answer: 4

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193. The electric potetnial in a region along x-axis varies with x according to the releation

$V(x) = 4 \times 5x^2$. Then the incorrect statement is

A. $(i), (ii), (iii)$

B. $(i), (iii), (iv)$

C. $(i), (ii), (iv)$

D. $(ii), (iii), (iv)$

Answer: 1

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194. A non-conducting ring of radius $0.5m$ carries a total charge of 1.11×10^{-10}C distributed non-uniformly on its circumference producing an electric field E everywhere is space. The value of the integral $\int_{l=\infty}^{l=0} -E.\,dI(l=0$ being centre of the ring) in volt is

A. $+2$

B. -1

C. -2

D. 0

Answer: 1

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195. The electric potential decreases unifromly from 120 V to 80 V as one moves on the x-axis from x=-1 cm to x=+1 cm. The electric field at the origin

A. (i) only

B. $(ii), (iii)$

C. $(ii), (iii), (iv)$

D. $(iii), (iv)$

Answer: 2

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196. A charge Q is placed at the centre of a spherical conducting shell. Choose the correct option.

A. Only $-Q$ will appear on its inner surface

B. Only $+Q$ will appear on its outer surface

C. A charge $-Q$ will appear on its surface and $+Q$ on its outer surface

D. A charge $+Q$ will appear on its inner surface and $-Q$ on its outer surface

Answer: 3

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197. A positive charge Q is placed at the centre O of a thin metalic spherical shell. Select the correct statements from the following:

(i) The electric field at any point outside the shell is zero

(ii) The electrostatic potential at any point outside the shell is $\frac{Q}{4\pi\varepsilon_0 r}$, where r is the distance of the point from O

(iii) The outer surface of the spherical shell is an equipotential surface

(iv) The electric field at any point inside the shell , other than O , is zero

A. (i), (ii)

B. $(ii), (iii)$

C. $(i), (iv)$

D. all

Answer: 2

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198. A spherical conductor A having charge Q lies inside a hollow spherical conductor B. (Choose incorrect option)

A. Charge $-Q$ will appear on the inner surface of B

B. Charge $+Q$ will appear on the outer surface of B

C. If B is connected to earth , the charge Q on the outer surface flows to earth

D. All options are correct

Answer: 4

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199. A spherical conductor A lies inside a hollow spherical conductor B. Charges Q_1 and Q_2 are given to A and B respectively (Choose the incorrect option)

A. Charge Q_1 will appear on the outer surface of A

B. Charge $-Q_1$ will appear on the inner surface of B

C. Charge Q_2 will appear on the outer surface of B

D. Charge $Q_1 + Q_2$ will appear on the outer surface of B

Answer: 3

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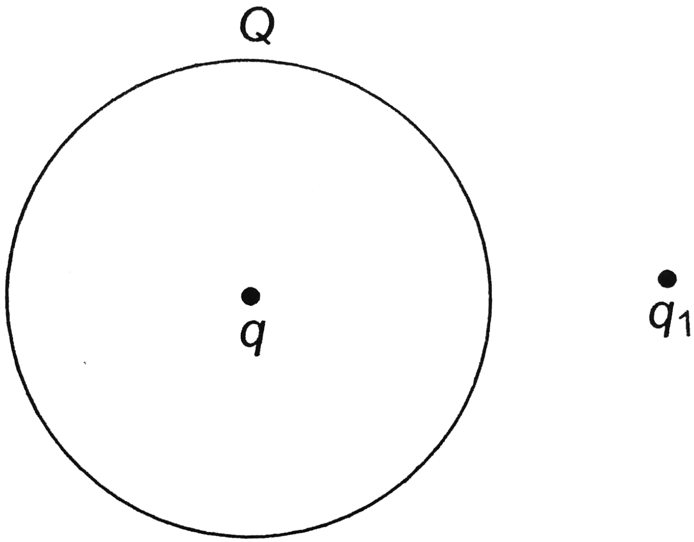
200. A thin metallic spherical shell contains a charge Q on it. A point charge q is placed at the centre of the shell and another charge q_1 is placed outside it as shown in figure. All the three charges are positive



The force on the charge at the centre is

A. towards left

B. towards right

C. upward

D. zero

Answer: 4

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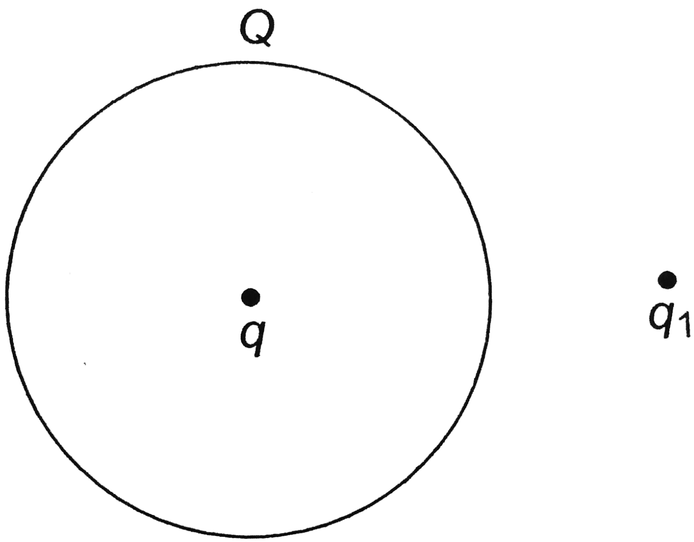
201. A thin metallic spherical shell contains a charge Q on it. A point charge q is placed at the centre of the shell and another charge q_1 is placed outside it as shown in figure. All the three charges are positive



The force on the charge at the centre is

A. towards left

B. towards right

C. upward

D. zero

Answer: 2

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202. Charges Q_1 and Q_2 lie inside and outside respectively of an uncharged conducting shell. Their separation is r.

(i) The force on Q_1 is zero

(ii) The force on Q_1 is $k\left(\frac{Q_1Q_2}{r^2}\right)$

(iii) The force on Q_2 is $k\left(\frac{Q_1Q_2}{r^2}\right)$

(iv) The force on Q_2 is zero

A. (i), (iii)

B. (ii), (iii)

C. (ii), (iv)

D. (i), (iii)

Answer: 1

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203. A point charge Q is placed outside a hollow spherical conductor of radius R , at a distance $r(r > R)$ from its centre C . The field at C due to the inducted charges on the conductor is

A. zero

B. $k\frac{Q}{(r-R)^2}$

C. $k\frac{Q}{r^2}$, directed towards Q

D. $k\frac{Q}{r^2}$, directed away from Q

Answer: 3

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204. A positive charge q is placed in front of conducting solid cube at a distance d from its centre. Find the electric field at the centre of the cube due to the charges appearing on its surface.

A. $\frac{1}{4\pi \in_0} \cdot \frac{q}{d^2}$

B. $\frac{1}{4\pi \in_0} \cdot \frac{2q}{d^2}$

C. $\frac{1}{4\pi \in_0} \cdot \frac{3q}{d^2}$

D. $\frac{1}{4\pi \in_0} \cdot \frac{4q}{d^2}$

Answer: 1

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205. Two concentric metallic spherical shells are given positive charges . Then

A. the outer sphere is always at a higher potential

B. the inner sphere is always at a higher potential

C. both the spheres are at the same potential

D. no prediction can be made about their potentials unless the actual values of charges and radii are known

Answer: 2

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206. 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. $-2V$

Answer: 1

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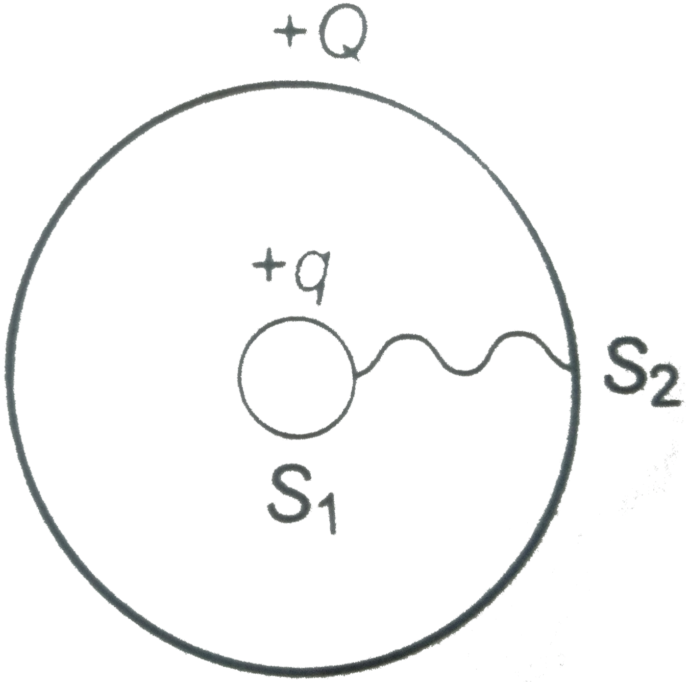
207. Charge q on a small conducting sphere S_1 is placed inside a large hollow metallic sphere S_2 having a charge Q as shown in figure. The sphere is connected to shell by a conducting wire. The charge on S_1 will then be



A. $Q - q$

B. $\frac{qQ}{2}$

C. $\frac{(Q+q)}{2}$

D. Zero

Answer: 4

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208. 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

A. $Q\left(\frac{R}{R+r}\right)$

B. $Q\left(\frac{r}{R+r}\right)$

C. Q

D. Zero

Answer: 3

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209. A, B and C are three concentric metallic shells . Shell A is the innermost and shell C is the outermost. A is given some charge

(i) The inner surfaces of $B$and C will have the same charge

(ii) The inner surfaces of B and C will have the same charge density

(iii) The outer surfaces of A, B and C will have the same charge

(iv) The outer surfaces of A, B and C will have the same charge density

A. $(i), (ii)$

B. $(ii), (iii)$

C. $(ii), (iv)$

D. $(i), (iii)$

Answer: 4

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210. A conducting sphere A of radius a ,with charge Q , is placed concentrically inside a conducting shell B of radius b . B is earthed. C is the common centre of the A and B

A. The field at a distance r from C , where $a \leq r \leq b$, is $k\frac{Q}{r^2}$

B. The potential difference between A and B is $kQ\left(\frac{1}{b} - \frac{1}{b}\right)$

C. The potential at a distance r from C, where $a \leq r \leq b$, is $kQ\left(\frac{1}{r} - \frac{1}{b}\right)$

D. All options are correct

Answer: 4

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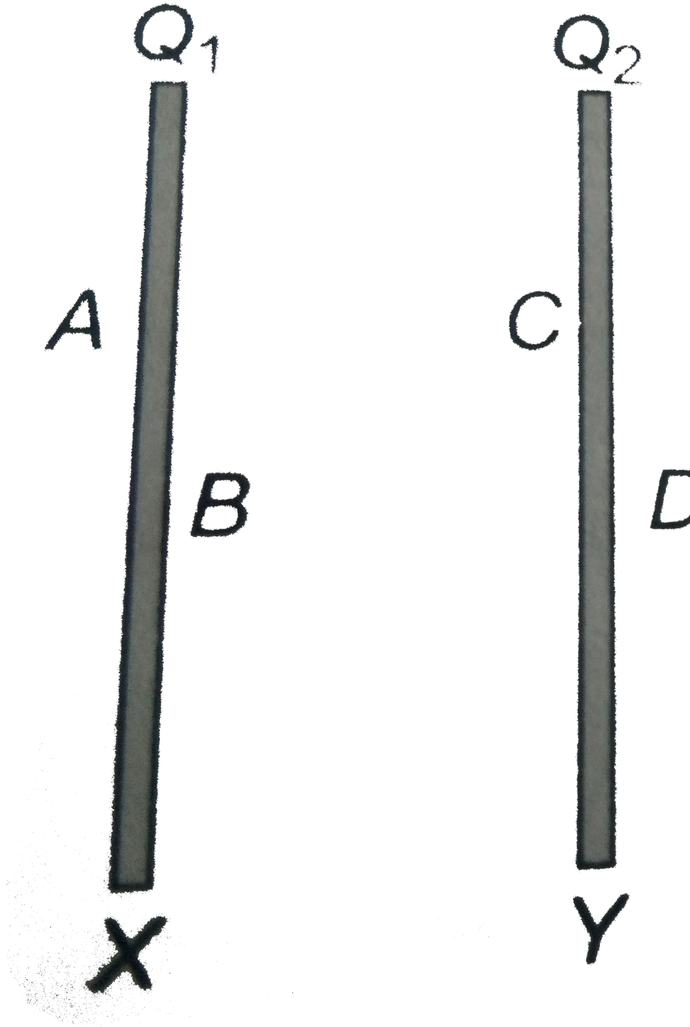
211. Two large , parallel conducting plates X and Y , kept close to each other , are given Q_1 and $Q_2(Q_1 > Q_2)$. The four surfaces of the plates are A, B, C and D , as shown



(i) The charge on A is $\frac{1}{2}(Q_1 + Q_2)$

(ii) The charge on B is $\frac{1}{2}(Q_1 - Q_2)$

(iii) The charge on C is $\frac{1}{2}(Q_2 - Q_1)$

(iv) The charge on D is $\frac{1}{2}(Q_1 + Q_2)$

A. $(i), (ii)$

B. $(ii), (iii)$

C. $(ii), (iv)$

D. All

Answer: 4

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212. Three identical metal plates with large surface areas are kept parallel to each as shown in figure (30-E8). The leftmost plate is given a charge Q, the rightmost a chrge _2Q and the middle one remains neutral. Finde the charge appearing on the outer surface of the rightmost plate.

A. $\frac{Q}{2}$

B. $\frac{Q}{3}$

C. $-\frac{Q}{2}$

D. $-\frac{Q}{4}$

Answer: 3

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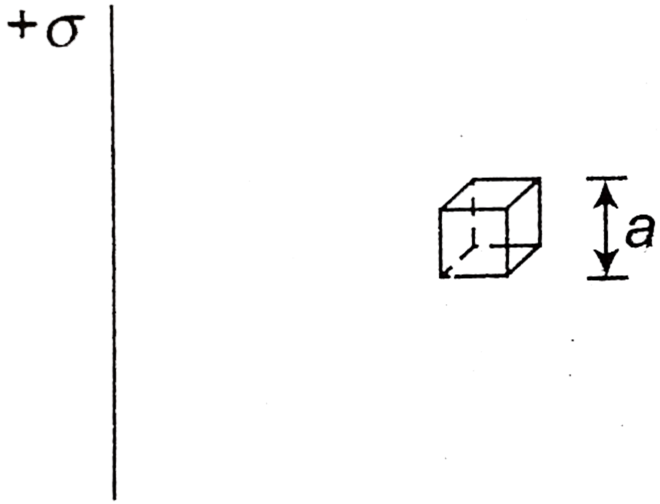
213. The electric energy stored in a cube



A. $\dfrac{\sigma^2 a^3}{8\varepsilon_0}$

B. $\dfrac{\sigma^2 a^3}{4\varepsilon_0}$

C. $\dfrac{\sigma^2 a^3}{2\varepsilon_0}$

D. $\dfrac{\sigma^2 a^3}{\varepsilon_0}$

Answer: 1

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214. A positively charged oil droplet remins stationary in the electric field between two horizontal plates separated by a distance of $1cm$. The charge on the drop is $10^{-15}C$ and mass of the droplet is $10^{-11}g$, the potential difference between the plates and if the polarity is reversed , the instantaneous of the droplet are

A. $1V, 9.8m/\sec^2$

B. $1V, 0m/\sec^2$

C. $1V, 19.6m/\sec^2$

D. $2V, 19.6m/\sec^2$

Answer: 3

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215. The electric field at the centre of a uniformly charged ring is zero. What is the electric field and potential at the centre of a half ring if the charge on it be Q and its radius be R?

A. $\frac{1}{4\pi\varepsilon_0}\frac{Q}{\pi R^2}, \frac{1}{4\pi\varepsilon_0}\frac{Q}{\pi R}$

B. $\frac{1}{4\pi\varepsilon_0}\frac{Q}{R^2}, \frac{1}{4\pi\varepsilon_0}\frac{2Q}{\pi R}$

C. $\frac{1}{4\pi\varepsilon_0}\frac{2Q}{\pi R^2}, \frac{1}{4\pi\varepsilon_0}\frac{Q}{R}$

D. $\frac{1}{4\pi\varepsilon_0}\frac{2Q}{R^2}, \frac{1}{4\pi\varepsilon_0}\frac{3Q}{\pi R}$

Answer: 3

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216. Two infinitely long parallel wires having linear charge densities λ_1 and λ_2 respectively are placed at a distance of R metres. The force per unit length on either wire will be $\left(k = \frac{1}{4\pi\varepsilon_0}\right)$

A. $k\frac{2\lambda_1\lambda_2}{R^2}$

B. $k\frac{2\lambda_1\lambda_2}{R}$

C. $k\frac{\lambda_1\lambda_2}{R^2}$

D. $k\frac{\lambda_1\lambda_2}{R}$

Answer: 2

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217. An electric charge $2 \times 10^{-8} C$ is placed at the point $(1, 2, 4)$. At the point $(3, 2, 1)$, the electric

(i) potential will be $50V$

(ii) field will have no Y-component

(iii) field will increase by a factor K if the space between the points is filled with a dielectric of constant K

(iv) field will be along Y-axis

A. $(i), (ii)$

B. $(i), (iii)$

C. $(i), (iv)$

D. all

Answer: 1

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218. A large solid sphere with uniformly distributed positive charge has a smooth narrow tunnel along its direction. A small particle with negative charge, initially at rest far from the sphere, approaches it along the line of the tunnel, reaches its surface with a speed v, and passes through the tunnel. Its speed at the centre of the sphere will be

A. 0

B. $\sqrt{3}v$

C. $\sqrt{2}v$

D. $\sqrt{1.5}v$

Answer: 4

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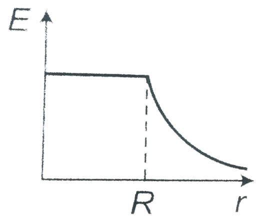
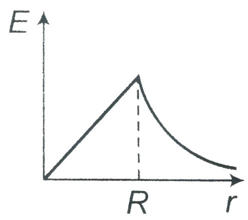
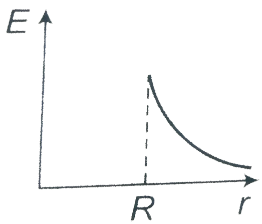
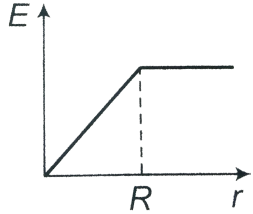
219. The electric field due to uniformly charged sphere of radius R as a function of the distance from its centre is represented graphically by

A. 

B. 

C. 

D. 

Answer: 2

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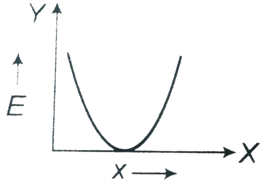
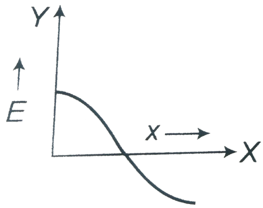
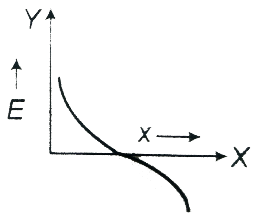
220. Two ideantical point charges are placed at a separation of d. P is a point on the line joining the charges, at a distance x from any one charge. The field at P is E, E is plotted against x for value of x from close to zero to slightly less then d. Which of the following represents the resulting curve

A. 

B.

C. 

D. 

Answer: 4

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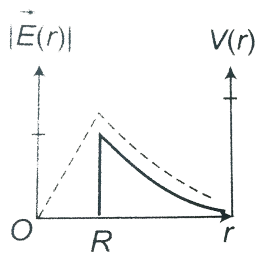
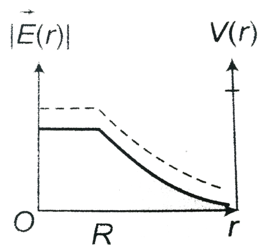
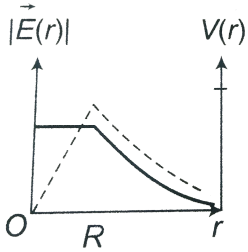
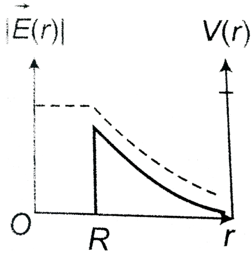
221. Conisder a thin spherical shell of radius R with centre at the origin, carrying uniform poistive surface charge denisty. The variation of the magnitude of the electric field $\left|\vec{E}(r)\right|$ and the electric potential V(r) with the distance r from the centre, is best represented by which graph?

A. 

B. 

C. 

D. 

Answer: 4

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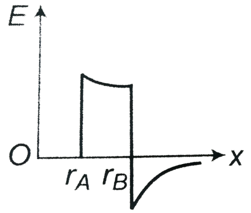
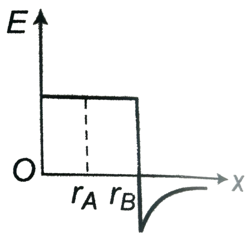
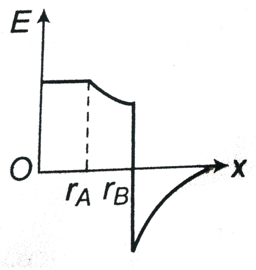
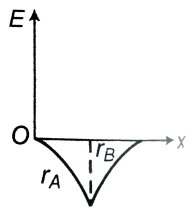
222. Two concentric coducting thin spherical shells A and B having radii r_A and $r_B(r_B > r_A)$ are charged to Q_A and $-Q_B(|Q_B| > |Q_A|)$. The electrical field along a line passing through the centre is

A. 

B. 

C. 

D. 

Answer: 1

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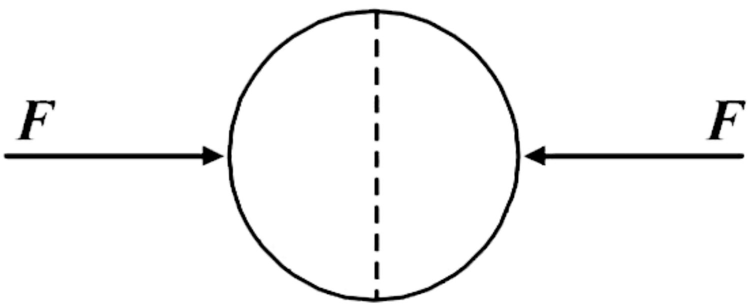
223. A uniformly charged thin spherical shell of radius R carries uniform surface charge denisty of $isgma$ per unit area. It is made of two hemispherical shells, held together by presisng them with force F(see figure). F is proportional to



A. $\frac{1}{\varepsilon_0}\sigma^2 R^2$

B. $\frac{1}{\varepsilon_0}\sigma^2 R$

C. $\frac{1}{\varepsilon_0}\frac{\sigma^2}{R}$

D. $\frac{1}{\varepsilon_0}\frac{\sigma^2}{R^2}$

Answer: 1

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224. A soap bubble is given a negative charge, then its radius

A. decreases

B. increases

C. remains unchanged

D. nothing can be predicted as information is insufficient

Answer: 2

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225. A conducting sphere of radius R is given a charge Q. The electric potential and the electric field at the centre of the sphere respectively are

A. $\dfrac{Q}{4\pi\varepsilon_0 R}$ and zero

B. $\dfrac{Q}{4\pi\varepsilon_0 R}$ and $\dfrac{Q}{4\pi\varepsilon_0 R^2}$

C. both are zero

D. zero and $\dfrac{Q}{4\pi\varepsilon_0 R^2}$

Answer: 1

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226. In a region, the potential is respresented by $V(x, y, z) = 6x - 8xy - 8y + 6yz$, where V is in volts and x, y, z are in meters. The electric force experienced by a charge of 2 coulomb situated at point $(1, 1, 1)$ is

A. $30N$

B. $24N$

C. $4\sqrt{35}N$

D. $6\sqrt{5}N$

Answer: 3

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