PHYSICS

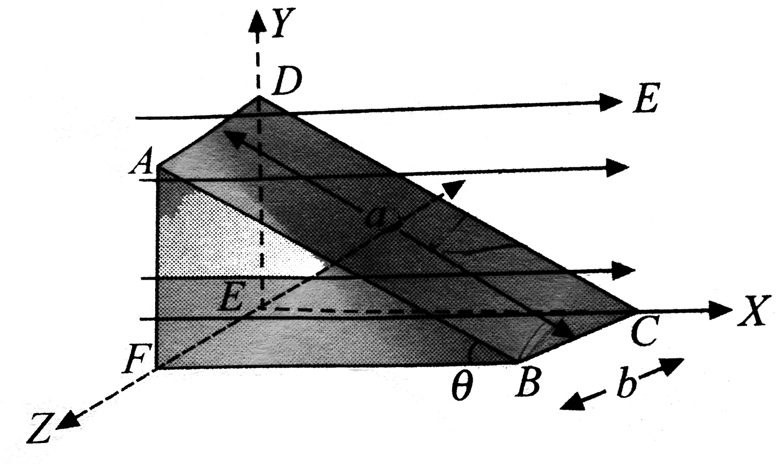
BOOKS - CENGAGE PHYSICS (ENGLISH)

ELECTRIC FLUX AND GAUSS LAW

Illustration

1. A point charge Q is placed at the corner of a square of side a. Find the flux through the square.

2. Find out the flux through the curved surface of a hemisphere of radius R if it is placed in a uniform electric field E as shown in figure



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3. Find the flux of the electric field through each of the five surfaces of the inclined plane as shown in figure. What is the total flux through the entire closed surface?

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4. Consider a cylindrical surface of radius R and length l in a uniform electric field E. Compute the electric flux if the axis of the cylinder is parallel to the field direction.

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5. A charge Q is placed at a distance $a/2$ above the centre of the square surface of edge a as shown in the figure

The electric flux through the square surface is :

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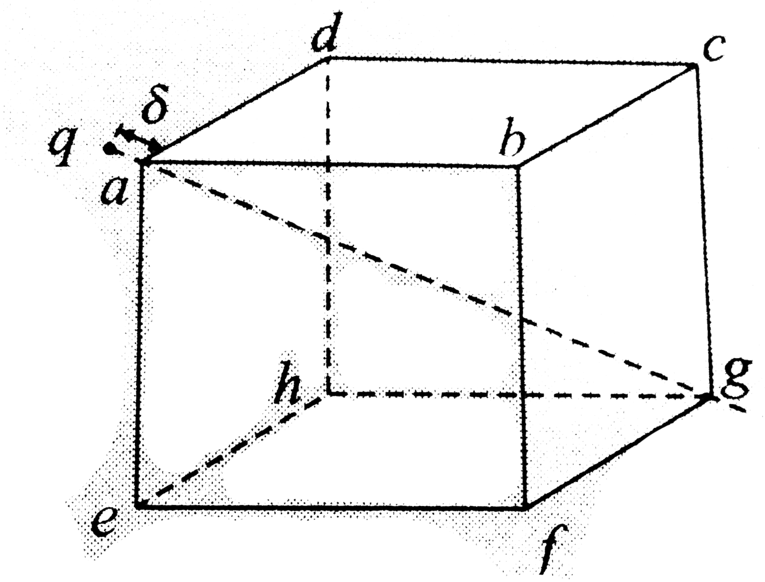
6. In figure, a charge q is placed at a distance $\delta \to 0$ near one of the corners of a cube of edge l on a line of symmetry along diagonal.



1. What is the flux through each of the faces containing the point a?

2. What is the flux through the other three faces?

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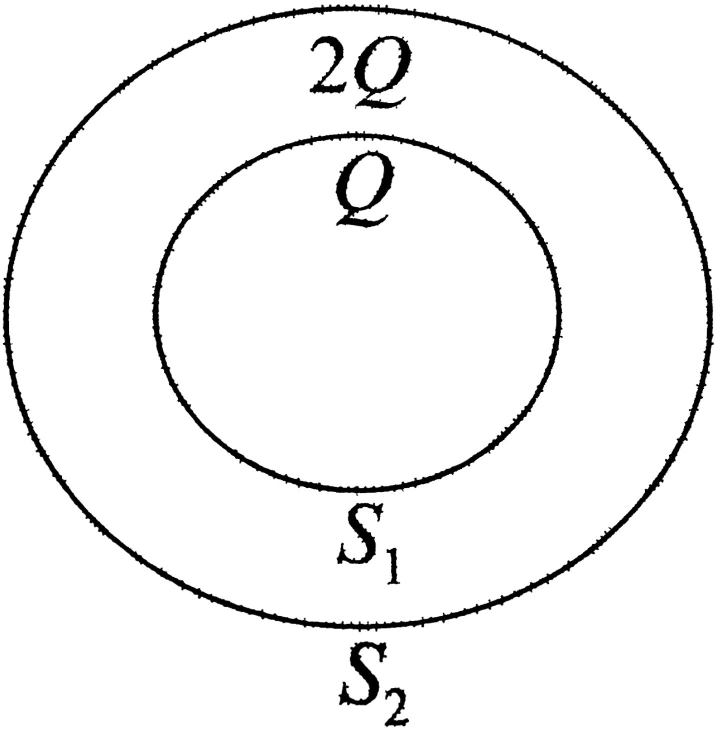
7. S_1 and S_2 are two hollow concentric spheres enclosing charges Q and $2Q$, respectively, as shown in figure.

i. What is the ratio of the electric flux through S_1 and S_2?

ii. How will the electric flux through sphere S_1 change if a medium of dielectric constant 5 is introduced in the space inside S_1 in place of air.



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8. A cube of side l has one corner at the origin of coordinates and extends along the positive $x-$, $y-$ and $z-axes$. Suppose that the electric field

in this region is given by $\vec{E} = (a + by)\hat{j}$. Determine the charge inside the cube (a and b are some constants).

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9. A point charge +Q is placed at the centre of an uncharged spherical conducting shell of inner radius a and outer radius b.

i. Find the electric field for $r < a$.

ii. What is the magnitude and sigh of the induced charge q' on the inner shell surface?

iii. What is the electric field at points $r > b$?

iv. What id the surface charge on the outer surface of the conductor?

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10. A long, straight wire is surrounded by a hollow metal cylinder whose axis coincides with that of the wire. The wire has a charge per unit length of λ, and the cylinder has a net charge per unit length of 2λ. From this information, use Gauss's law to find (i) the charge per unit length on the inner and outer surfaces of the cylinder and (ii) the electric field outside the cylinder, a distance r from the axis.

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11. Prove that if an isolated (isolated means no charges are near the sheet) large conducting sheet is given a charge, then the charge distributes equally on its two surfaces.

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12. If an isolated infinite plate contains a charge Q_1 on one of its surfaces and a charge Q_2 on its other surface, then prove that electric field intensity at a point in front of the plate will be $Q/2A\varepsilon_0$, where $Q = Q_1 + Q_2$

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13. Two conducting plates A and B are placed parallel to each other. A is given a charge Q_1 and B a charge Q_2. Prove that the charges on the inner surfaces are of equal magnitude and opposite sign.

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14. Two identical metal plates each having surface area A, having charges q_1 and q_2, are placed facing each other at a separation d. Find the charge appearing on surface (1),(2),(3), and (4). Assume the size of the plate is much larger than the separation between the plates.

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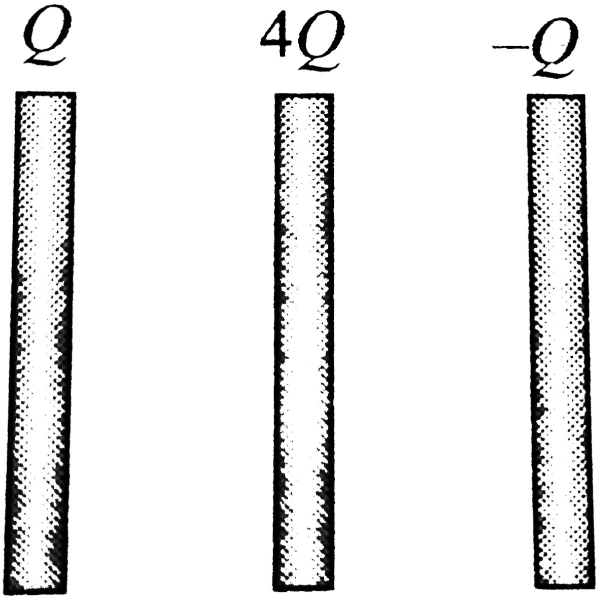
15. Figure shows three metallic plates with charges Q, 4Q, and -Q, respectively. Determine the final charges on all the surfaces.



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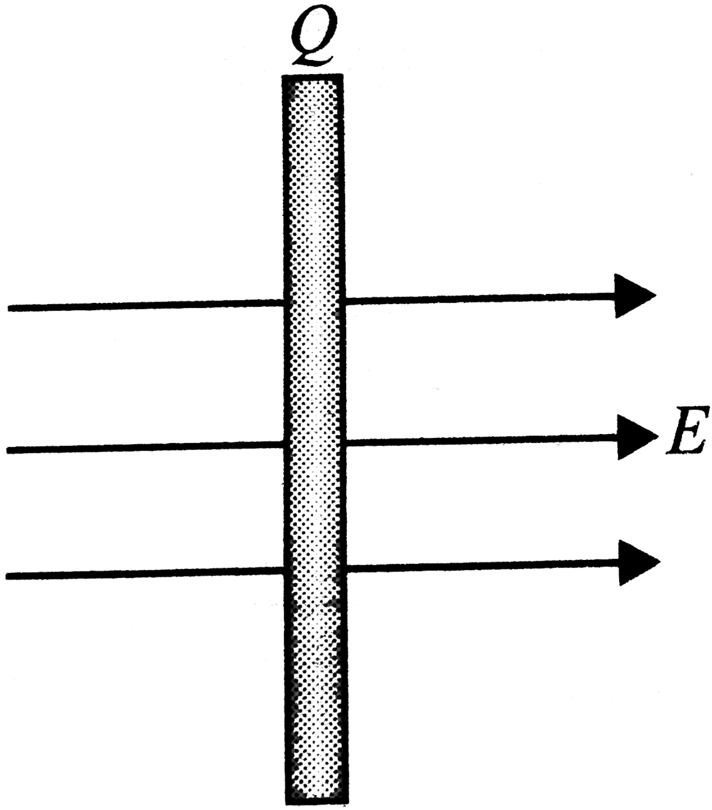
16. An isolated conducting sheet of area A and carrying a charge Q is placed in a uniform electric field E, such that the electric field is perpendicular to the sheet and covers all the sheet. Find out the charges appearing on its two surfaces.



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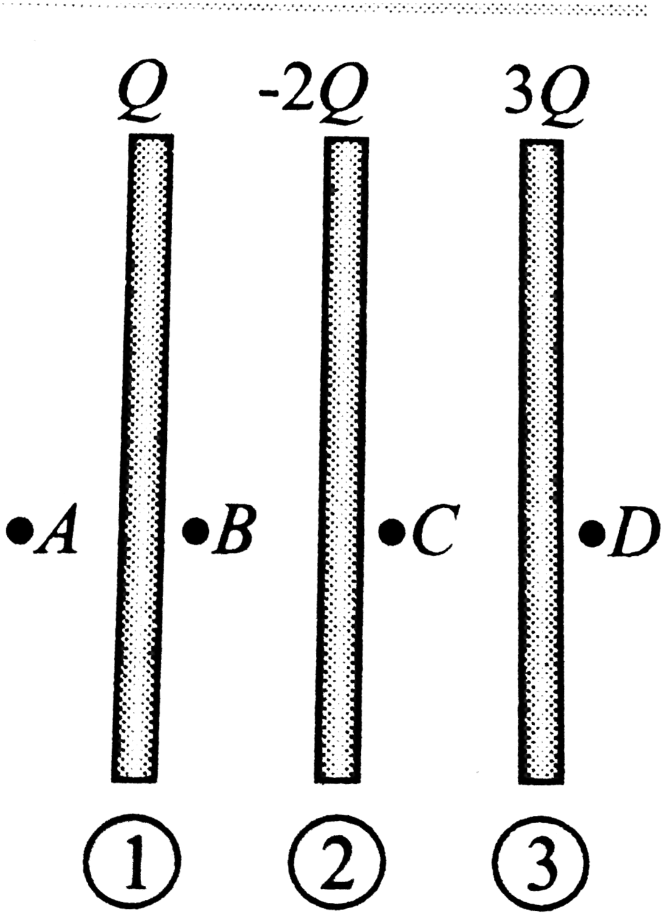
17. Three large conducting sheets placed parallel to each other at a finite distance contain charges

$Q, -2Q,$ and $3Q$, respectively. Find the electric fields at points A, B, C, and D.



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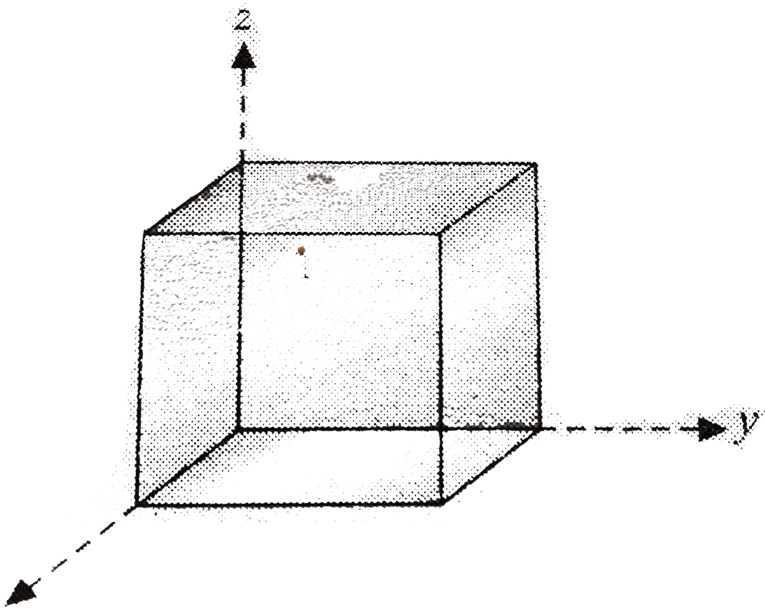
Example

1. The electric field in a cubical volume is

$$\vec{E} = E_0\left(1+\frac{z}{a}\right)\hat{i} + E_0\left(\frac{z}{a}\right)\hat{j}$$



Each edge of the cube measures d, and one of the corners lies at the origin of the coordinates. Determine the net charge within the cube.

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2. A point charge q is placed on the top of a cone of semi vertex angle θ. Show that the electric flux through the base of cone is $\dfrac{q(1-\cos\theta)}{2\varepsilon_0}$

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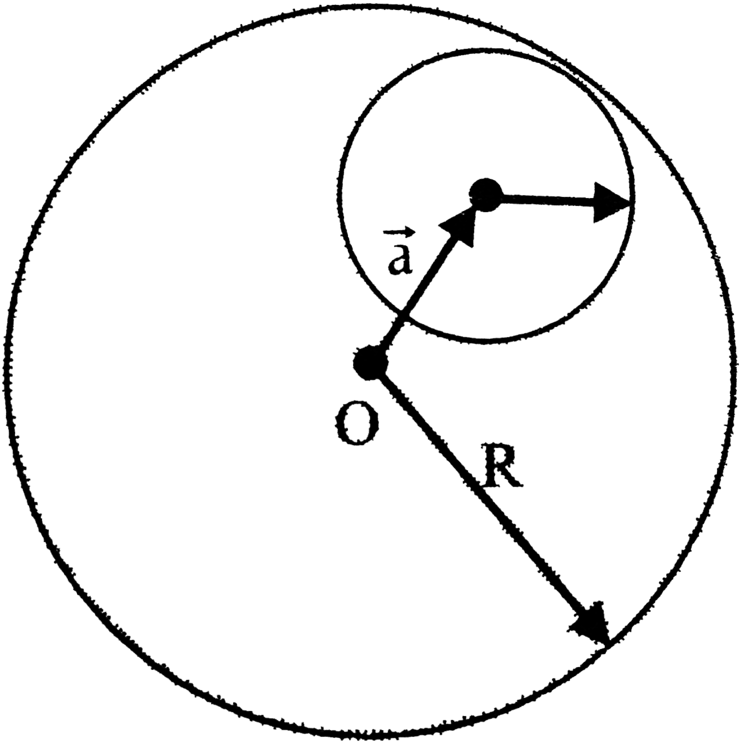
3. A sphere of radius R has a uniform volume density ρ. A spherical cavity of radius b, whose center lies at $\vec{a}$, is removed from the sphere.

i. Find the electric field at any point inside the spherical cavity.

ii. Find the electric field outside the cavity

(a) at points inside the large sphere but outside the cavity and

(b) at points outside the large sphere.



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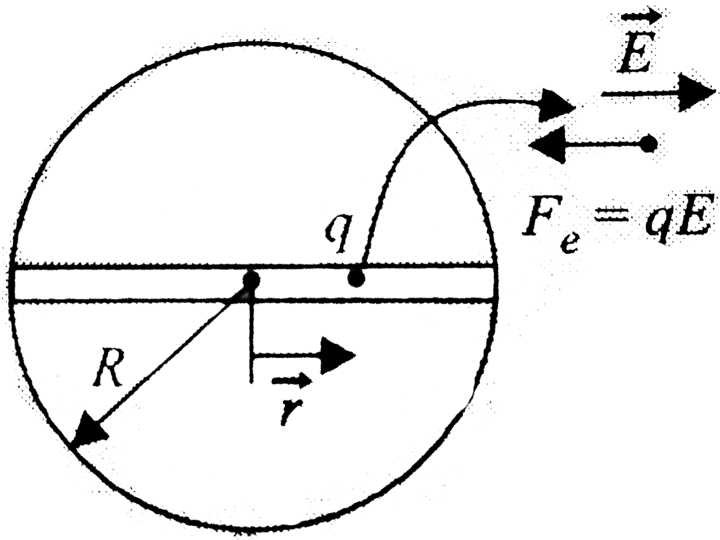
4. A smooth chute is made in a dielectric sphere of radius R and uniform volume charge density. ρ. A charge particle of mass m and charge -q is placed at the centre of the sphere. Find the time period of motion of the particle?



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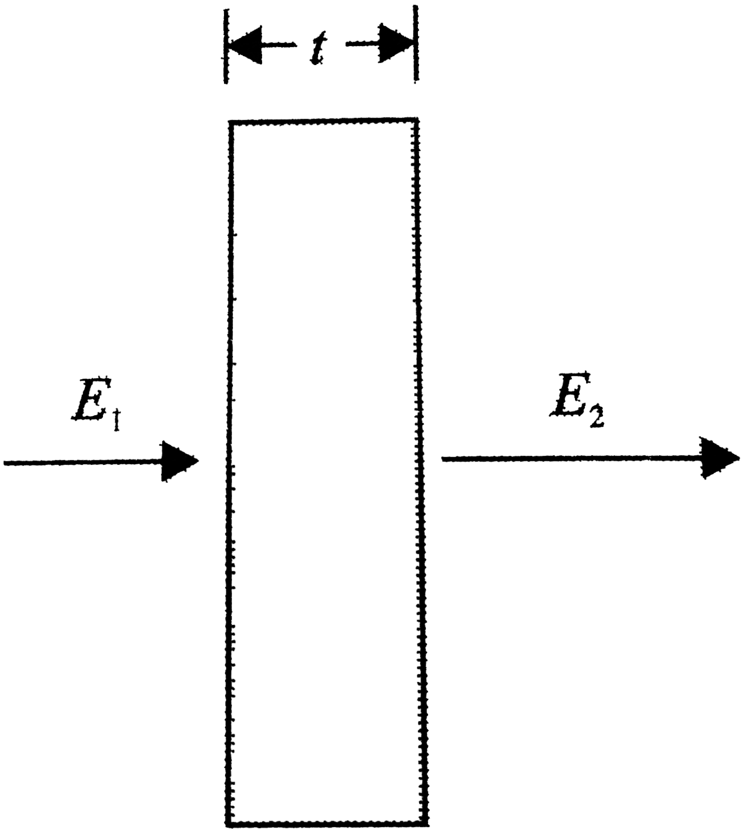
5. An infinitely large layer of charge of uniform thickness t is placed normal to an existing uniform electric field. The charge on the sheet alters the electric field so that it still remains uniform on both the sides of the sheet and

assumes values E_1 and E_2 as shown in figure. The charge distribution in the layer is not uniform and depends only on the distance from its faces. Find the expressions for the force F per unit experienced by the charge layer.



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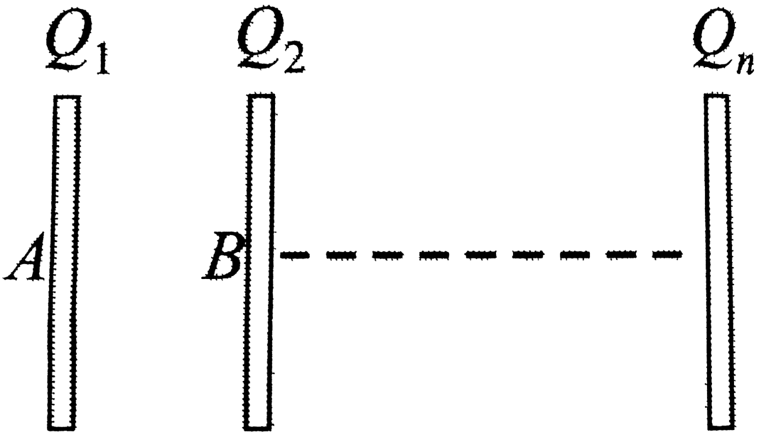
6. There are n large parallel plate conductors carrying charge $Q_1, Q_2, \ldots\ldots\ldots\ldots Q_n$ respectively.



i. Find the charge induced at surface A.

ii. Find the charge induced at surface B.

iii. If the left conductor is earthed, find the magnitude of charge flowing from plate to earth.

iv. If any conductor is earthed, find the magnitude of charge flowing from plate to earth.

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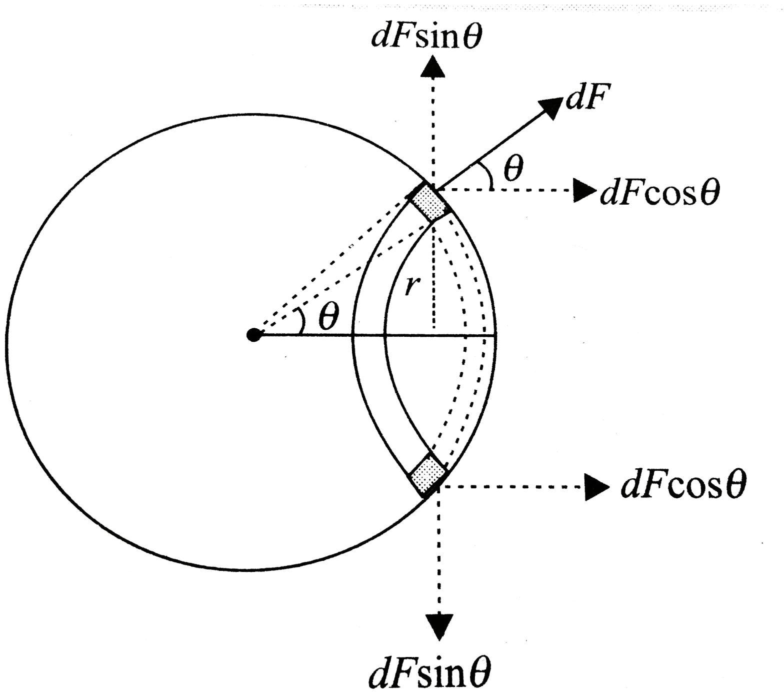
7. Find the electrostatic force of interaction between two halves of a spherical conductor of radius R carrying a charge Q.



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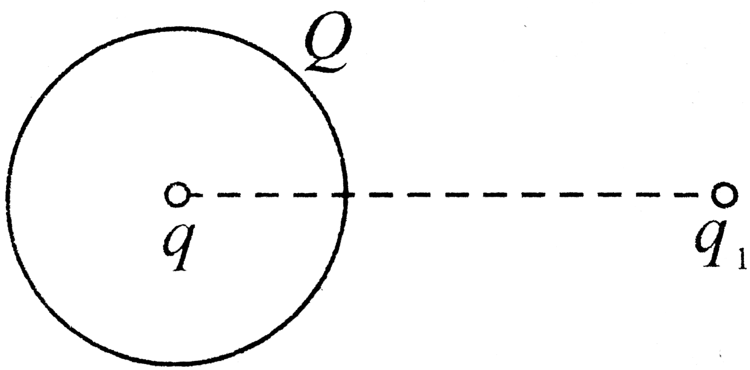
Exercise 2.1

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



a. at centre due to all charges.

b. at center due to shell.

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2. If we introduce a large thin metal plate between two point charges, what will happen to the force between the charges?

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3. A dipole lies on the x-axis, with the positive charge $+q$ at $x = +d/2$ and the negative charge at $x = -d/2$. Find the electric flux ϕ_E through the yz plane midway between the charges.

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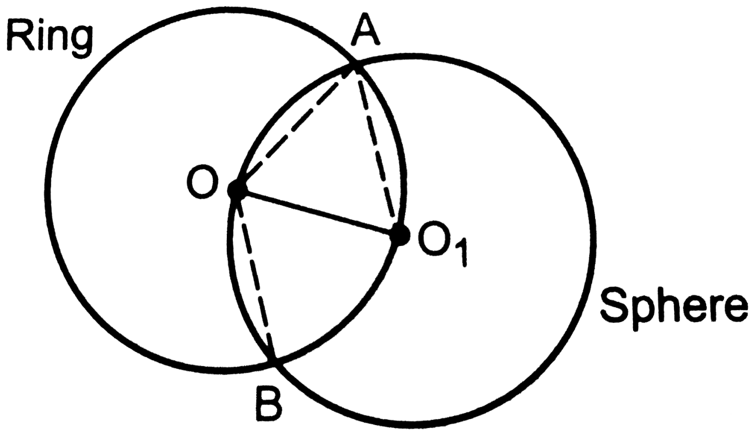
4. A Charge Q is distributed uniformly on a ring of radius r. A sphere of equal r is constructed with its centre at the periphery of the ring (figure 30.12) Find the flux of the electric field through the surface of the sphere.



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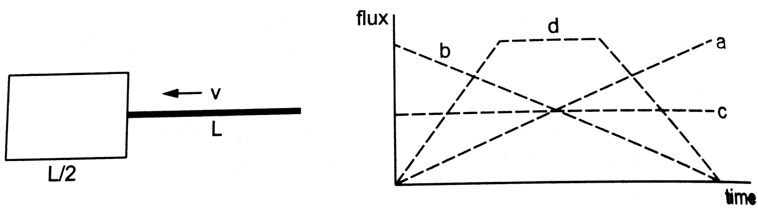
5. Figure shown an imaginary cube of edge L/2. A uniformly Charged rod of length L moves towards left at a small but constant speed v. At t=0, the left end just touches the centre of the cube opposite it. Which of the graphs shown in figure represents the flux of the electic field through the cube as the rod goes through it?



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6. A hemispherica 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

(i) parallel to the base

(ii) perpendicular to the base

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7. What is the field in the cavity if a conductor having a cavity is charged? Does the result depend on the shape and size of cavity or conductor ?

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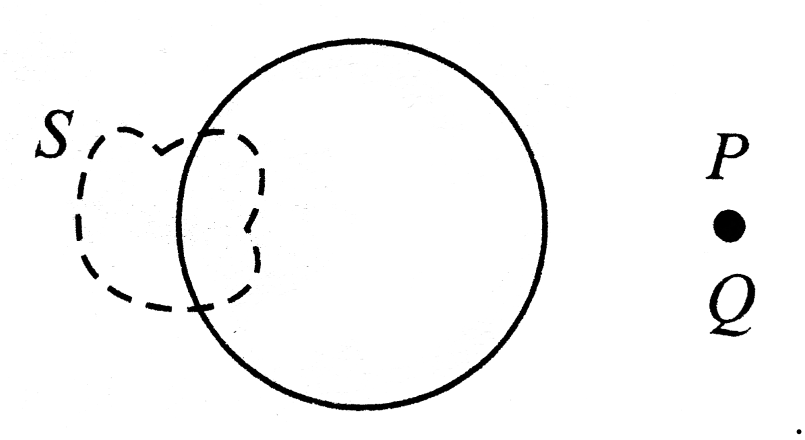
8. Figure shows a closed surface which intersects a conducting sphere. If a positive charge is placed at point P, find the sign of flux passing through the curved surface S.



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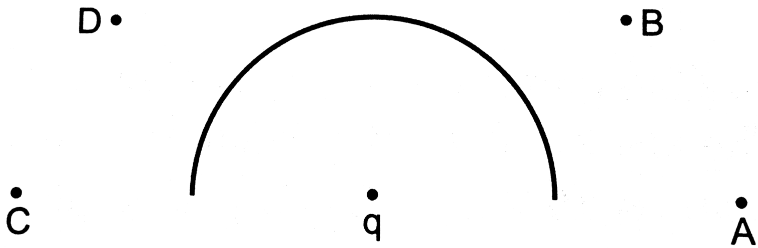
9. Figure shows a charge q placed at the centre of a hemisphere. A second charge Q is placed at one of the positions A, B, C and D. In which position(s) of this second charge, the flux of the electric field through the hemisphere remains unchanged?



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10. A charge Q is placed at the centre of an imaginary hemispherical surface. Using symmetry arguments and the Gauss\'s law, find the flux of the electric field due to this charge through the surface of the hemisphere (figure).

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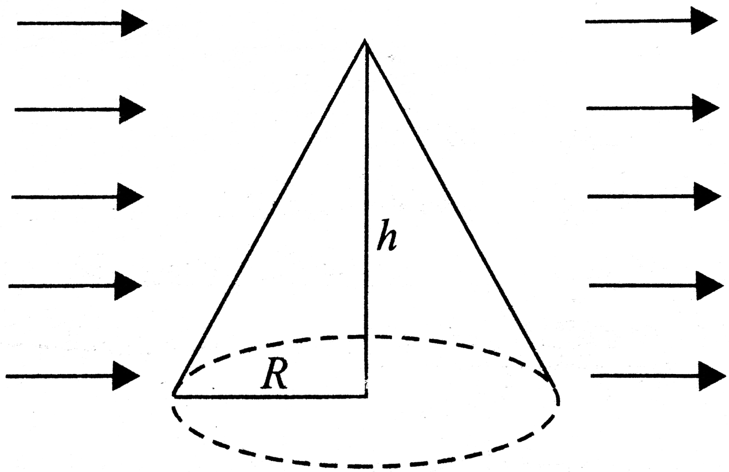
11. In figure , a cone lies in a uniform electric field E. Determine the electric flux entering the cone.



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12. A uniform electric field $a\hat{i} + b\hat{j}$ intersects a surface of area A. What is the flux through this area if the surface lies (a) in the yz plane, (b) in the xz plane, (c) in the xy plane?

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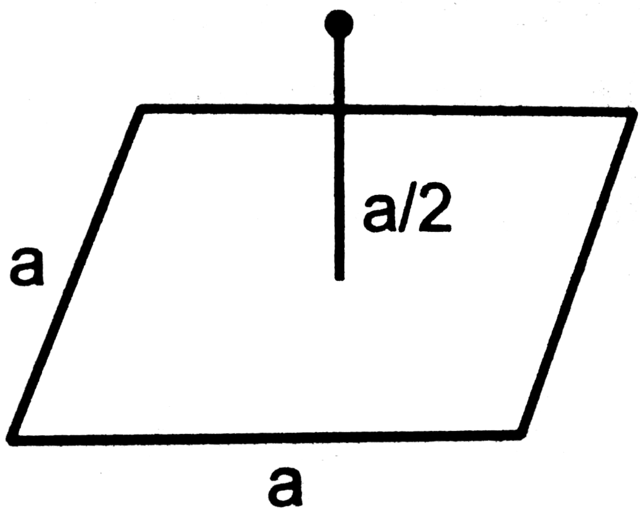
13. A charge Q is placed at a distance $\frac{a}{2}$ above the centre of a horizontal, spuare surface of edge a as shown in figure (30-E1). Find the flux of the electric field through the square surface.



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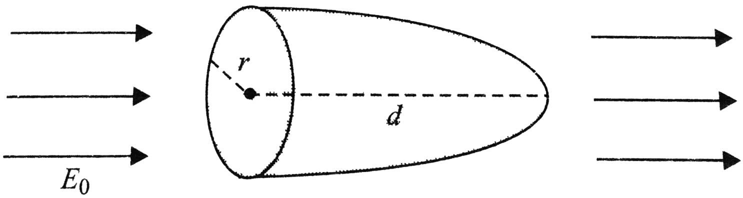
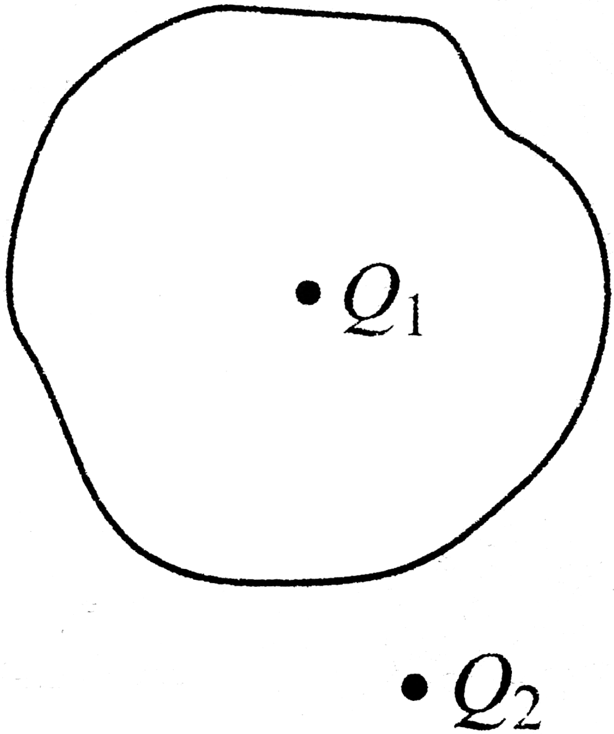
14. Calculate the total electric flux through the paraboloidal surface due to a uniform electric field of magnitude E_0 in the direction shown in figure.



15. Consider a closed surface of arbitatry shape as shown in figure. Suppose a single charge Q_1 is located at some point within the surface and second charge Q_2 is located outside the surface.



a. What is the total flux passing through the surface due to charge Q_1?

b. What is the total flux passing through the surface due to charge Q_2?

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16. If Coulomb's law involved $\frac{1}{r^3}$ (instead of $\frac{1}{r^2}$), would Gauss's law still be true?

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Exercise 2.2

1. A ball of charge q is placed in a hollow conducting uncharged sphere. After this, the sphere is connected with earth for a short time and the ball is then removed from the sphere. The ball has not been brought into contact with the sphere.

a. What charge will the sphere have after these operations? Where and how will this charge be distributed?

b. What will be the electric field inside as well as outside the sphere?

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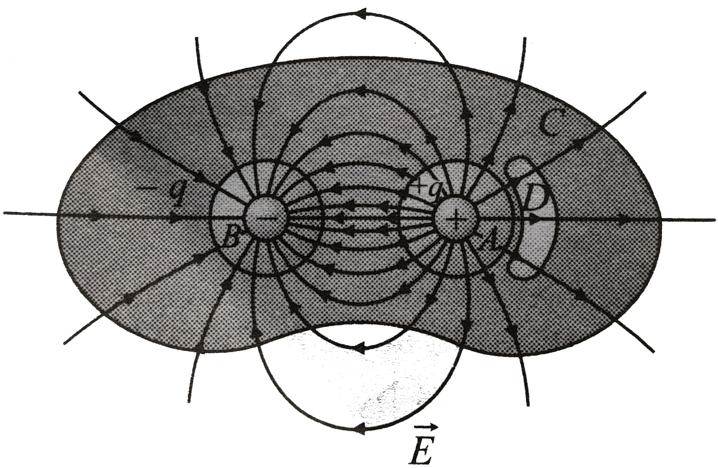
2. figure shows the field produced by two point charges +q and -q of equal magnitude but opposite signs (an electric dipole). Find the electric flux through each of the closed surfaces A,B,C, and D.



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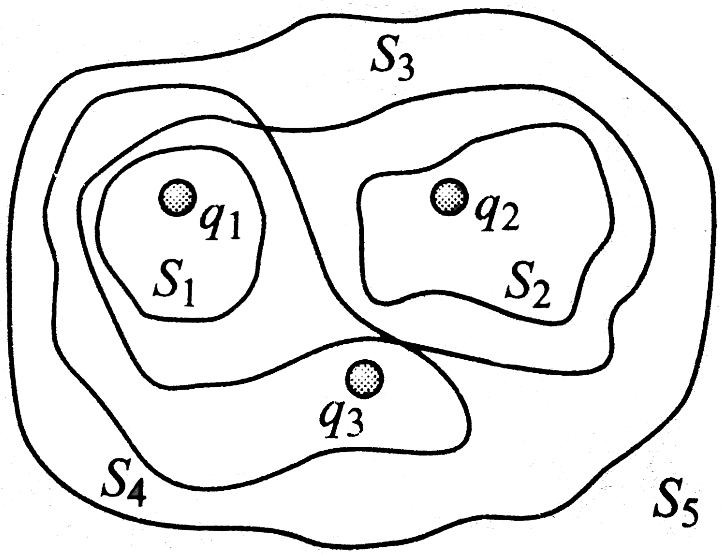
3. The three small spheres as shown in figure carry charges $q_1 = 4nC, q_2 = -7.8nC$ and $q_3 = 2.4nC$. Find the net electic flux through each of the following closed surfaces shown in cross section in the figure.

a. S_1 b.S_2

c. S_3 d. S_4

e. S_5.

Do your answers to parts from (a) to (e) depend on how the charge is distributed over each small sphere? Why or why not?



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4. 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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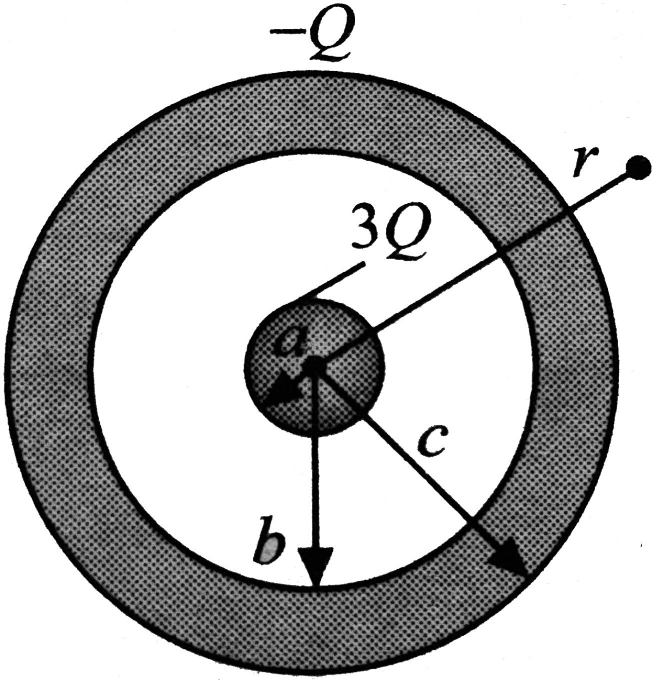
5. A solid insulating sphere of radius a carries a net positive charge $3Q$, uniformly distributed throughout its volume. Concentric with this sphere is a conducting spherical shell with inner radius b and outer radius c and having a net charge -Q, as shown in figure



a. Consider a spherical Gaussian surface of radius rgtc, the net charge enclosed by this surface is ....

b. The direction of the electric field rgtc is ....

c. The electric field at rgtc is ....

d. The electric field in the region with radius r, which cgtrgtb, is ....

e. Consider a spherical Gaussian surface of radius r, where $c > r > b$, the net charge enclosed by this surface is

....

f. Consider a spherical Gaussian surface of radius r, where $b > r > a$, the net charge enclosed by this surface is

....

g. The electric field in the region $b > r > a$ is ....

h. Consider a spherical Gaussian surface of radius $r < a$. Find an expression for the net charge Q(r) enclosed by this surface as a function of r. Note that the charge inside the surface is less than 3Q.

i. The electric field in the region $r < a$ is ....

j. The charge on the inner surface of the conducting shell is ....

k. The charge on the outer surface of the conducting shell is ....

l. Make a plot of the magnitude of the electric field versus r.

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6. A small conducting spherical shell with inner radius a and outer radius b is concentric with a larger conducting sphereical shell with inner radius c and outer radius d. The inner shell has total charge $+2q$ and the outer shell has charge $+4q$.

a. Make a plot of the magnitude of the electric field versus r.

b. Calculate the electric field $(\text{magnitude and direction in terms of q})$ and the distance r from the common centre of the two shell for $(i) r < a$, $(ii) a < r < b$, (iii)bltrltc,(iv)cltrltd, (v)rgtd $. Showuourrest \underline{t} \in agraphwithradialcompo \ne ntof$vecE $asfunctionof$r`.

c. What is the total charge on the

i. inner surface of the small shell,

ii. outer surface of the small shell,

iii. inner surface of the large shell,

iv. outer surface of the large shell?

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7. Which of the following statements is/are correct?

a. Electric field calculated by Gauss law is the field due to only those charges which are enclosed inside the Gaussian surface.

b. Gauss law is applicable only when there is a symmetrical distribution of charge.

c. Electric flux through a closed surface is equal to total flux due to all the charges enclosed within that surface only.

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8. Which of the following statement is correct ? If E = 0 , at all points of a closed surface.

a. the electirc flux through the surface is zero.

b. the total charge enclosed by the surface is zero.

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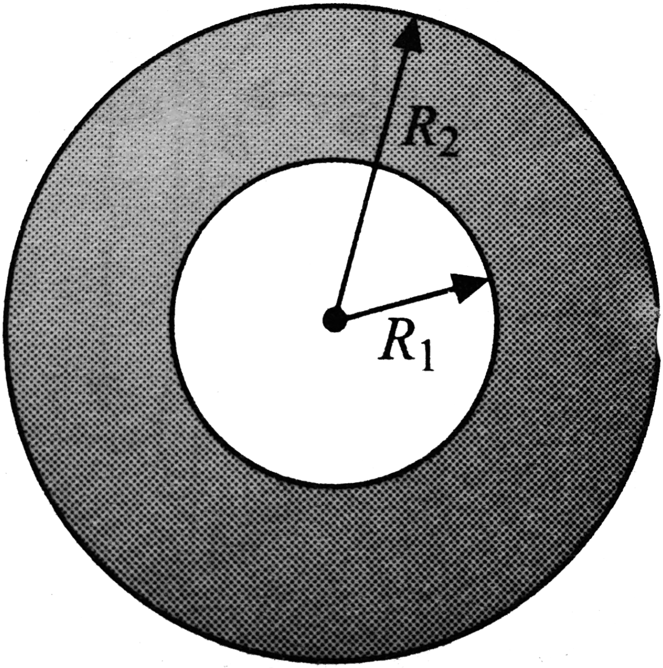
9. A hollow dielectric sphere, as shown in figure, has inner and outer radii of R_1 and R_2, respectively. The total charge carried by the sphere is +Q, this charge is uniformly distributed R_1 and R_2.



a. the electric field for $r < R_1$ is zero. (Yes/No)

b. the electric field for $R_1 < r < R_2$ is given by ....

c. the electric field for $r > R_2$ is given by ....

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10. A ring of diameter d is rotated in a uniform electric field until the position of maximum electric flux is found. The flux is found to be ϕ. What is the electric field strength?

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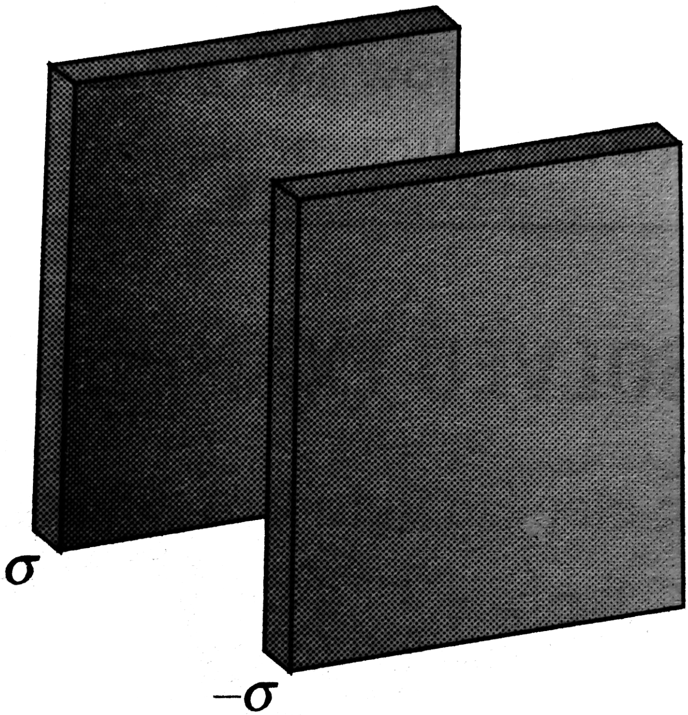
11. Two infinite, non-conducting sheets of charge are parallel to each other, as shown in figure. The sheet on the left has a uniform surface charge density σ, and the one on the right has a uniform charge density $-\sigma$. Calculate the electric field at points (a) to the left of, (b) in between, and (c) to the right of the two sheets.



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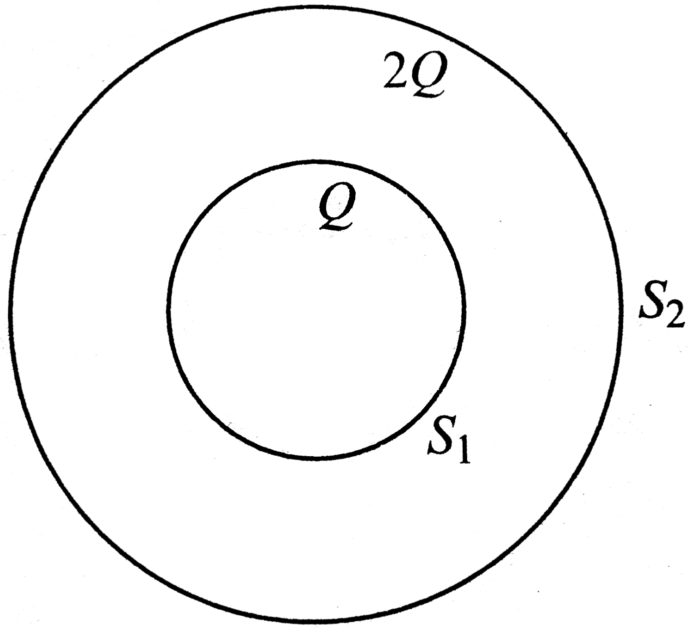
12. S_1 and S_2 are two hollow concentric spheres enclosing charge Q and 2Q, respectively, as shown in figure. What is the ratio of the electric flux leaving through

the surface of S_1 and S_2?



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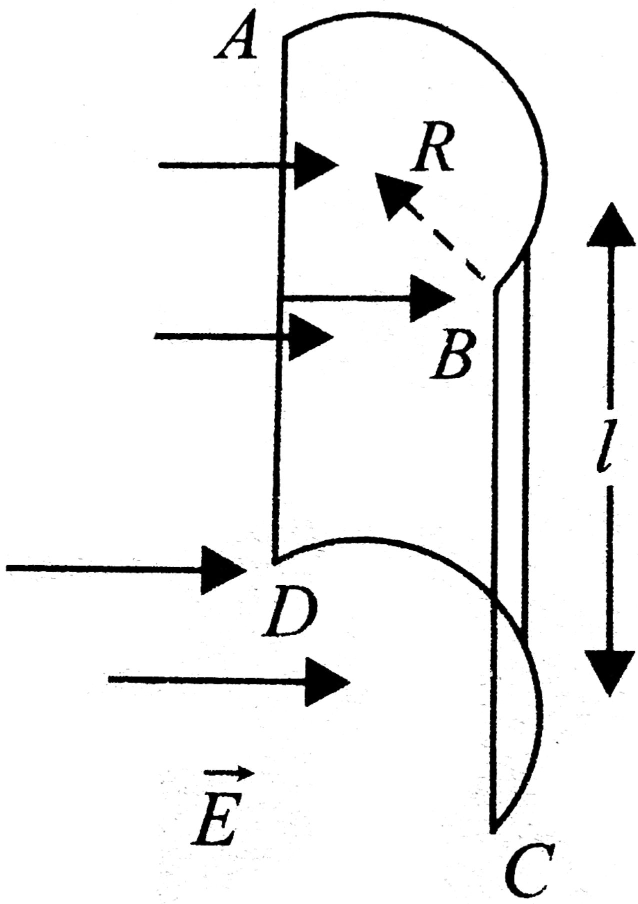
13. A hollow half cylinder surface of radius R and length l is placed in a uniform electric field $\vec{E}$. Electric field is acting perpendicular on the plane ABCD. Find the flux through the curved surface of the hollow cylindrical surface



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14. Consider two concentric conducting spheres. The outer sphere is hollow and initially has a charge $-7Q$ on it. The inner sphere is solid and has a charge $+2Q$ on it.

a. How much charge is on the outer surface and inner surface of the outer sphere.

b. If a wire is connected between the inner and outer sphere, after electrostatic equilibrium is established how much total charge is on the outer sphere? How much charge is on the outer surface and inner surface of the outer sphere? Does the electric field at the surface of the inside sphere change when the wire is connected?

c. We return to original condition in (a). We now connect the outer sphere to ground with a wire and then disconnect it. How much total charge will be on the outer sphere? How much charge will be on the inner surface and outer surface of the outer sphere?

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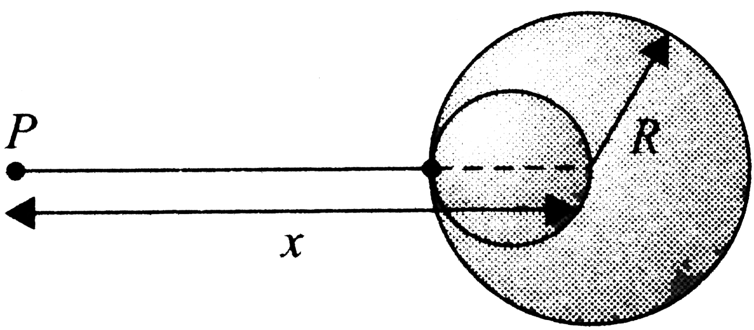
Subjective

1. A solid spherical region, having a spherical cavity whose diameter R is equal to the radius of the spherical region, has a total charge Q. Find the electric field at a point P as shown in figure



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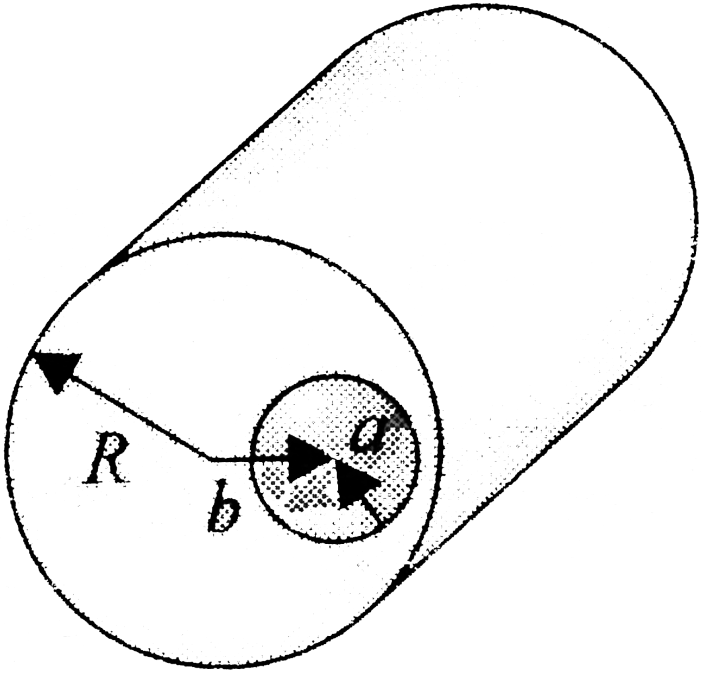
2. A very long, solid insulating cylinder with radius R has a cylindrical hole with radius a bored along its entire length. The axis of the hole is at a distance b from the axis of the cylinder, where $a < b < R$ (as shown in figure). The solid material of the cylinder has a uniform volume charge density ρ. Find the magnitude and direction of the electric field inside the hole, and show that this is uniform over

the entire hole.



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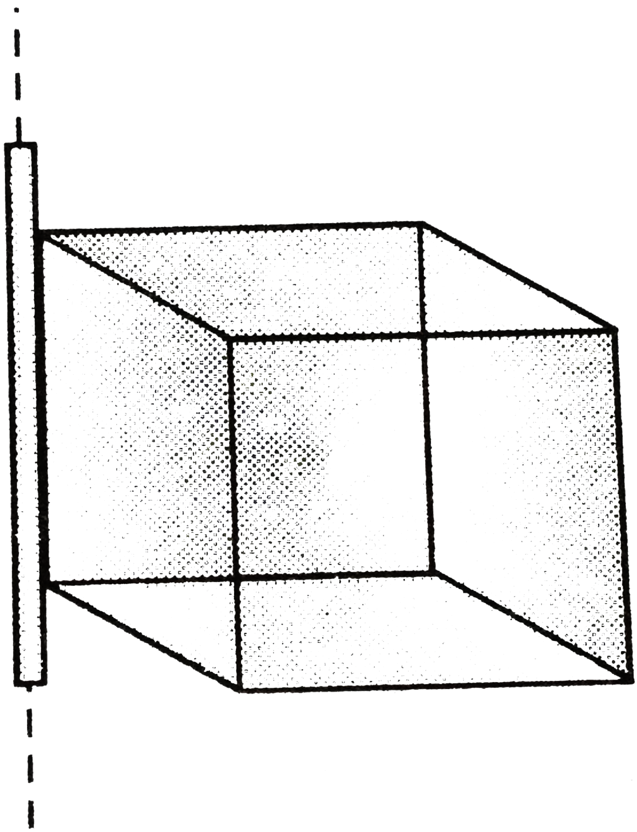
3. An infinite wire having charge density λ passes through one of the edges of a cube having edge length l.

a. Find the total flux passing through the cube.

b. Find the flux passing through the surfaces in contact with the wire.

c. Find the flux passing through the surfaces not in contact with the wire.



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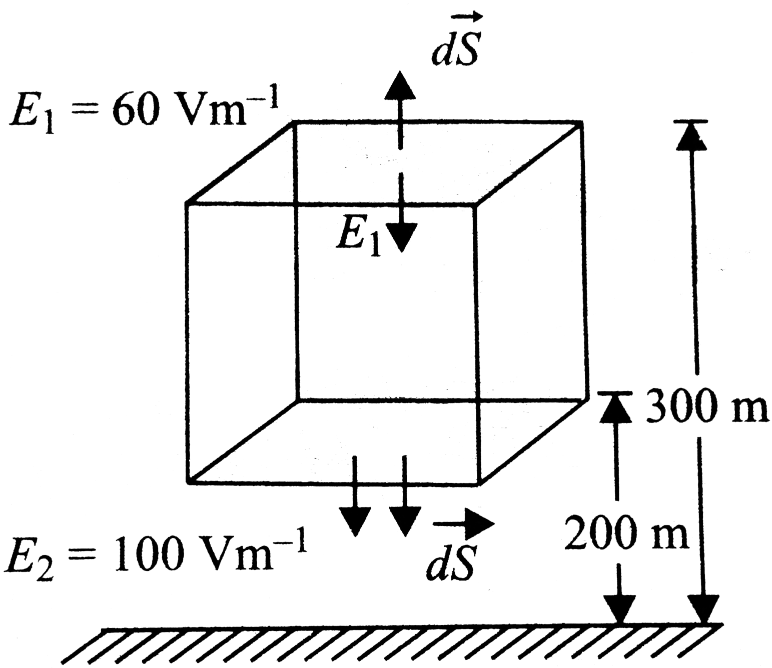
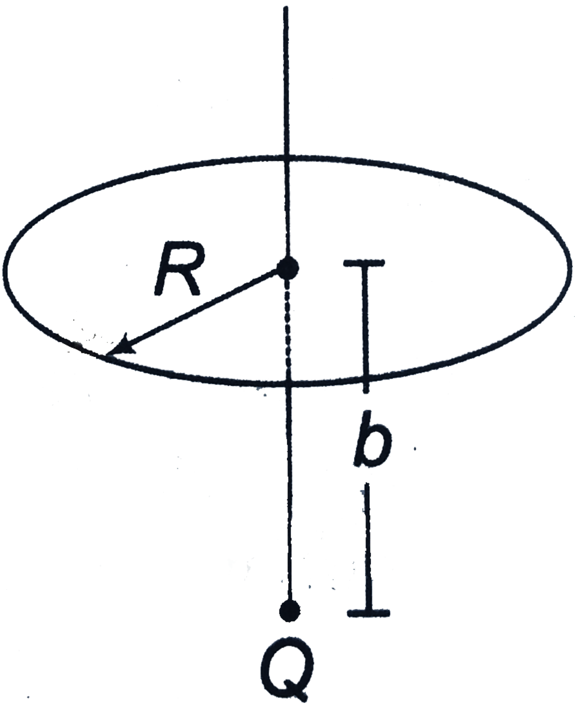
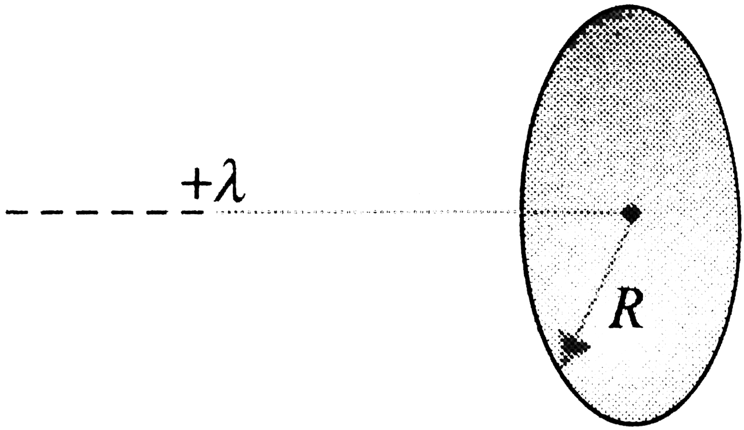
4. It has been experimentally observed that the electric field in a large region of earth's atmosphere is directed vertically down. At an altitude of 300 m, the electric field $60Vm^{-1}$. At an altitude of 200 m, the field is 100 V m^(-1), the field is $100Vm^{-1}$. Calculate the net amount of charge contained in the cube of 100 m edge, located between 200 and 300 m altitude.



5. A point charge Q is located on the axis of a disc of radius R at a distance b from the plane of the disc (figure). Show that if one-fourth of the electric flux from the charge passes through the disc, then $R = \sqrt{3}b$.



6. A very long uniformly charged wire oriented along the axis of a circular ring of radius R rests on its centre with one of the ends (as shown in figure). The linear charge density on the wire is λ. Evalute the flux of the vector $\overrightarrow{E}$ across the circle area.



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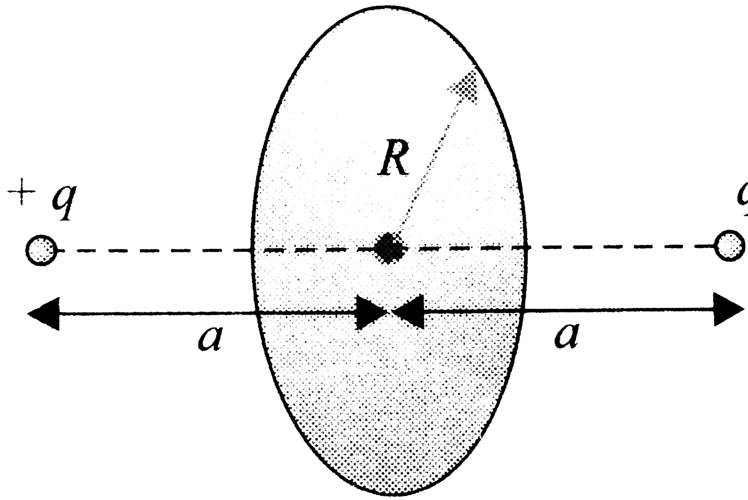
7. Two point charges q and -q are separated by a distance 2a. Evaluate the flux of the electric field strength vector across a circle of radius R.



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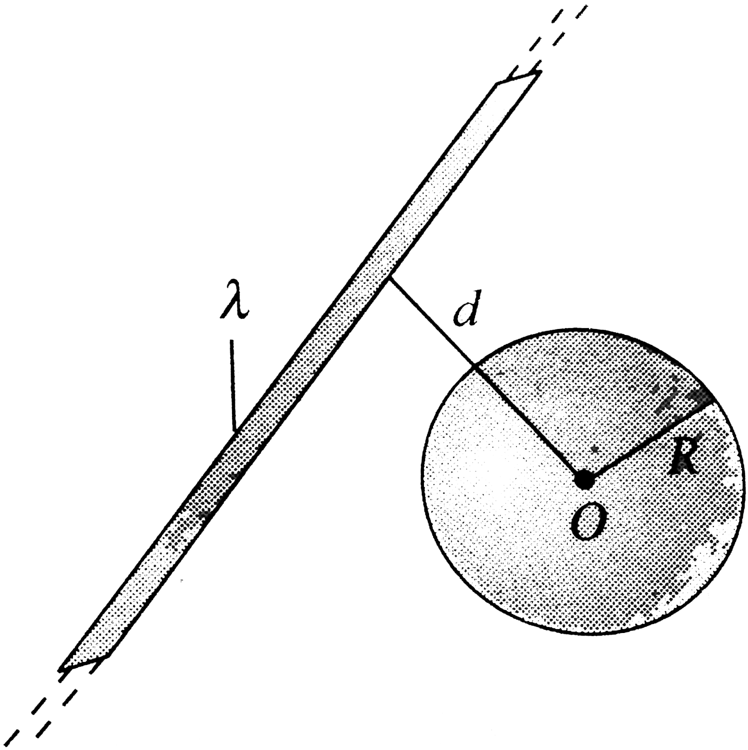
8. An infinitely long line charge having a uniform charge per unit length λ lies at a distance d from a point O as shown in figure. Determine the total electric flux through through the surface of a sphere of radius R centered at O resulting from this line charge. Consider both cases where $R < d$ and $R > d$.



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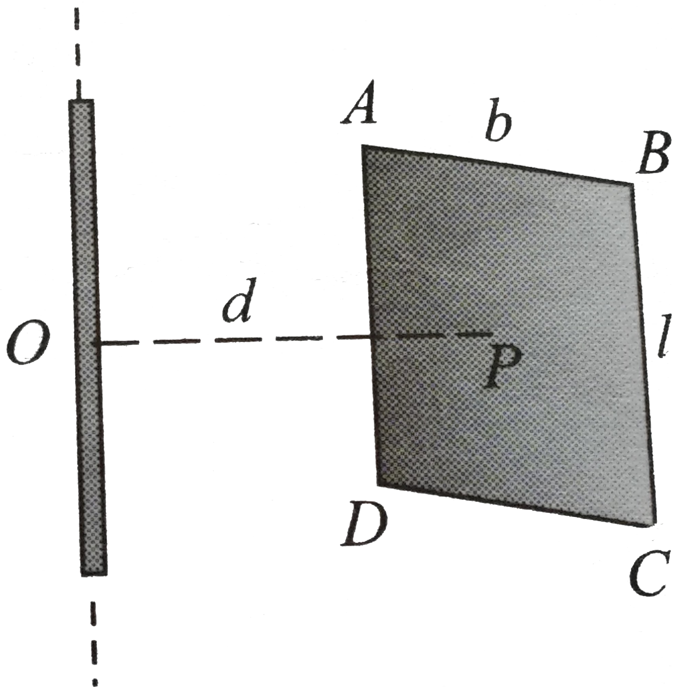
9. Find the electric flux crossing the wire frame ABCD of length l, width b, and center at a distance OP = d from an infinite line of charge with linear charge density λ. Consider that the plane of the frame is perpendicular to the line OP



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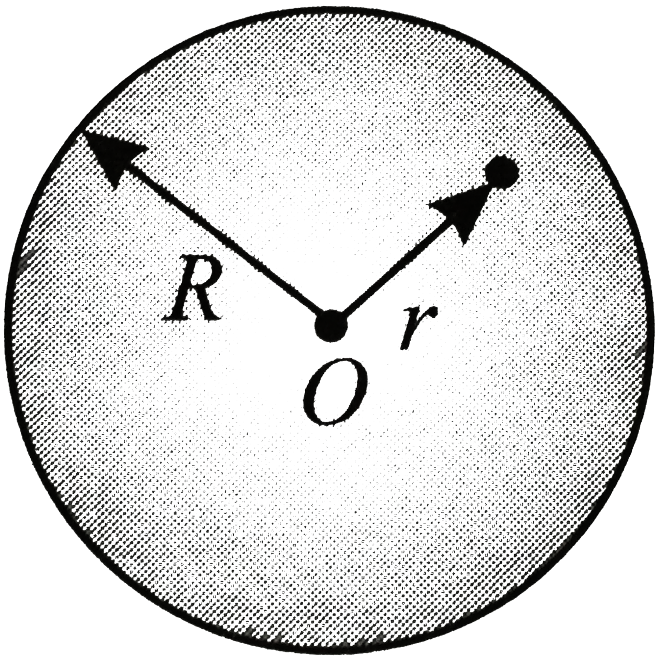
10. A solid insulating sphere of radius R has a nonuniform charge density that varies with r according to the expression $\rho = Ar^2$, where A is a constant and $r < R$ is measured from the centre of the sphere. Show that (a) the magnitude of the electric field outside $(r > R)$ the sphere is $E = AR^5 / 5\varepsilon_0 r^2$ and (b) the magnitude of the electric field inside $(r < R)$ the sphere is $E = Ar^3 / 5\varepsilon_0$.



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11. The electric field in a region is radially outward with magnitude $E = Ar$. Find the charge contained in a sphere of radius a centred at the origin. Take $A = 100Vm^{-2}$ and $a = 20.0cm$.

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12. A system consits of a uniformly charged sphere of radius R and a surrounding medium filled by a charge with the volume density $\rho = \frac{\alpha}{r}$, where α is a positive constant and r is the distance from the centre of the sphere. Find the charge of the sphere for which the electric field intensity E outside the sphere is independent of R.

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Single Correct

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

A. 0

B. $200\pi b^2$

C. $100\pi b^2$

D. $-200\pi b^2$

Answer: D

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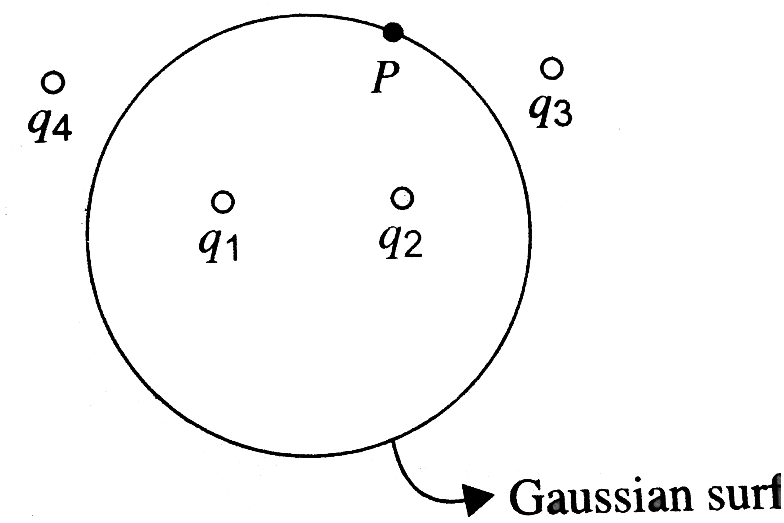
2. Consider the Gaussian surface that surrounds parts of the charge distribution shown in figure. Then the contribution to the electric field at point P arises from charges



A. q_1 and $q_2 only$

B. q_3 and $q_4 only$

C. $q_1, q_2, q_3,$ and q_4

D. none of the above

Answer: C

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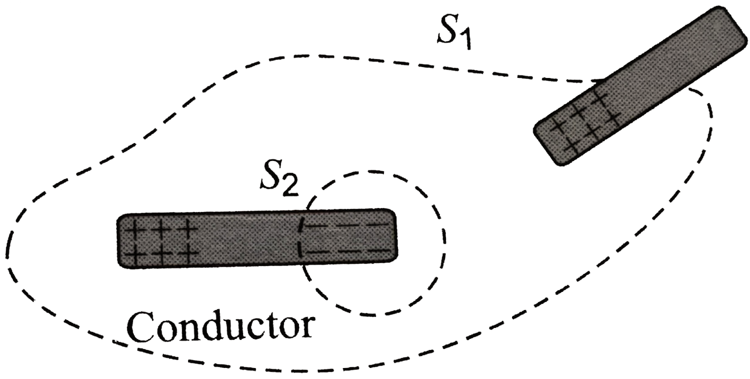
3. Charge on an originally uncharged conductor is separated by holding a positively charged rod very closely nearby, as shown in figure. Assume that the induced negative charge on the conductor is equal to the positive charge q on the rod. Then the flux through surface S_1 is



A. zero

B. q/ε_0

C. $-q/\varepsilon_0$

D. none of these

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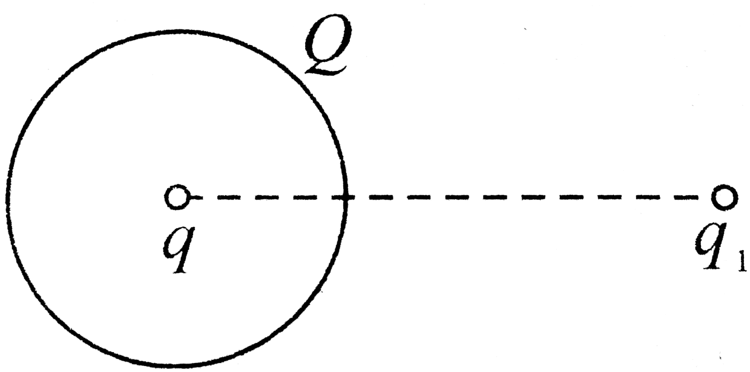
4. A thin metallic spherical shell contains a charge Q on it. A point charge q is placed at the center of the shell and another charge q_1 is placed outside it as shown in the figure. All the three charges are positive. Find the force on the charge



a. at centre due to all charges.

b. at center due to shell.

A. toward right

B. toward left

C. zero

D. none of these

Answer: C

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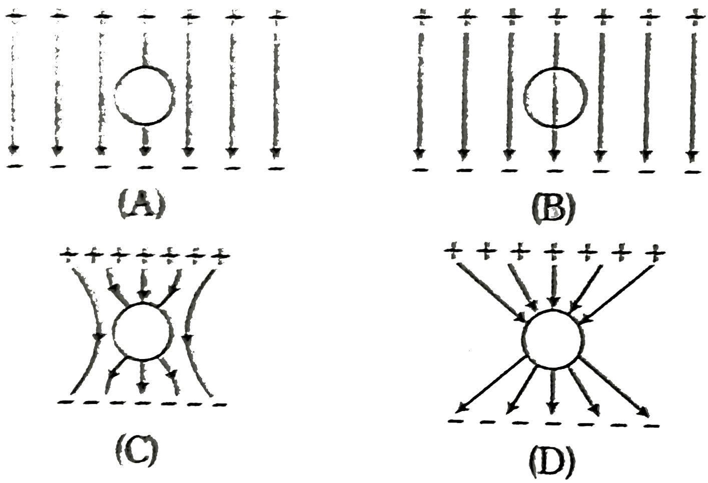
5. An ucharged sphere of metal is placed in between two charged plates as shown. The lines of force look like



A.

B.

C.

D.

Answer: B

6. A hollow metallic sphere of radius 10 cm is given a charge of $3.2 \times 10^{-9} C$. The electric intensity at a point 4 cm from the center is

A. $9 \times 10^{-9} NC^{-1}$

B. $288 NC^{-1}$

C. $2.88NC^{-1}$

D. zero

Answer: D

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7. The surface density on a copper sphere is σ. The electric field strength on the surface of the sphere is

A. σ

B. $\sigma/2$

C. $\sigma/2\varepsilon_0$

D. σ/ε_0

Answer: D

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8. 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. zero

B. $\pi R^2 E$

C. $2\pi R^2 E$

D. $E / \pi R^2$

Answer: A::B::C::D

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9. A cube of side 10 cm encloses a charge of $0.1\mu C$ at its center. Calculate the number of lines of force through each face of the cube.

A. 1.113×10^{11}

B. 1.13×10^{4}

C. 1.13×10^{9}

D. 1883

Answer: D

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10. The electric flux from a cube of edge l is ϕ. If an edge of the cube is made $2l$ and the charge enclosed is halved, its value will be

A. 4ϕ

B. 2ϕ

C. $\phi/2$

D. ϕ

Answer: C

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11. In a certain region of space, there exists a uniform electric field of value $2 \times 10^{2}\hat{k}Vm^{-1}$. A rectangular coil of dimension $10cm \times 20cm$ is placed in the xy plane. The electric flux through the coil is

A. zero

B. 30 V m

C. 40 V m

D. 50 V m

Answer: C

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12. Consider two concentric spherical surfaces S_1 with radius a and S_2 with radius 2a, both centered at the origin. There is a charge +q at the origin and there are no other charges. Compare the flux ϕ_1 through S_1 with the flux ϕ_2 through S_2.

A. $\phi_1 = 4\phi_2$

B. $\phi_1 = 2\phi_2$

C. $\phi_1 = \phi_2$

D. $\phi_1 = \phi_2 / 2$

Answer: C

13. Under what conditions can the electric flux ϕ_E be found through a closed surface?

A. If the magnitude of the electric field is known everywhere on the surface.

B. If the total charge inside the surface is specified.

C. If the total charge outside the surface is specified.

D. Only if the location of each point charge inside the surface is specified.

Answer: B

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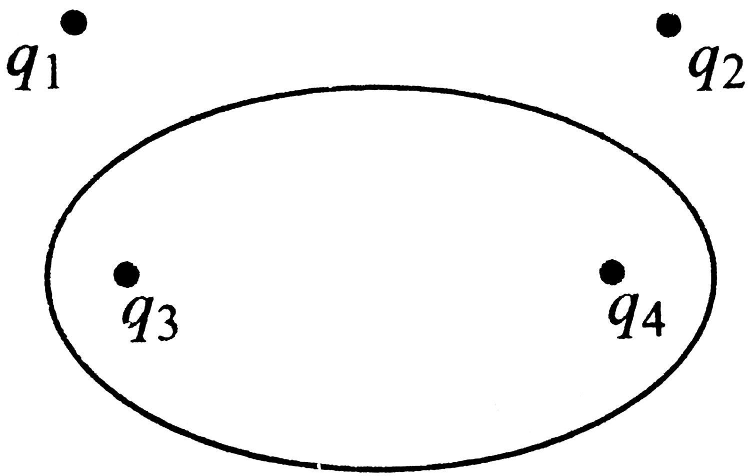
14. Figure shows four charges $q_1, q_2, q_3,$ and q_4 fixed is space. Then the total flux of the electric field through a closed surface S, due to all the charges, is



A. not equal to the total flux through S due to q_3 and q_4

B. equal to the total flux through S due to q_3 and q_4

C. zero if $q_1 + q_2 = q_3 + q_4$

D. twice the total flux through S due to q_3 and q_4 if $q_1 + q_2 = q_3 + q_4$.

Answer: B

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

A. the electric field must be zero every where on the surface.

B. the total charge inside the surface must be zero

C. the electric field must be uniform throughout the closed surface

D. the charge outside the surface must be zero

Answer: B

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16. Eight charges, 1muC, -7muC , -4muC, 10muC, 2muC, -5muC, -3muC, and 6muC`, are situated at the eight cornersof a cube of side 20 cm. A spherical surface of radius 80 cm encloses this cube. The center of the sphere coincides with the center of the cube. Then, the total outgoing flux from the spherical surface (in units of Vm) is

A. $36\pi \times 10^3$

B. $684\pi \times 10^3$

C. zero

D. none of these

Answer: C

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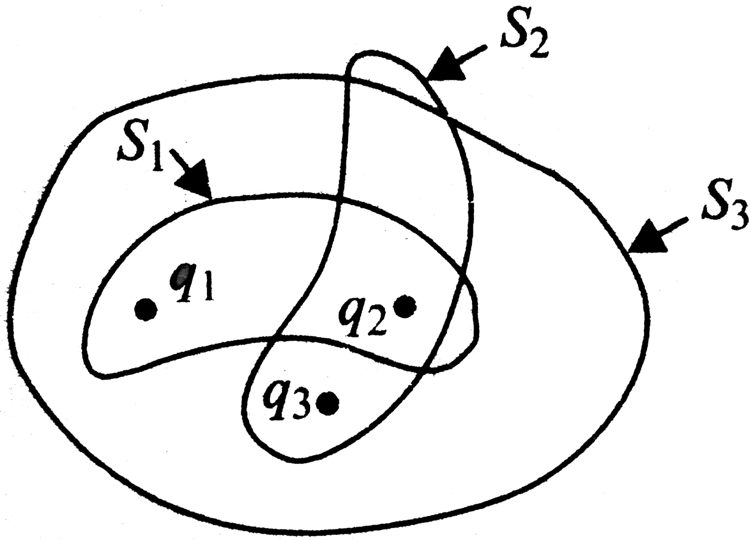
17. Three charges $q_1 = 1 \times 10^{-6} C, q^2 = 2 \times 10^{-6} C,$ and $q_3 = -3 \times 10^{-6} C$ have been placed as shown in figure. Then the net electric flux will be maximum for the surface



A. 1. S_1

B. 2. S_2

C. 3. S_3

D. 4. same of all three

Answer: A

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18. In a region of space, the electric field is given by $\overrightarrow{E} = 8\hat{i} + 4\hat{j} + 3\hat{k}$. The electric flux through a surface of area 100 units in the xy plane is

A. 800 units

B. 300 units

C. 400 units

D. 1500 units

Answer: B

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19. A spherical shell of radius $R = 1.5cm$ has a charge $q = 20\mu C$ uniformly distributed over it. The force exerted by one half over the other half is

A. zero

B. $10^{-2}N$

C. 500 N

D. 2000 N

Answer: D

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20. A flat, square surface with sides of length L is described by the equations

$x = L, 0 \leq y \leq L, 0 \leq z \leq L$

The electric flux through the square due to a positive point charge q located at the origin $(x = 0, y = 0, z = 0)$ is

A. $\frac{q}{4\varepsilon_0}$

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

C. $\frac{q}{24\varepsilon_0}$

D. $\frac{q}{48\varepsilon_0}$

Answer: C

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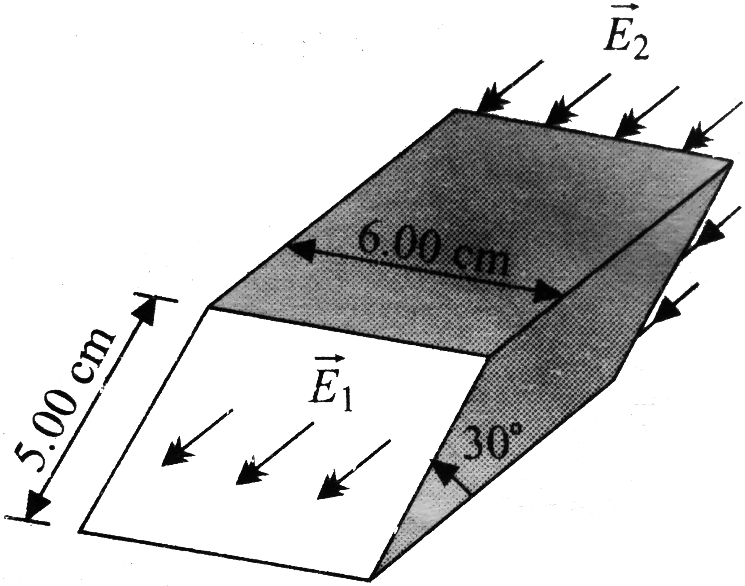
21. The electric field $\overrightarrow{E}_1$ at one face of a parallelopiped is uniform over the entire face and is directed out of the face. At the opposite face, the electric field $\overrightarrow{E}_2$ is also uniform over the entire face and is directed into that face (as shown in figure). The two faces in question are inclined at 30° from the horizontal, $\overrightarrow{E}_1$ and $\overrightarrow{E}_2$(both horizontal) have magnitudes of $2.50 \times 10^4 NC^{-1}$ and $7.00 \times 10^4 NC^{-1}$. respectively. Assuming that no other electric field lines cross the surfacesof the parallelopiped, the net charge contained with in is



A. $-67.5\varepsilon_0 C$

B. $37.5\varepsilon_0 C$

C. $105\varepsilon_0 C$

D. $-105\varepsilon_0 C$

Answer: A

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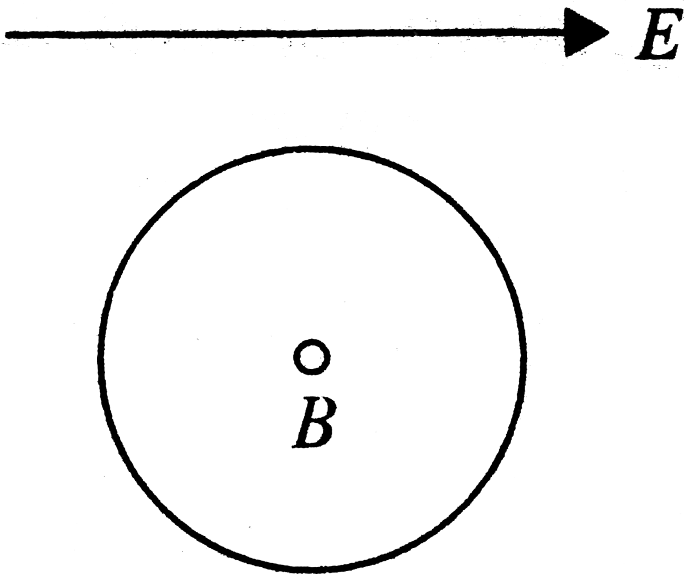
22. A dielectric in the form of a sphere is introduced into a homogeneous electric field. A, B, and C are three pointsas shown in figure. Then



A. intensity at A increases while that at B and C decreases

B. intensity at A and B decreases, whereas intensity at C increases

C. intensity at A and C increases and that at B decreases

D. intensity at A, B, and C decreases

Answer: C

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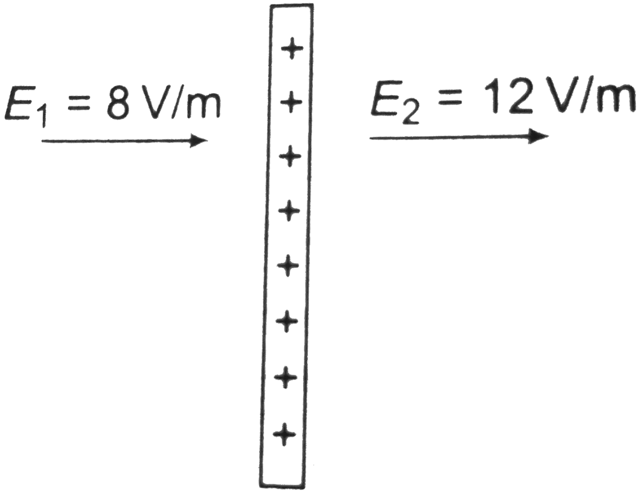
23. The electric field on two sides of a thin sheet of charge is shown in the figure. The charge density on the sheet is



A. $2\varepsilon_0$

B. $4\varepsilon_0$

C. $10\varepsilon_0$

D. zero

Answer: B

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24. A sphere of radius R carries charge such that its volume charge density is proportional to the square of the distance from the centre. What is the ratio of the magnitude of the electric field at a distance 2 R from the centre to the magnitude of the electric field at a distance of $R/2$ from the centre?

A. 1

B. 2

C. 4

D. 8

Answer: B

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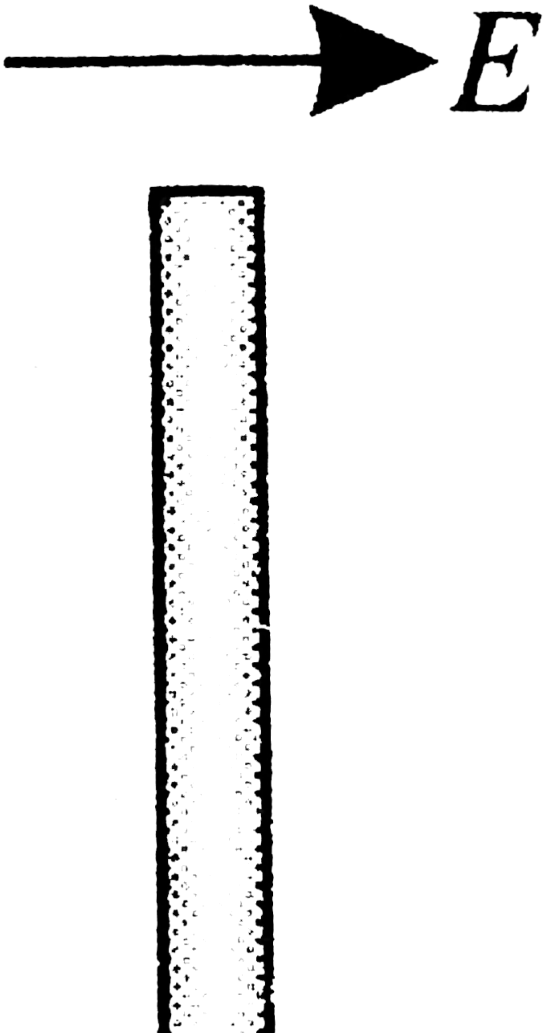
25. An uncharged conducting large plate is placed as shown. Now an electric field E towards right is applied. Find the induced charge density on the right surface of the plate.



A. $-\varepsilon_0 E$

B. $\varepsilon_0 E$

C. $-2\varepsilon_0 E$

D. $2\varepsilon_0 E$

Answer: B

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26. An uncharge aluminium block has a cavity within it. The block is placed in a region where a uniform electric field is directed upward. Which of the following is a correct statement descrining conditions in the interior of the block's cavity?

A. The electric field in the cavity is directed upward.

B. The electric field in the cavity is directed downward.

C. There is no electric field in the cavity.

D. The electric field in the cavity is of varying magnitude and is zero at the exact center.

Answer: C

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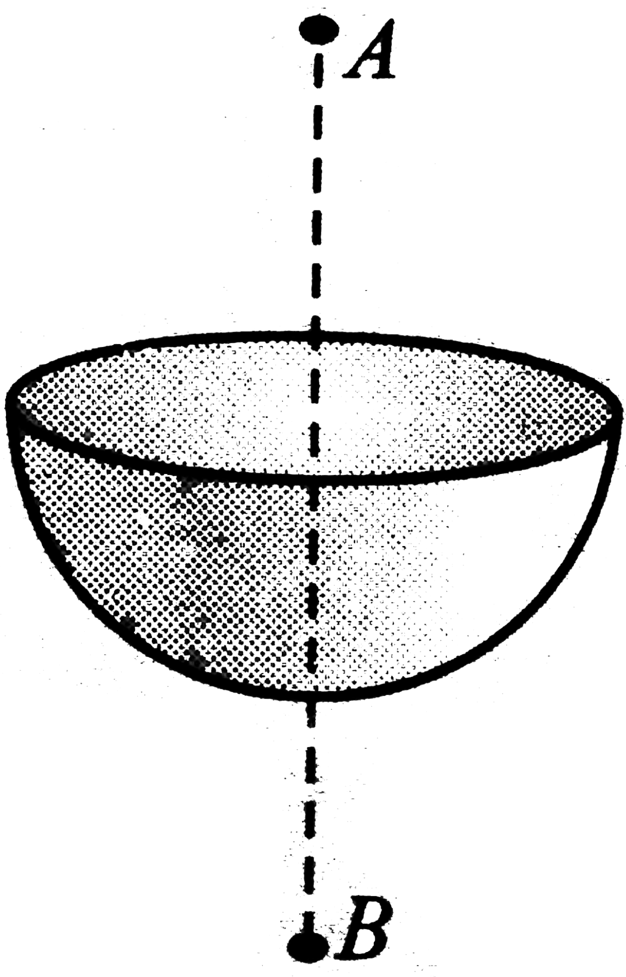
27. Figure shows a uniformly charged hemisphere of radius R. It has a volume charge density ρ. If the electric field at a point 2R, above the its center is E, then what is the electric field at the point 2R below its center?



A. $\rho R / 6\varepsilon_0 + E$

B. $\rho R / 12\varepsilon_0 - E$

C. $-\rho R / 6\varepsilon_0 + E$

D. $\rho R / 12\varepsilon_0 + E$

Answer: B

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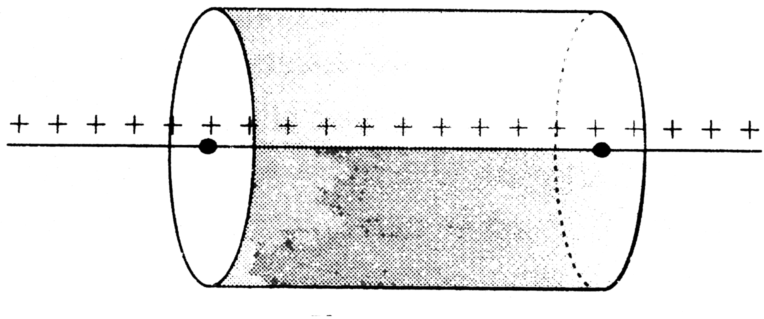
28. Consider an infinite line charge having uniform linear charge density and passing through the axis of a cylinder is removed.



A. decrease

B. increases

C. remains same

D. cannot say

Answer: A

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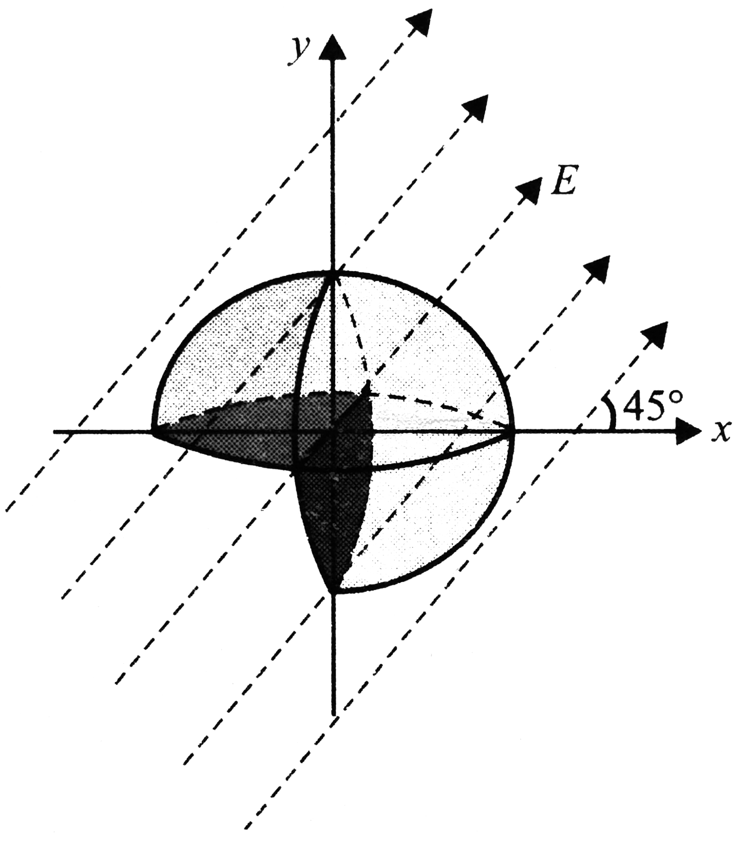
29. One-fourth of a sphere of radius R is removed as shown in figure. An electric field E exists parallel to the xy plane . Find the flux through the remaining curved part.



A. $\pi R^2 R$

B. $\sqrt{2}\pi R^2 E$

C. $\pi R^2 E / \sqrt{2}$

D. none of these

Answer: C

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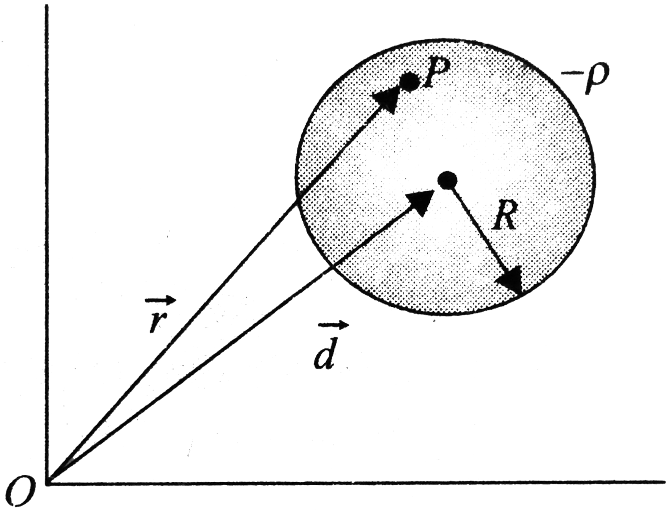
30. A nonconducting sphere of radius R is filled with uniform volume charge density $-\rho$. The center of this sphere is displaced from the origin by $\overrightarrow{d}$. The electric field $\overrightarrow{E}$ at any point P having position vector inside the sphere is



A. $\frac{\rho}{3\varepsilon_0}\vec{d}$

B. $\frac{\rho}{3\varepsilon_0}\left(\vec{r}-\vec{d}\right)$

C. $\frac{\rho}{3\varepsilon_0}\left(\vec{d}-\vec{r}\right)$

D. $\frac{\rho}{3\varepsilon_0}\left(\vec{r}\right)$

Answer: C

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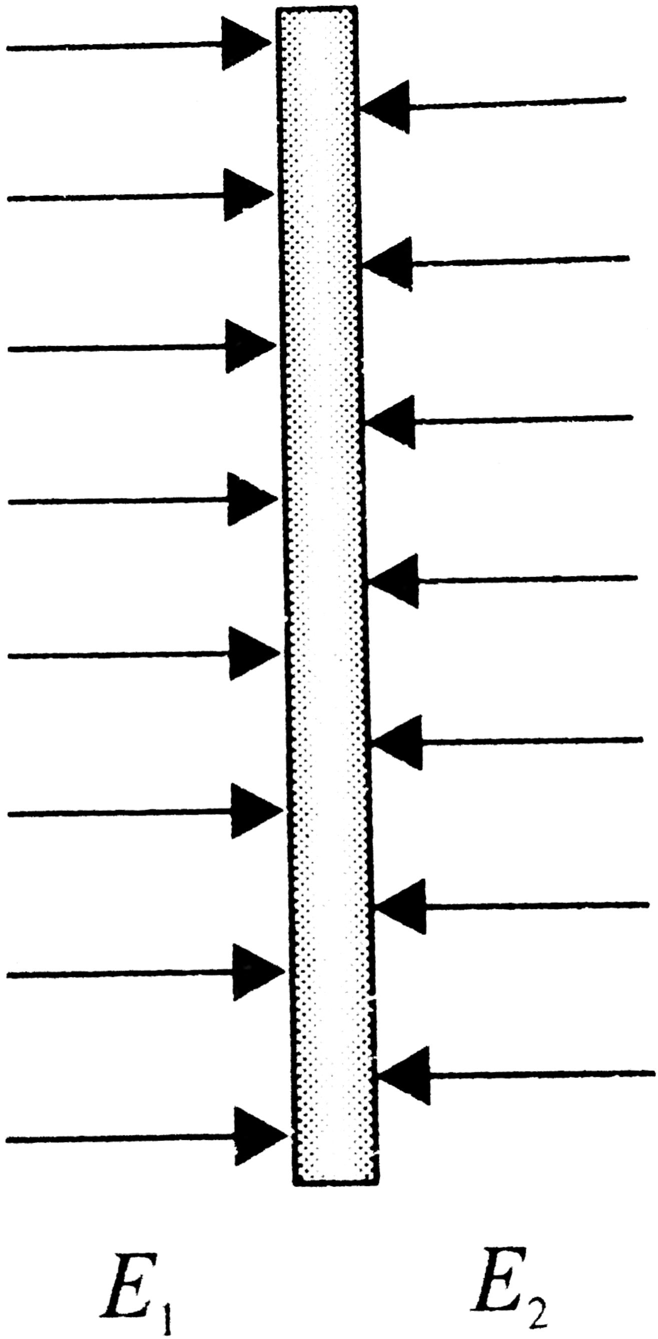
31. A large charged metal sheet is placed in a uniform electric field, perpendicular to the electric field lines. After placing the sheet into the field, the electric field on the left side of the sheet is $E_1 = 5 \times 10^5 Vm^{-1}$ and on the right it is $E_2 = 3 \times 10^5 Vm^{-1}$. The sheet experiences a net electric force of 0.08 N. Find the area of one face of the sheet. Assume the external field to remain constant after introducing the large sheet. Use

$$\left(\frac{1}{4\pi\varepsilon_0}\right) = 9 \times 10^9 Nm^2C^{-2}$$


E_1
E_2

A. $3.6\pi \times 10^{-2} m^2$

B. $0.9\pi \times 10^{-2} m^2$

C. $1.8\pi \times 10^{-2} m^2$

D. none

Answer: A

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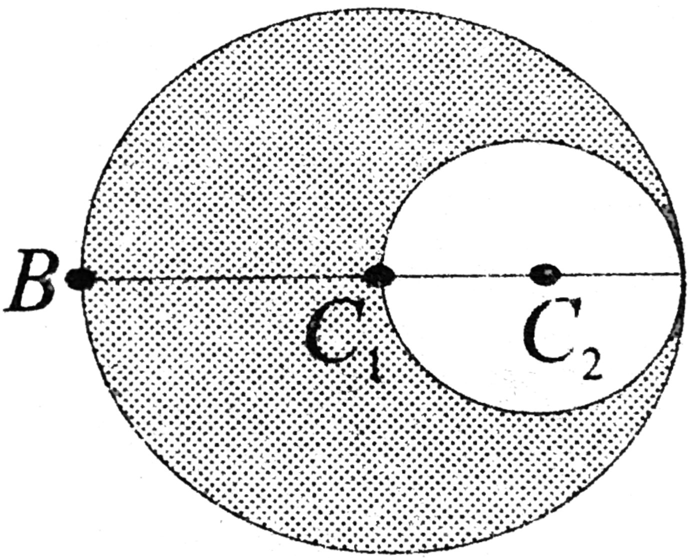
32. A positively charge sphere of radius r_0 carries a volume charge density ρ. A spherical cavity of radius $r_0/2$ is then scooped out and left empty. C_1 is the center of the sphere and C_2 that of the cavity. What is the direction and magnitude of the electric field at point B?



A. $\frac{17\rho r_0}{54\varepsilon_0}$ left

B. $\frac{\rho r_0}{6\varepsilon_0}$ left

C. $\frac{17\rho r_0}{54\varepsilon_0}$ right

D. $\frac{\rho r_0}{6\varepsilon_0}$ right

Answer: A

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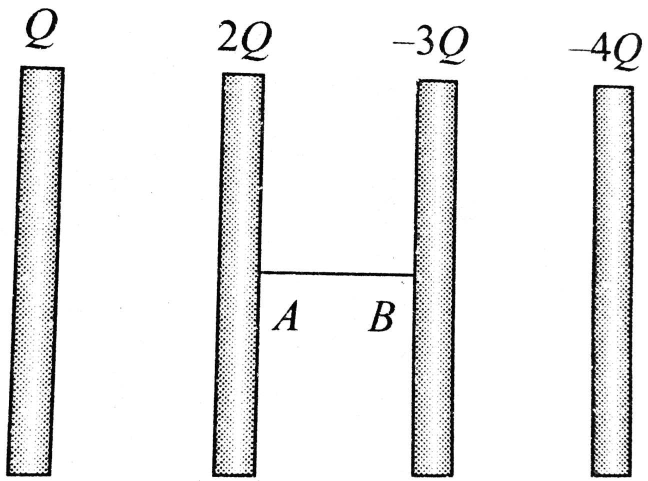
33. Four very large metal plates are given charges as shown in figure. The middle two are then connected through a wire. Find the charge that will flow through the wire.



A. $5QomA \rightarrow B$

B. $5Q / 2omA \rightarrow B$

C. $5QomB \rightarrow A$

D. no charge will flow

Answer: A

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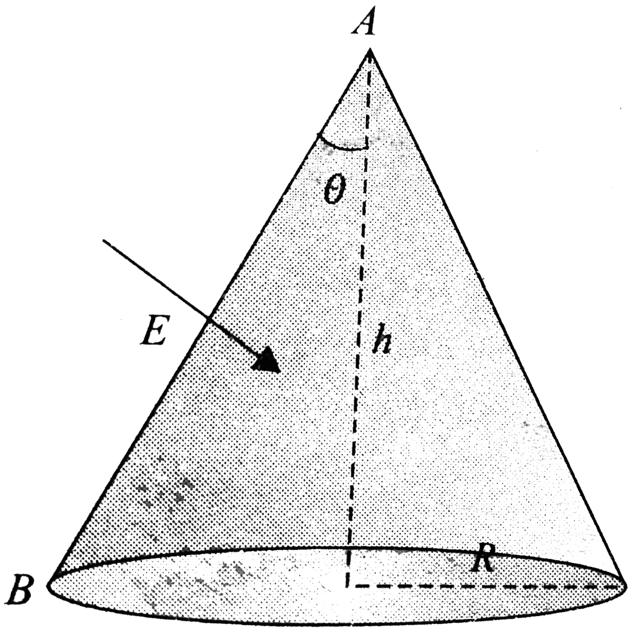
34. A conic surface is placed in a uniform electric field E as shown in figure. Such that the field is perpendicular to the surface on the side AB. The base of the cone is of radius R, and the height of the cone is h. The angle of the cone is θ.



Find the magnitude of the flux that enters the cone's curved surface from the left side. Do not count the outgoing flux ($\theta < 45^\circ$).

A. $ER[h\cos\theta + \pi(R/2)\sin\theta]$

B. $ER[h\cos\theta + \pi R/2\sin\theta]$

C. $ER[h\cos\theta + \pi R\sin\theta]$

D. none of these

Answer: A

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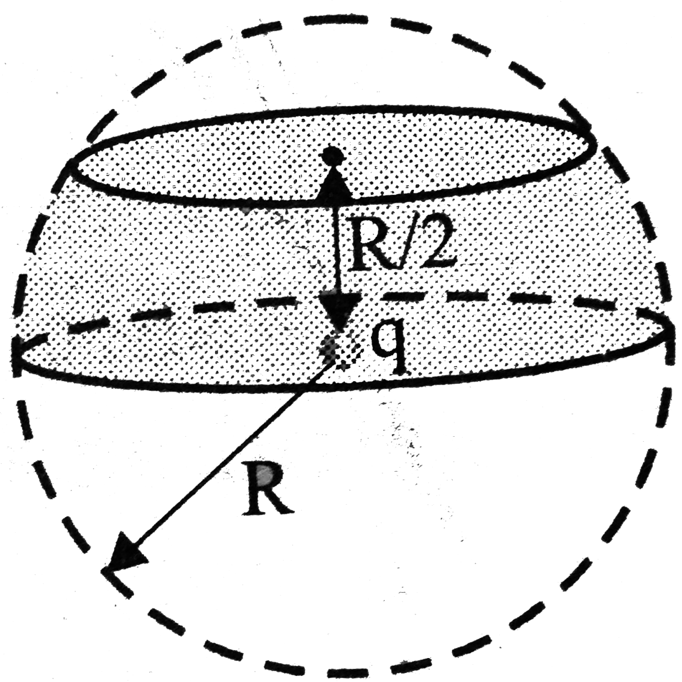
35. Flux passing through the shaded surface of a sphere when a point charge q is placed at the center is (radius of the sphere is R)



A. $\dfrac{q}{\varepsilon_0}$

B. $\dfrac{q}{2}\varepsilon_0$

C. $\dfrac{q}{4}\varepsilon_0$

D. zero

Answer: C

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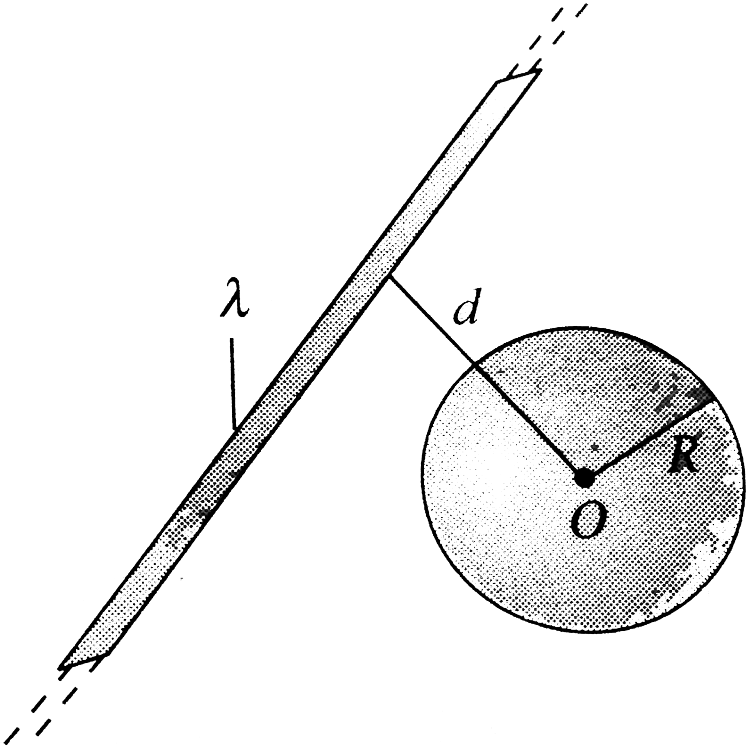
36. An infinitely long line charge having a uniform charge per unit length λ lies at a distance d from a point O as shown in figure. Determine the total electric flux through through the surface of a sphere of radius R centered at O resulting from this line charge. Consider both cases where

$R < d$ and $R > d$.



A. zero

B. $\frac{2\lambda R}{\varepsilon_0}$

C. $\frac{2\lambda\sqrt{R^2 - y^2}}{\varepsilon_0}$

D. $\frac{\lambda\sqrt{R^2 + y^2}}{\varepsilon_0}$

Answer: C

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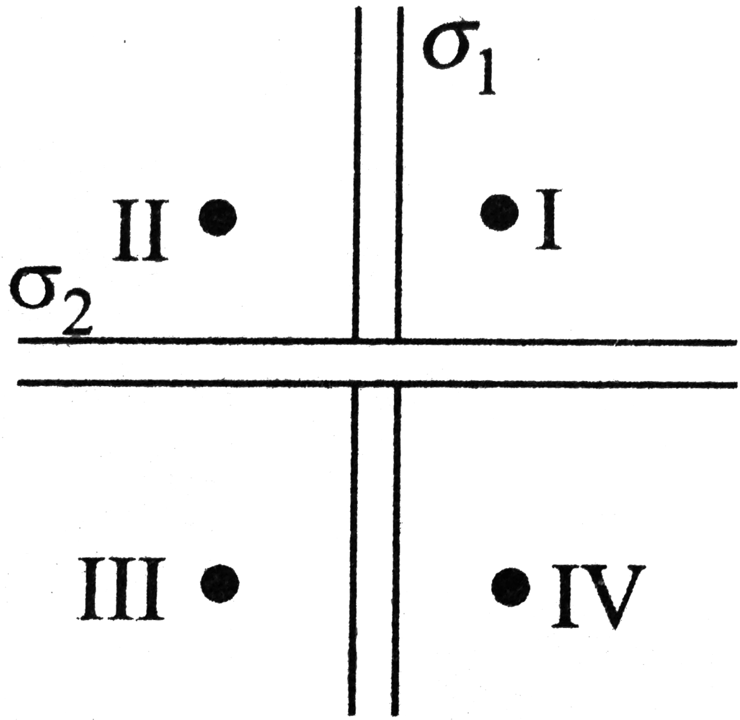
37. Two infinite sheets having charge densities σ_1 and σ_2 are placed in two perpendicular planes whose two-dimensional view is shown in figure. The charges are distributed uniformly on the sheets in electrostatic equilibrium condition. Four points are marked I, II, III and IV. The electric field intensities at these points are $\overrightarrow{E}_1, \overrightarrow{E}_2, \overrightarrow{E}_3$, and $\overrightarrow{E}_4$, respectively. The correct expression for the electric field intensities is



A. $\left|\vec{E}_1\right| = \left|\vec{E}_2\right| = \frac{\sqrt{\sigma_1^2 + \sigma_2^2}}{2\varepsilon_0} \neq \left|\vec{E}_4\right|$

B. $\left|\vec{E}_1\right| = \left|\vec{E}_4\right| = \frac{\sqrt{\sigma_1^2 + \sigma_2^2}}{2\varepsilon_0}$

C. $\left|\vec{E}_1\right| = \left|\vec{E}_2\right| = \left|\vec{E}_3\right| = \left|\vec{E}_4\right| = \frac{\sqrt{\sigma_1^2 + \sigma_2^2}}{2\varepsilon_0}$

D. none of these

Answer: C

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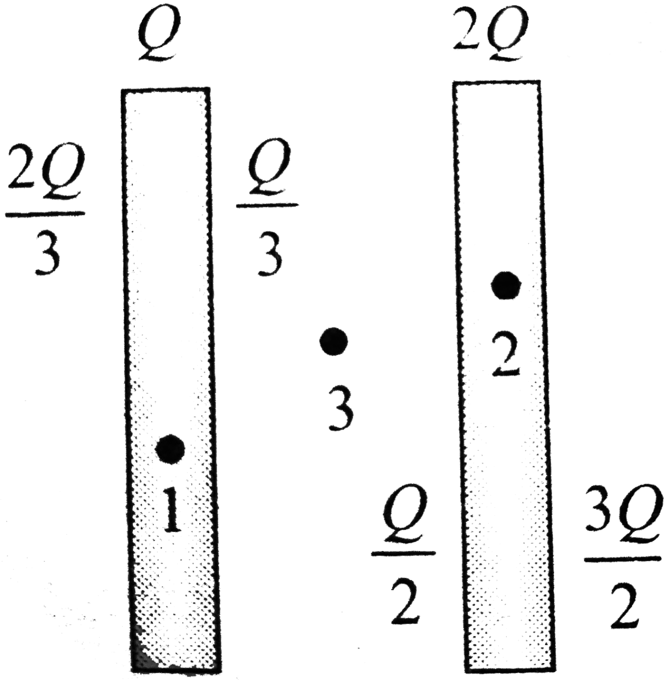
38. Two nonconducting infinite planes sheets having charges Q and 2Q are placed parallel to each other as shown in figure. The charge distribution on the four faces of the two plates is also shown. The electric field intensities at three points 1, 2, and 3 are $\overrightarrow{E}_1, \overrightarrow{E}_2,$ and $\overrightarrow{E}_3$, respectively. Then the magnitudes of $\overrightarrow{E}_1, \overrightarrow{E}_2,$ and $\overrightarrow{E}_3$ are, respectively (surface area of plates

) :



A. $zero, \frac{Q}{\varepsilon_0 S}, zero$

B. $\frac{5Q}{6\varepsilon_0 S}, \frac{Q}{2\varepsilon_0 S}, zero$

C. $\frac{5Q}{6\varepsilon_0 S}, \frac{Q}{2\varepsilon_0 S}, \frac{Q}{3\varepsilon_0 S}$

D. $zero, \frac{Q}{2\varepsilon_0 S}, zero$

Answer: B

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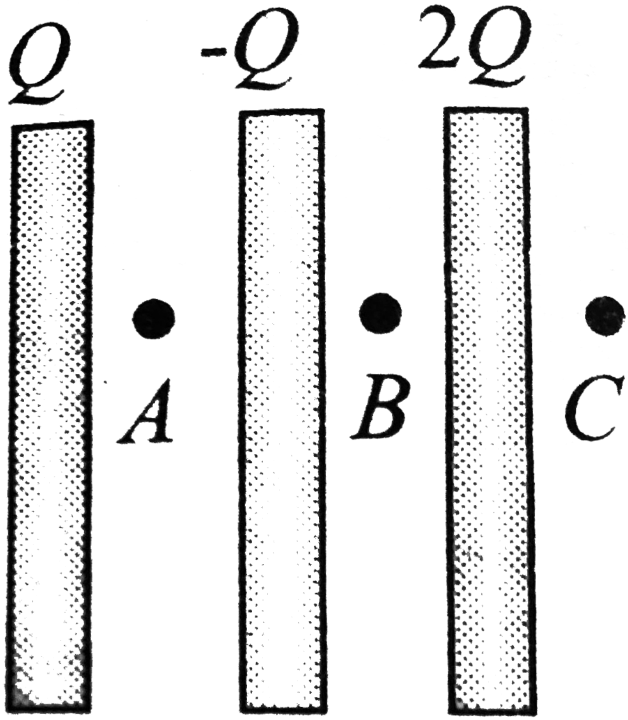
39. Three large identical conducting parallel plates carrying charge $+Q, -Q,$ and $+2Q$, respectively, are placed as shown in figure. If $E_A, E_b,$ and E_C refer to the magnitudes of the electric field at points A, B, and C, respectively. Then



A. $E_A > E_B > E_C$

B. $E_A = E_B > E_C$

C. $E_A = 0$ and $E_B > E_C$

D. $E_A = 0$ and $E_B = E_C$

Answer: D

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40. The number of electric field lines crossing an area $\Delta S is n_1 when \Delta \overrightarrow{S} \mid \mid \overrightarrow{E}$, while the number of field lines crossing the same area is n_2 when $\Delta \overrightarrow{E}$ makes an angles of 30° with $\overrightarrow{E}$. Then

A. $n_1 = n_2$

B. $n_1 > n_2$

C. $n_1$ltn_2

D. cannot say anything

Answer: B

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Multiple Correct

1. A 10 C charge is given to a conducting spherical shell, and a-3 C point charge is placed inside the shell. For this arrangement, find the correct statement(s).

A. The charge on the inner surface of the shell will be $+3C$, and it can be distributed uniformly or nonuniformly

B. The charge on the inner surface of the shell will be $+3C$, and it can be distributed would be uniform.

C. The net charge on the outer surface of the shell will be $\_\ 7C$, and its distribution can be uniform or nonuniform

D. The net charge on the outer surface of the shell will be $+7C$, and its distribution would be uniform.

Answer: A::D

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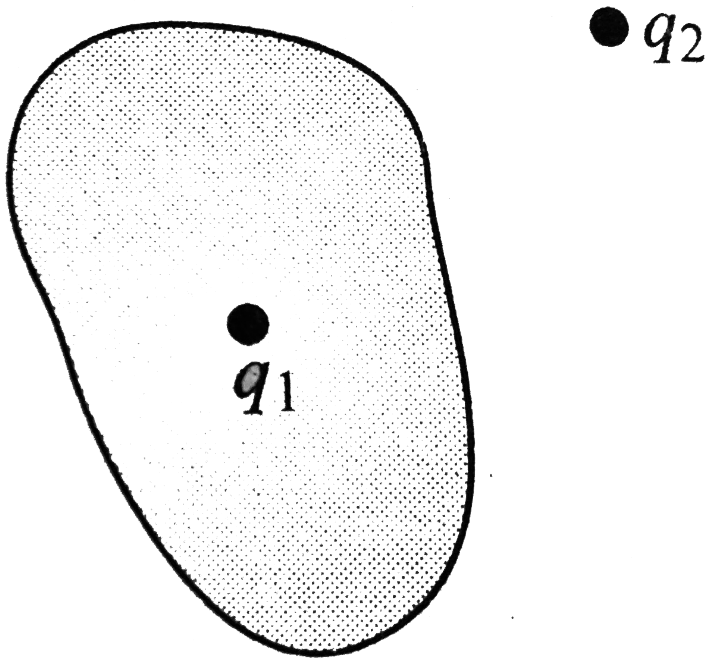
2. Consider Gauss's law

$$\oint \vec{E} \cdot \vec{d}\ s = \frac{q}{\varepsilon_0}$$

Then, for the situation shown in figure at the Gaussian surface



A. $\overrightarrow{E}\ due \rightarrow\ q_2$ would be zero.

B. $\overrightarrow{E}$ due to both q_1 and q_2 would not be zero

C. ϕ due to both q_1 and q_2 would not be zero.

D. ϕ due to q_2 would be zero.

Answer: B::D

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3. For Gauss's law, mark the correct statements (s).

A. If we displace the enclosed charges (within a Gaussian surface) without crossing the boundary, then both $\overrightarrow{E}$ and ϕ remain same.

B. If we displace the enclosed charges without crossing the boundary, then $\overrightarrow{E}$ changes but ϕ remains the same.

C. If the charge crosses the boundary, then both $\overrightarrow{E}$ and ϕ would change.

D. If we charge the boundary, then ϕ changes but $\overrightarrow{E}$ remians the same.

Answer: B::C

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4. Consider a Gaussian spherical surface covering a dipole of charge q and -q, then

A. $q_{\in} = 0$ (net charge enclosed by the spherical surface)

B. $\phi_{\neq t} = 0$ (net flux coming out the spherical surface)

C. $E = 0$ at all points on the spherical surface.

D. $\int \overrightarrow{E} \cdot d\overrightarrow{s}$ = 0 (surface integral of over the spherical surface)

Answer: A::B::D

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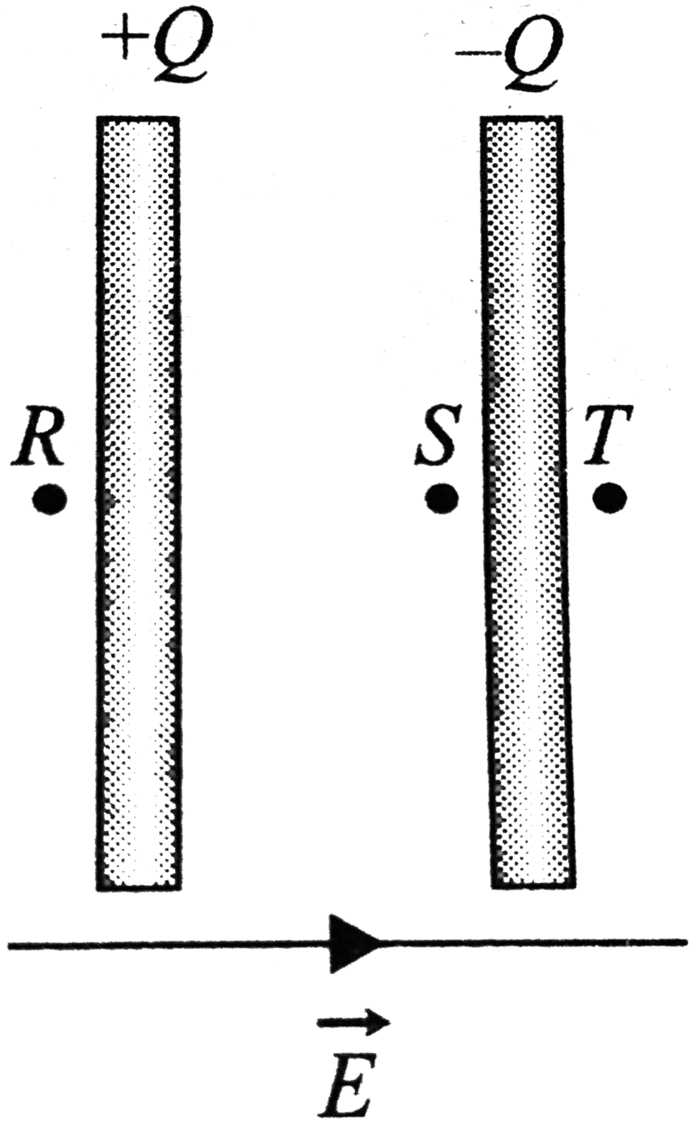
5. Two large thin conducting plates with a small gap in between are placed in a uniform electric field E (perpendicular to the plates.)The area of each plate is A, and charges $+Q$ and $-Q$ are given to these plates as shown in figure. If R,S, and T are three points in space, then the



A. field at point R is E

B. field at point S is E

C. field at point T is $\left(E + \frac{Q}{A\varepsilon_0}\right)$

D. field at point S is $\left(E + \frac{Q}{A\varepsilon_0}\right)$

Answer: A::D

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

A. If Q_1 changes, both E and ϕ will change.

B. If Q_2 changes, E will changes but ϕ will not change.

C. If $Q_1 = 0 \text{ and } Q_2 \neq 0$, then $E \neq 0 but \phi = 0$

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

Answer: A::B::C

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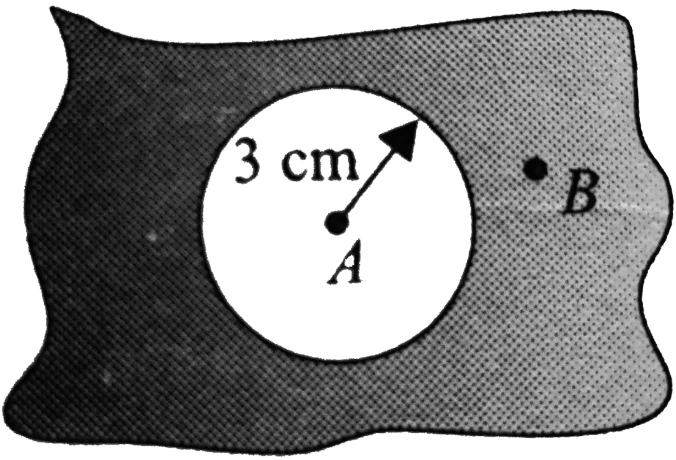
7. Figure shows a point charge of 0.5×10^{-6} C at the center of the spherical cavity of radius 3 cm of a piece of metal. The electric field at



A. A (2 cm from the charge) is 0.

B. A (2 cm from the charge) is $1.125 \times 10^7 NC^{-1}$

C. B (5 cm from the charge) is 0

D. B (5 cm from the charge) is $1.8 \times 10^6 NC^{-1}$

Answer: B::C

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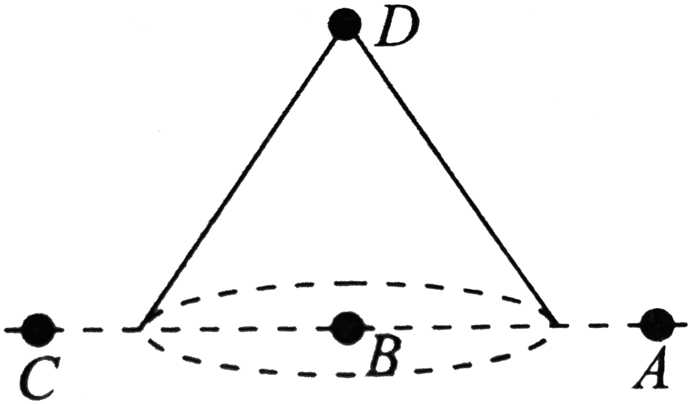
8. A right circular imaginary cone is shown in figure A, B, and C are the points in the plane containing the base of the cone, while D is the point at the vertex of the cone. If ϕ_A, ϕ_B, ϕ_C and ϕ_D represent the fulx through the curved surface of the cone when a point charge Q is at points A, B, C, and D. respectively. then.



A. $\phi_A = \phi_C \neq 0$

B. $\phi_D \neq 0$

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

D. $\phi_A = \phi_C = \phi_D = 0$

Answer: C::D

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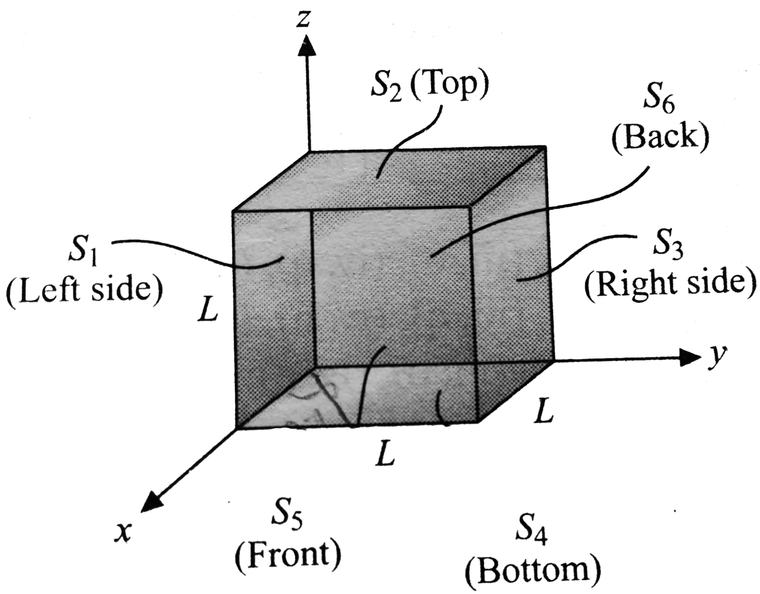
Comprehension

1. The cube shown in Fig. 2.119 has sides of length $L = 10.0cm$. The electric field is uniform , has a magnitude $E = 4.00 \times 10^3 NC^{-1}$ and is parallel to the xy plane at an angle of 37° measured from the $+x - a\xi s$ toward the $+y - a\xi s$.



The surface that have zero flux are

A. S_1 and S_3

B. S_5 and S_6

C. S_2 and S_4

D. S_1 and S_1

Answer: C

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2. The cube shown in Fig. 2.119 has sides of length $L = 10.0cm$. The electric field is uniform, has a magnitude $E = 4.00 \times 10^3 NC^{-1}$ and is parallel to the xy plane at an angle of 37° measured from the $+x - a\xi s$ toward the $+y - a\xi s$.

Electric flux passing through surface S_1 is

A. $-24Nm^2C^{-1}$

B. $24Nm^2C^{-1}$

C. $32Nm^2C^{-1}$

D. $-32Nm^2C^{-1}$

Answer: A

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3. The cube shown in Fig. 2.119 has sides of length $L = 10.0cm$. The electric field is uniform , has a magnitude $E = 4.00 \times 10^3 NC^{-1}$ and is parallel to the

xy plane at an angle of 37° measured from the $+x-a\xi s$ toward the $+y-a\xi s$.

Electric flux passing through surface S_6 is

A. $-24Nm^2C^{-1}$

B. $-24Nm^2C^{-1}$

C. $32Nm^2C^{-1}$

D. $-32Nm^2C^{-1}$

Answer: D

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4. The cube shown in Fig. 2.119 has sides of length $L = 10.0cm$. The electric field is uniform , has a magnitude $E = 4.00 \times 10^3 NC^{-1}$ and is parallel to the xy plane at an angle of 37° measured from the $+x - a\xi s$ toward the $+y - a\xi s$.

The total net electric flux through all faces of the cube is

A. $8Nm^2C^{-1}$

B. $-8Nm^2C^{-1}$

C. $24Nm^2C^{-1}$

D. zero

Answer: D

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5. A cube has sides of length $L = 0.300m$. It is placed with one corner at the origin (refer to Fig.2.119).The electric field is not uniform but is given by $\overrightarrow{E} = \left(-5.00NC^{-1}\right)x\hat{i} + \left(3.00NC^{-1}\right)z\hat{k}$.

The flux passing through the surface S_5 will be

A. $S_2, S_4, \text{ and } S_5$

B. $S_1, S_3, S_4, \text{ and } S_6$

C. $S_1, S_2, \text{ and } S_3$

D. $S_2, S_3, \text{ and } S_4$

Answer: B

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6. A cube has sides of length $L = 0.300m$. It is placed with one corner at the origin (refer to Fig.2.119).The electric field is not uniform but is given by $\overrightarrow{E} = (-5.00NC^{-1})x\hat{i} + (3.00NC^{-1})z\hat{k}$.

The flux passing through the surface S_5 will be

A. $-0.135Nm^2C^{-1}$

B. $-0.054Nm^2C^{-1}$

C. $0.081Nm^2C^{-1}$

D. $0.054Nm^2C^{-1}$

Answer: A

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7. A cube has sides of length $L = 0.300m$. It is placed with one corner at the origin (refer to Fig.2.119).The electric field is not uniform but is given by $\vec{E} = (-5.00NC^{-1})x\hat{i} + (3.00NC^{-1})z\hat{k}$.

The flux passing through the surface S_5 will be

A. $-0.135Nm^2C^{-1}$

B. $-0.054Nm^2C^{-1}$

C. $0.081Nm^2C^{-1}$

D. zero

Answer: B

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8. A cube has sides of length $L = 0.300m$. It is placed with one corner at the origin (refer to Fig.2.119).The electric field is not uniform but is given by $\vec{E} = (-5.00NC^{-1})x\hat{i} + (3.00NC^{-1})z\hat{k}$.

The total electric charge inside the cube is

A. $-0.054\varepsilon_0 C$

B. $0.081\varepsilon_0 C$

C. $0.135\varepsilon_0 C$

D. $0.054\varepsilon_0 C$

Answer: A

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9. A cube has sides of length L. It is placed with one corner at the origin (refer to Fig.2.119). The electric field is uniform and given by $\overrightarrow{€} = -B\hat{i} + C\hat{j} - D\hat{k}$, where $B, C,$ and D are positive constants.

The total flux passing through the cube is

A. $(B + C + D)L^2$

B. $2(B + C + D)L^2$

C. $6(B + C + D)L^2$

D. zero

Answer: D

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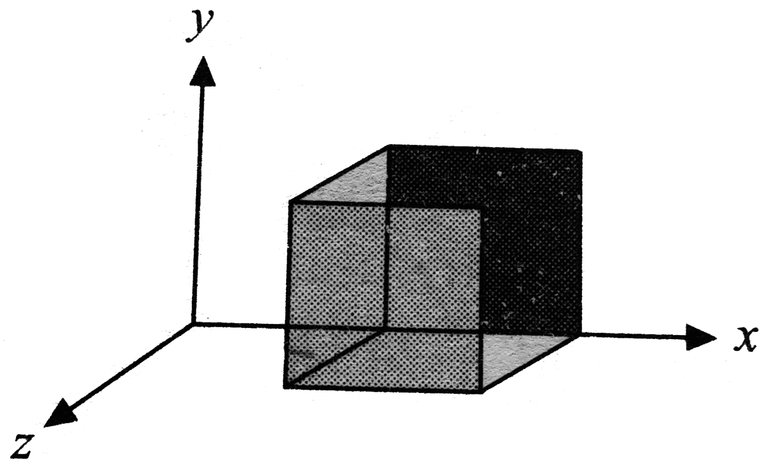
10. A cube of side a is placed such that the nearest face , which is parallel to the yz plane , is at a distance a from the origin . The electric field components are

$E_x = \alpha x^{1/2}, E_y = E_z = 0.$

The flux ϕ_E through the cube is



A. $2\sqrt{2}\alpha a^{5/2}$

B. $\alpha a^{5/2}$

C. $\left(\sqrt{2}-1\right)\alpha a^{5/2}$

D. zero

Answer: C

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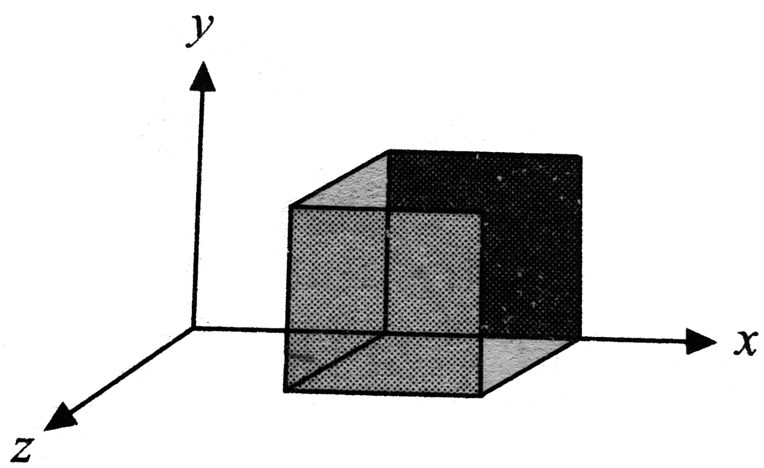
11. A cube of side a is placed such that the nearest face , which is parallel to the yz plane , is at a distance a from the origin . The electric field components are

$E_x = \alpha x^{1/2}, E_y = E_z = 0.$

The charge within the cube is



A. $\sqrt{2}\alpha\varepsilon_0 a^{5/2}$

B. $\alpha\varepsilon_0 a^{5/2}$

C. $(\sqrt{2}-1)\alpha\varepsilon_0 a^{5/2}$

D. zero

Answer: C

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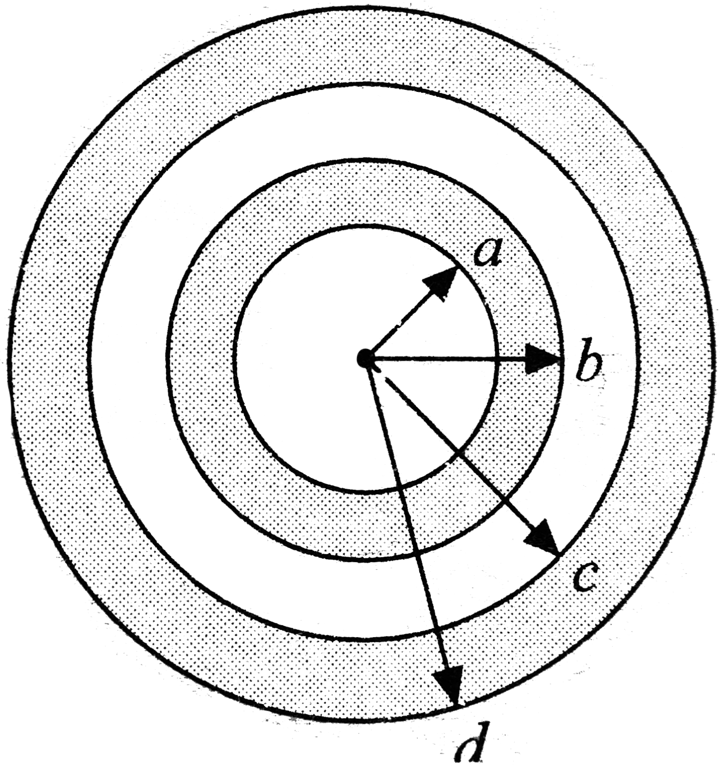
12. A small conducting spherical shell with inner radius a and outer radius b is concentric with a larger conducting spherical shell with inner radius c and outer radius d (as shown in Fig . 2.121). The inner shell has a total charge $+2q$, and the outer shell has a total charge $+4q$. Calculate the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



$r < a$

A. zero

B. $\frac{1}{4\pi\varepsilon_0}\frac{2q}{r^2}$

C. $-\frac{1}{4\pi\varepsilon_0}\frac{6q}{r^2}$

D. $\frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$

Answer: A

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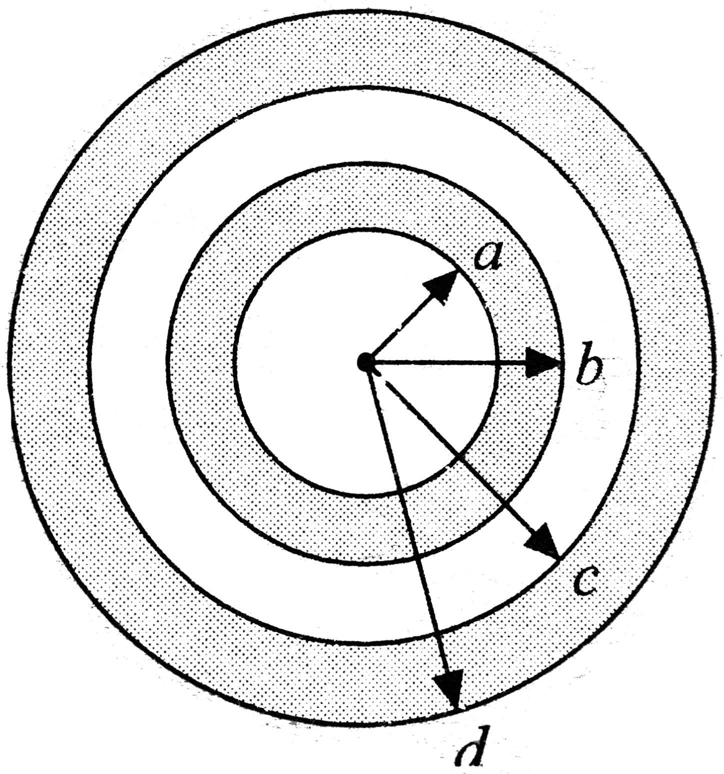
13. A small conducting spherical shell with inner radius a and outer radius b is concentric with a larger conducting spherical shell with inner radius c and outer radius d (as shown in Fig . 2.121). The inner shell has a total charge $+2q$, and the outer shell has a total charge $+4q$. Calculate the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



$a < r < b$

A. zero

B. $\frac{1}{4\pi\varepsilon_0}\frac{2q}{r^2}$

C. $-\frac{1}{4\pi\varepsilon_0}\frac{6q}{r^2}$

D. (1)/(4 pi epsilon_(0)) (q)/(r^(2))`

Answer: A

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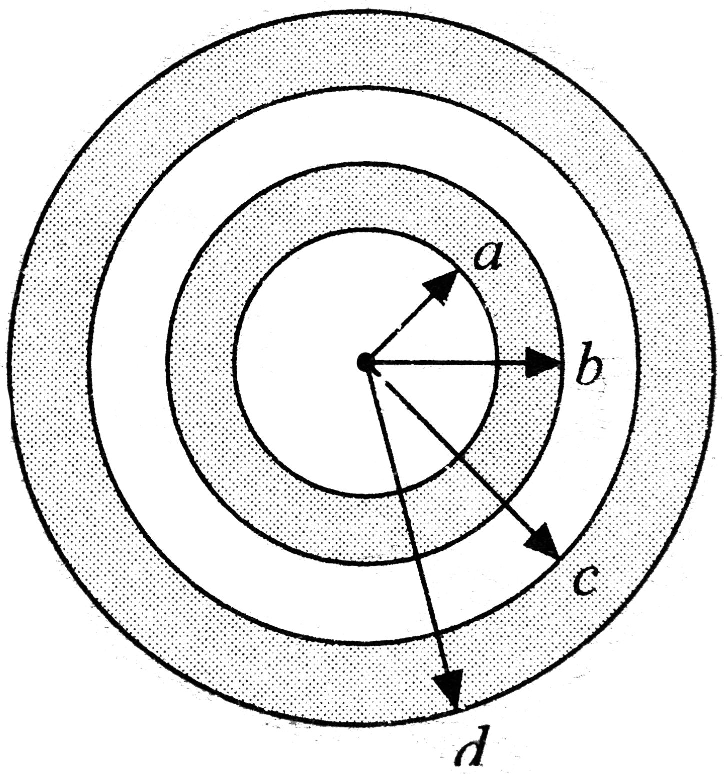
14. A small conducting spherical shell with inner radius a and outer radius b is concentric with a larger conducting spherical shell with inner radius c and outer radius d (as shown in Fig . 2.121). The inner shell has a total charge $+2q$, and the outer shell has a total charge $+4q$. Calculate the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



$b < r < c$

A. zero

B. $\frac{1}{4\pi\varepsilon_0}\frac{2q}{r^2}$

C. $-\frac{1}{4\pi\varepsilon_0}\frac{6q}{r^2}$

D. $\frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$

Answer: B

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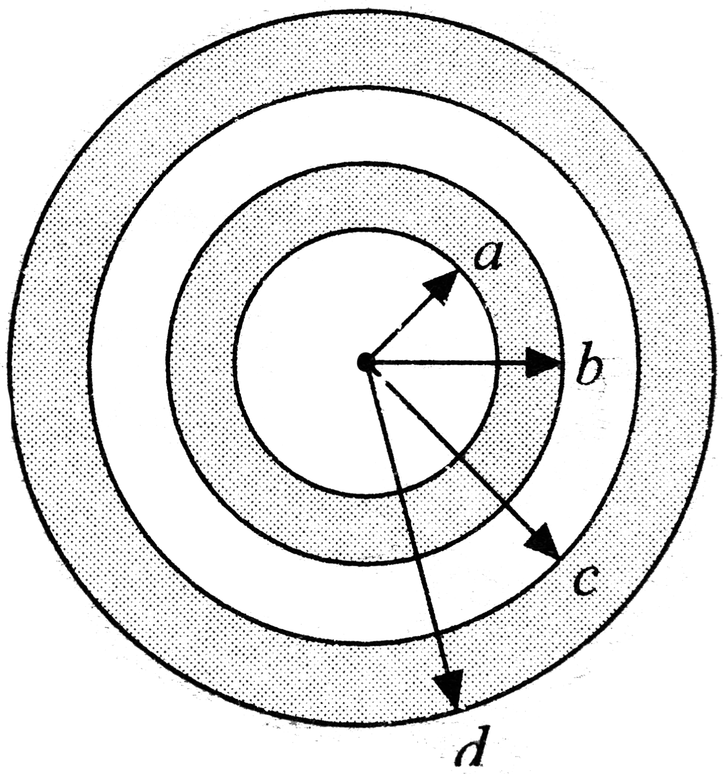
15. A small conducting spherical shell with inner radius a and outer radius b is concentric with a larger conducting spherical shell with inner radius c and outer radius d (as shown in Fig . 2.121). The inner shell has a total charge $+2q$, and the outer shell has a total charge $+4q$. Calculate the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



$c < r < d$

A. zero

B. $\frac{1}{4\pi\varepsilon_0}\frac{2q}{r^2}$

C. $-\frac{1}{4\pi\varepsilon_0}\frac{6q}{r^2}$

D. $\frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$

Answer: A

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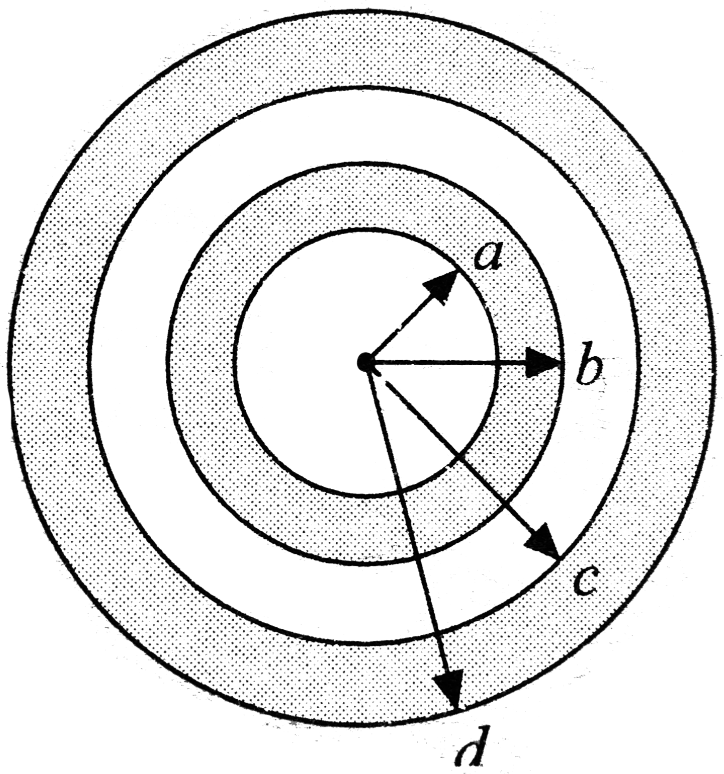
16. A small conducting spherical shell with inner radius a and outer radius b is concentric with a larger conducting spherical shell with inner radius c and outer radius d (as shown in Fig . 2.121). The inner shell has a total charge $+2q$, and the outer shell has a total charge $+4q$. Calculate the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



$r < a$

A. zero

B. $\frac{1}{4\pi\varepsilon_0}\frac{2q}{r^2}$

C. $-\frac{1}{4\pi\varepsilon_0}\frac{6q}{r^2}$

D. $\frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$

Answer: C

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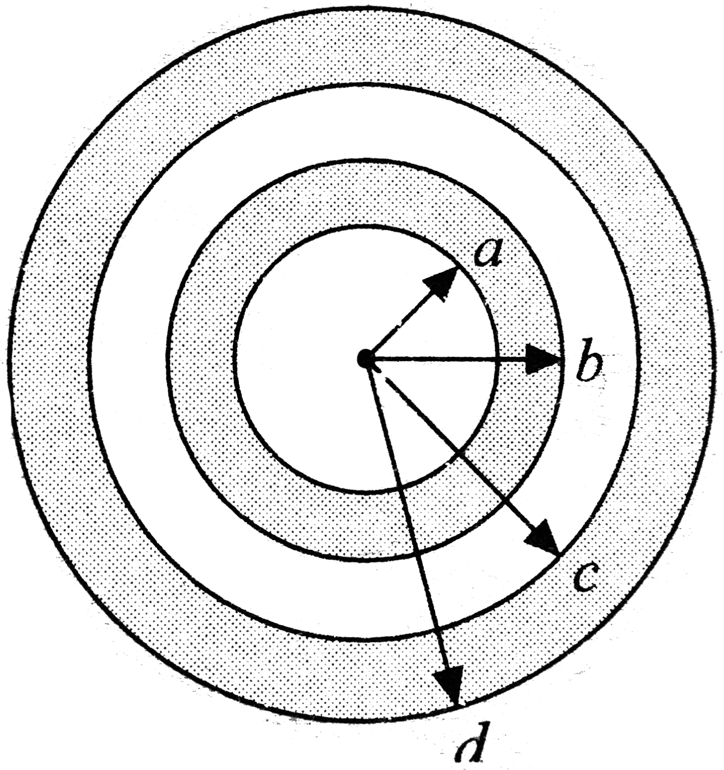
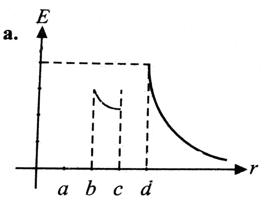
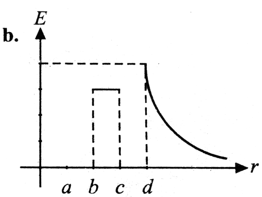
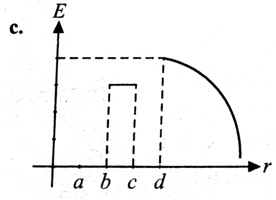
17. A small conducting spherical shell with inner radius a and outer radius b is concentric with a larger conducting spherical shell with inner radius c and outer radius d (as shown in Fig . 2.121). The inner shell has a total charge $+2q$, and the outer shell has a total charge $+4q$. Calculate the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

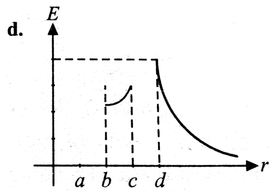


$r < a$

A. 

B. 

C. 

D. 

Answer: A

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18. Consider the previous problem , let the outer shell have the charge $-4q$. As in the above problem , the inner shell has the charge $+2q$. Calculate the electric field in terms of q and the distance r from the common center of the two shells for

$r < a$

A. zero

B. $\frac{1}{4\pi\varepsilon_0}\frac{2q}{r^2}$

C. $-\frac{1}{4\pi\varepsilon_0}\frac{2q}{r^2}$

D. $\frac{1}{4\pi\varepsilon_0}\frac{6q}{r^2}$

Answer: A

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19. Consider the previous problem , let the outer shell have the charge $-4q$. As in the above problem , the inner shell has the charge $+2q$. Calculate the electric field in terms of

q and the distance r from the common center of the two shells for

$a < r < b$

A. zero

B. $\frac{1}{4\pi\varepsilon_0}\frac{2q}{r^2}$

C. $-\frac{1}{4\pi\varepsilon_0}\frac{2q}{r^2}$

D. $\frac{1}{4\pi\varepsilon_0}\frac{6q}{r^2}$

Answer: A

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20. Consider the previous problem , let the outer shell have the charge $-4q$. As in the above problem , the inner shell has the charge $+2q$. Calculate the electric field in terms of q and the distance r from the common center of the two shells for

$b < r < c$

A. zero

B. $\frac{1}{4\pi\varepsilon_0}\frac{2q}{r^2}$

C. $-\frac{1}{4\pi\varepsilon_0}\frac{2q}{r^2}$

D. $\frac{1}{4\pi\varepsilon_0}\frac{6q}{r^2}$

Answer: B

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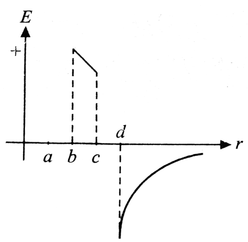
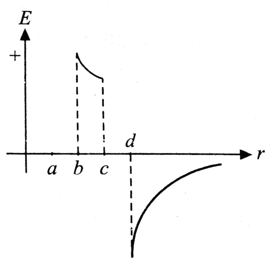
21. Consider the previous problem , let the outer shell have the charge $-4q$. As in the above problem , the inner shell has the charge $+2q$. Calculate the electric field in terms of q and the distance r from the common center of the two shells for

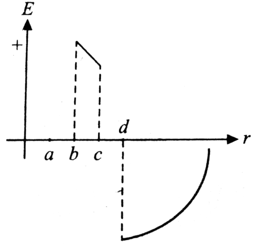
The graph of the radial component of E as function of r will be

A. 

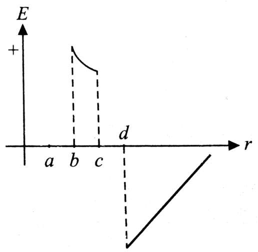
(a)

B. 

(b)

C. 

(c)

D. 

(d)

Answer: B

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22. Consider the previous problem , let the outer shell have the charge $-4q$. As in the above problem , the inner shell has the charge $+2q$. Calculate the electric field in terms of q and the distance r from the common center of the two shells for

$c < r < d$

A. zero

B. $\frac{1}{4\pi\varepsilon_0}\frac{2q}{r^2}$

C. $-\frac{1}{4\pi\varepsilon_0}\frac{2q}{r^2}$

D. $\frac{1}{4\pi\varepsilon_0}\frac{6q}{r^2}$

Answer: A

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23. Consider the previous problem , let the outer shell have the charge $-4q$. As in the above problem , the inner shell has the charge $+2q$. Calculate the electric field in terms of q and the distance r from the common center of the two shells for

A. zero

B. $\frac{1}{4\pi\varepsilon_0}\frac{2q}{r^2}$

C. $-\frac{1}{4\pi\varepsilon_0}\frac{2q}{r^2}$

D. $\frac{1}{4\pi\varepsilon_0}\frac{6q}{r^2}$

Answer: C

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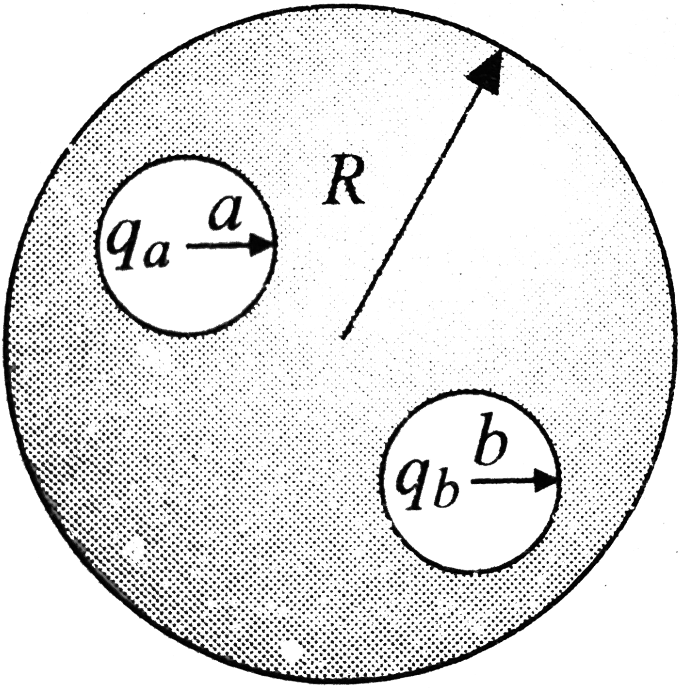
24. Two spherical cavities of radii a and b are hollowed out from the interior of a neutral conducting sphere of radius R. At the center of each cavity , a point charge is placed .

Call these charges q_a and q_b.

The electric field at a distance r outside the conductor is



A. $\frac{1}{4\pi\varepsilon_0}\frac{q_b}{r^2}$

B. zero

C. $\frac{1}{4\pi\varepsilon_0}\frac{q_a+q_b}{r^2}$

D. $\frac{1}{4\pi\varepsilon_0}\frac{q_a}{r^2}$

Answer: C

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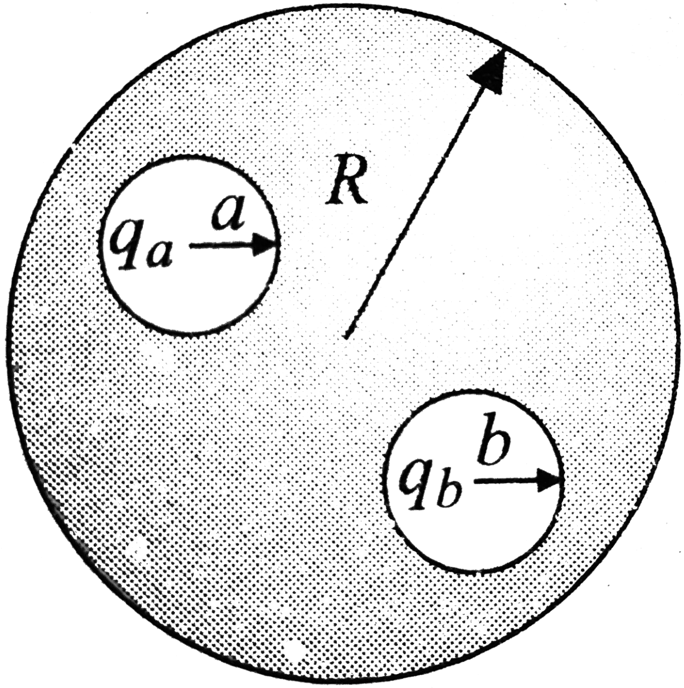
25. Two spherical cavities of radii a and b are hollowed out from the interior of a neutral conducting sphere of radius R. At the center of each cavity , a point charge is placed . Call these charges q_a and q_b.

The electric field inside the cavity of radius a at a distance

r from the center of cavity is



A. $\frac{1}{4\pi\varepsilon_0}\frac{q_a}{r^2}$

B. $\frac{1}{4\pi\varepsilon_0}\frac{q_a}{r^2}$

C. $\frac{1}{4\pi\varepsilon_0}\frac{q_a+q_b}{r^2}$

D. zero

Answer: A

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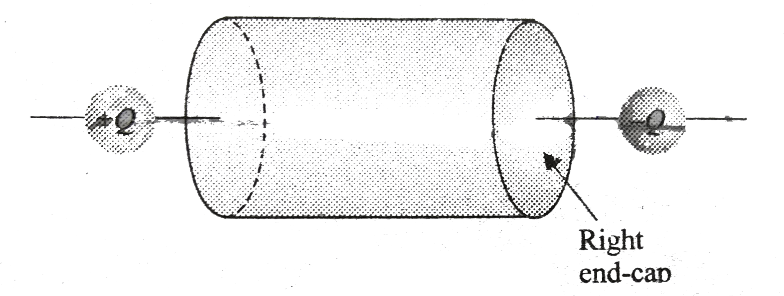
26. Positive and negative charges of equal magnitude lie along the symmetry axis of a cylinder. The distance from the positive charge to the left - end cap of the cylinder is the same as the distance from the negative charge to the right - end cap.



What is the flux of the electric field through the closed cylinder ?

A. zero

B. $+Q/\varepsilon_0$

C. $+2Q/\varepsilon_0$

D. $-Q/\varepsilon_0$

Answer: A

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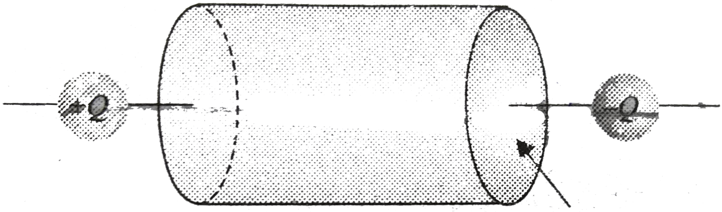
27. Positive and negative charges of equal magnitude lie along the symmetry axis of a cylinder. The distance from the positive charge to the left - end cap of the cylinder is the same as the distance from the negative charge to the right - end cap.



What is the flux of the electric field through the closed cylinder ?

A. Positive

B. Negative

C. There is no flux through the right - end cap.

D.

Answer: A

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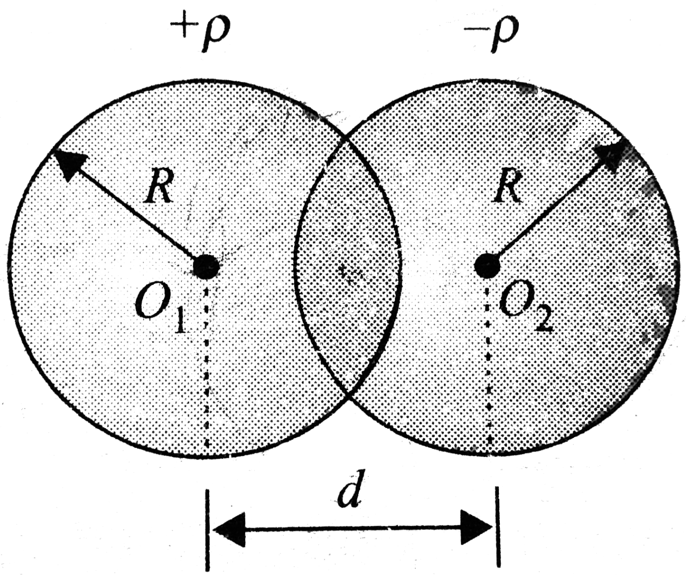
28. There are two nonconducting spheres having uniform volume charge densities ρ and $-\rho$. Both spheres have equal radius R. The spheres are now laid down such that they overlap as shown in Fig.2.125. Take $\vec{d} = \overrightarrow{O_1O_2}$.



The electric field $\vec{E}$ in the overlapped region is

A. nonuniform

B. zero

C. $\frac{\rho}{3\varepsilon_0}\vec{d}$

D. $\frac{-\rho}{3\varepsilon_0}\vec{d}$

Answer: C

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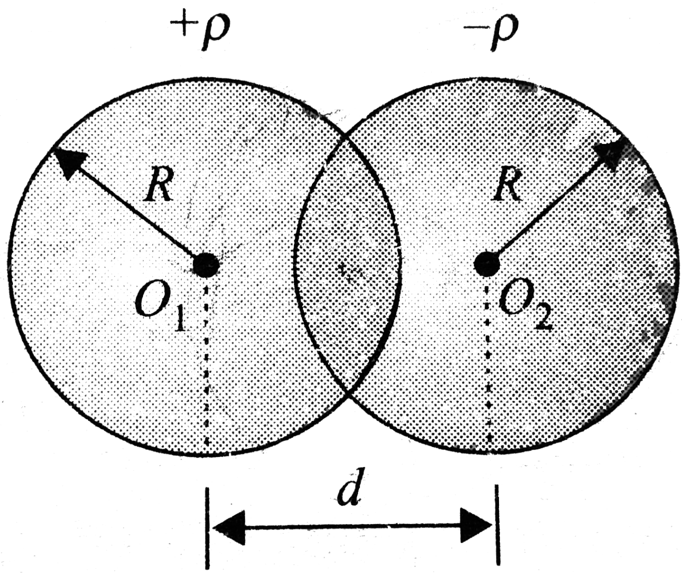
29. There are two nonconducting spheres having uniform volume charge densities ρ and $-\rho$. Both spheres have equal radius R. The spheres are now laid down such that they overlap as shown in Fig.2.125. Take $\vec{d} = \overrightarrow{O_1O_2}$.



The potential difference ΔV between the centres of the two spheres for $d = R$ is

A. $\frac{\rho}{3\varepsilon_0} d^2$

B. $\frac{\rho}{\varepsilon_0} \overrightarrow{d^2}$

C. zero

D. $\frac{2\rho}{\varepsilon_0} d^2$

Answer: A

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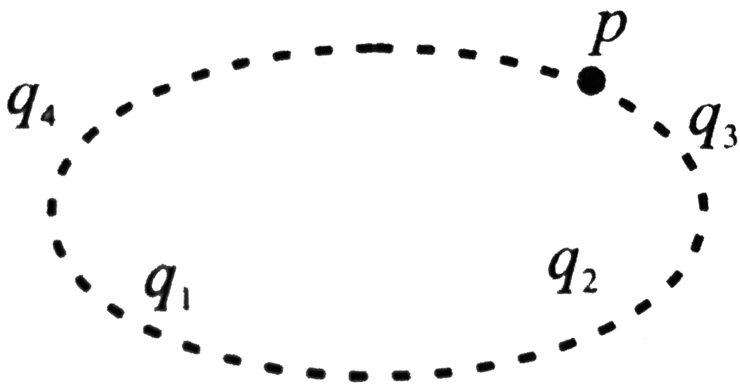
30. Gauss's law and Coulomb's law , although expressed in different forms , are equivalent ways of describing the relation between charge and electric field in static conditions . Gauss's law is $\varepsilon_0 \phi = q_{encl}$,when $q(encl)$ is the net charge inside an imaginary closed surface called Gaussian surface. The two equations hold only when the net charge is in vaccum or air .

A Gaussian surface encloses two of the four positively charged particles. The particles that contribute to the electric field at a point P on the surface are



A. q_1 and q_2

B. q_2 and q_3

C. q_4 and q_3

D. q_1, q_2, q_3 and q_4

Answer: D

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31. Gauss's law and Coulomb's law , although expressed in different forms , are equivalent ways of describing the relation between charge and electric field in static conditions . Gauss's law is $\varepsilon_0 \phi = q_{encl}$,when q_{encl} is the net charge inside an imaginary closed surface called Gaussian surface. The two equations hold only when the net charge is in vaccum or air .

The net flux of the electric field through the surface is

A. due to q_1 and q_2 only

B. due to q_3 and q_4 only

C. equal due to all the four charges

D. cannot say

Answer: A

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32. Gauss's law and Coulomb's law , although expressed in different forms , are equivalent ways of describing the relation between charge and electric field in static conditions . Gauss's law is $\varepsilon_0 \phi = q_{encl}$,when $q(encl)$ is the net charge inside an imaginary closed surface called Gaussian surface. The two equations hold only when the net charge is in vaccum or air .

The net flux of the electric field through the surface due to q_3 and q_4 is

A. zero

B. positive

C. negative

D. cannot say

Answer: A

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33. Gauss's law and Coulomb's law , although expressed in different forms , are equivalent ways of describing the relation between charge and electric field in static conditions . Gauss's law is $\varepsilon_0 \phi = q_{encl}$,when $q(encl)$ is the net charge inside an imaginary closed surface called Gaussian surface. The two equations hold only when the net charge is in vaccum or air .

If the charge q_3 and q_4 are displaced (always remaining outside the Gaussian surface), then consider the following two statements :

A: Electric field at each point on the Gaussian surface will remain same .

B: The value of $\oint \vec{E} \cdot d\vec{A}$ for the Gaussian surface will remain same.

A. Both A and B are true .

B. Both A and B are false.

C. A is true , but b is false.

D. B is true , but A is false.

Answer: D

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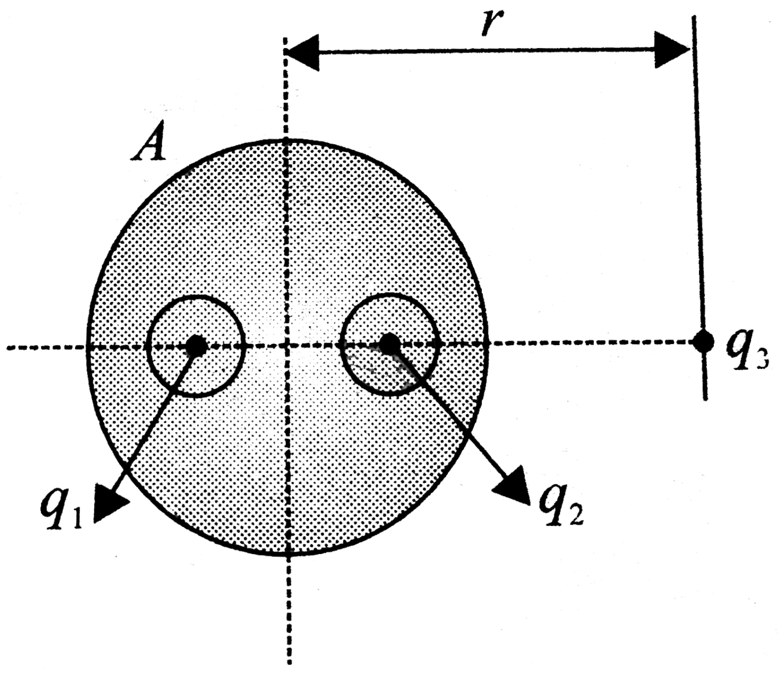
34. A spherical conductor A contains two spherical cavities as shown in Fig.2.127. The total charge on conductor itself is zero . However , there is a point charge q_1 at the center of one cavity and q_2 at the center of the other cavity . Another charge q_3 is placed at a large distance r from the center of the spherical conductor.



Which of the following statements are true ?

A. Charge q_3 applies a larger force on the charge q_2 than on charge q_1.

B. Charge q_3 applies a smaller force on the charge q_2 than on charge q_1.

C. Charge q_3 applies equal force on both the charges.

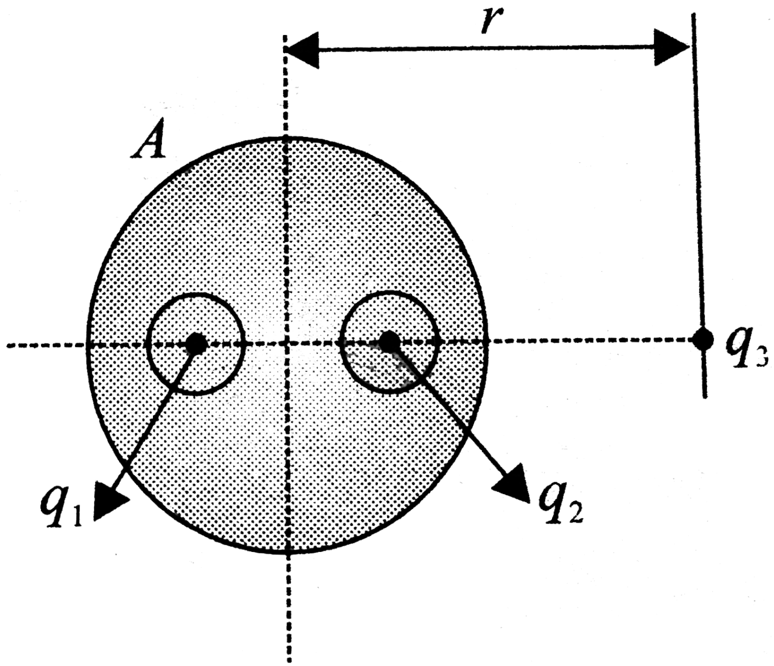
D. Charge q_3 applies no force on any of the charges.

Answer: D

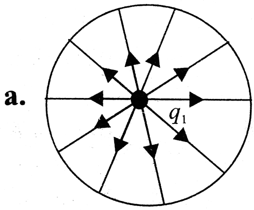
Watch Video Solution

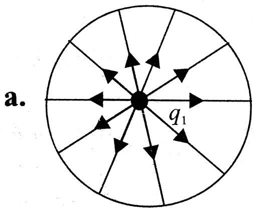
35. A spherical conductor A contains two spherical cavities as shown in Fig.2.127. The total charge on conductor itself is zero . However , there is a point charge q_1 at the center of one cavity and q_2 at the center of the other cavity .

Another charge q_3 is placed at a large distance r from the center of the spherical conductor.

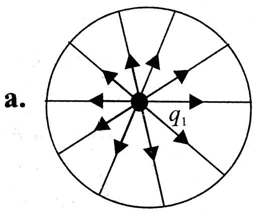


If q_1 is displaced from its center slightly (being always inside the same cavity), then the correct representation of field lines inside the same cavity is

A. 

B. 

C. There will be no field lines inside the cavity.

D. 

Answer: B

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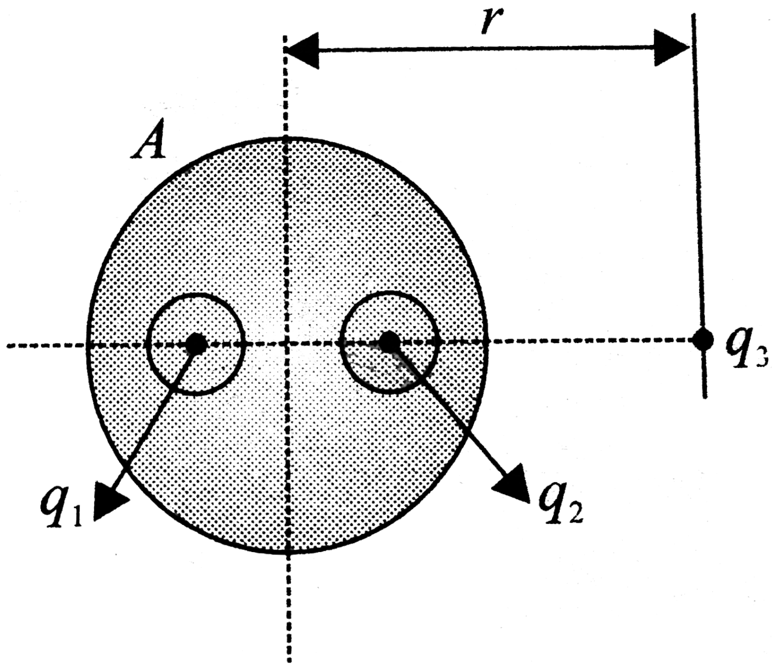
36. A spherical conductor A contains two spherical cavities as shown in Fig.2.127. The total charge on conductor itself is zero . However , there is a point charge q_1 at the center of one cavity and q_2 at the center of the other cavity . Another charge q_3 is placed at a large distance r from the center of the spherical conductor.



The force acting on conductor A will be

A. zero

B. $\frac{q_3(q_1 + q_2)}{4\pi\varepsilon_0 r^2}$

C. $\frac{-q_3(q_1 + q_2)}{4\pi\varepsilon_0 r^2}$

D. $\frac{q_3 q_1 + q_2 q_3 + q_1 q_2}{4\pi\varepsilon_0 r^2}$

Answer: B

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Subjective type

1. A suface has the area vector $\overrightarrow{A}\left(2\hat{i} + 3\hat{j}\right)$ what is the flux erof a uniform electric though the area if the field is a $\overrightarrow{E} = 4\hat{i} N/c$ and $\overrightarrow{E} = 4\hat{k} N/C$?

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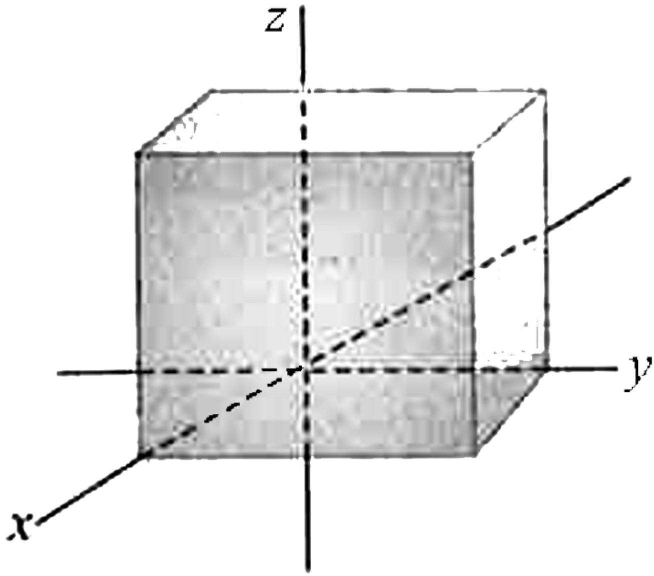
2. An electric field given $\overrightarrow{E} = 4.0\hat{i} - 3.0(y^2 + 2.0)j$ pierces a Gaussian cube of edge length 2.0 m and positioned as shown in the figure. (The magnitude E is in newtons per coulomb and the position z is in meters.) what is the electric flux through the (a) top face, (b) bottom face, (c) left face , (b) bottom facem (c) left face, and (d) back face ? (e) what is the net electric flux through the cube ?



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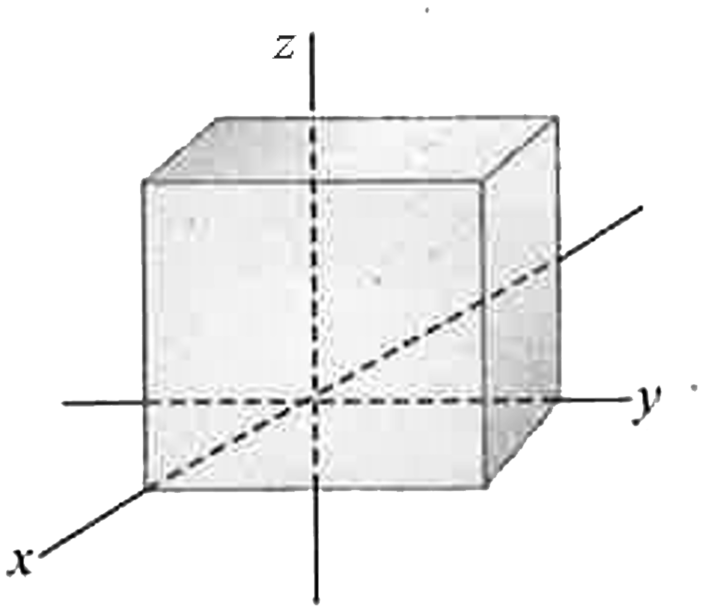
3. The cube in figure has edge length $\sqrt{2}m$ and is oriented as shown in a region of uniform electric field , in newtons per coulomb, is given by $(a) 6.00\hat{i}, (b) -2.00\hat{j}$, and $(c) -3.00\hat{j} + 4.00\hat{k}$. (d) what is the total flux through the cube for each field ?



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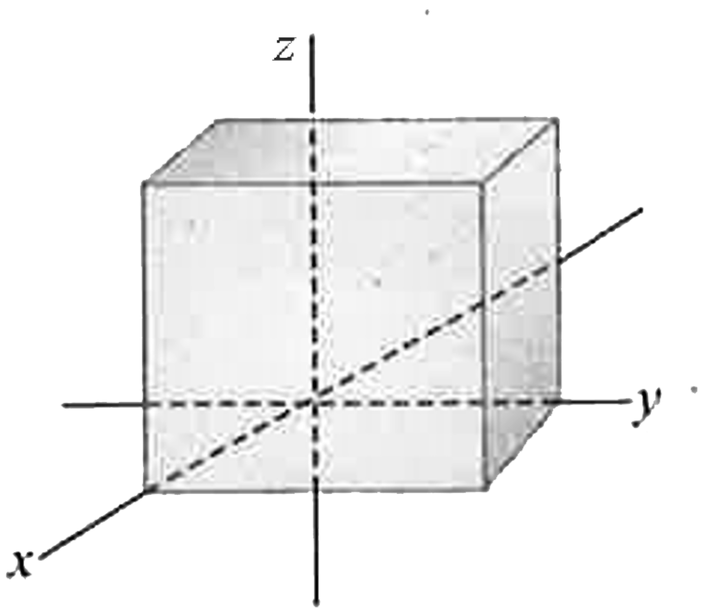
4. At each point on the surface of the cube shown in the figure, the electric field is parllel to the z- axis. The length of each edge of the cube is 3.0 m on the bottom face it is $\overrightarrow{E} = 34\hat{k}N/C$ and on the bottom face it is

$\overrightarrow{E} = 20\hat{k}N/C$. Find the net flux contained within the cube.



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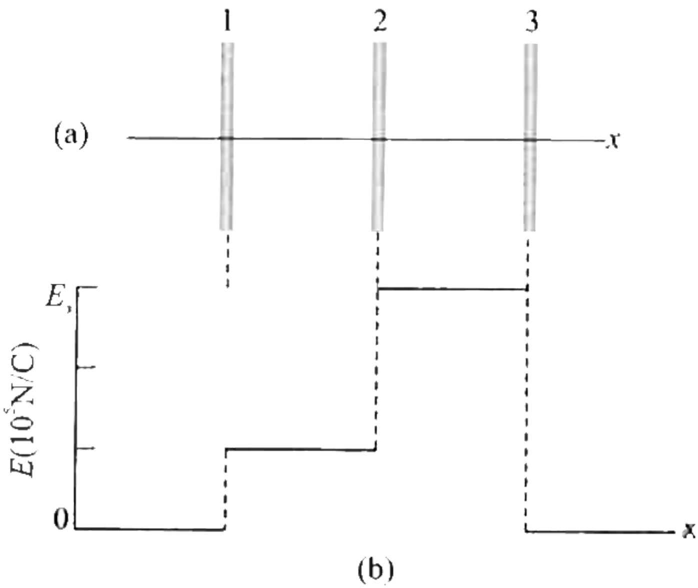
5. figure(a) shows three sheets that are large, parallel and uniformaly charged. Figure (b) gives the component of the net electric field along and x-axis through the sheets. The scale of the vertical axis is set by $E_s = 6.0 \times 10^5 N/C$ what is the ratio of the charge density on sheet 3 to that on sheet 2?



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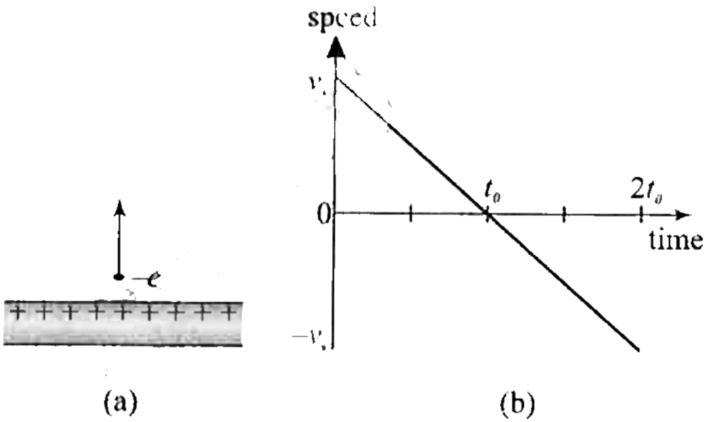
6. In fig(a) electron is shot directly away from a uniformly charged plastic sheet, at speed V_s the sheet is nonconducting flat , and very velical component versus time t until the return to the launch point. What is the sheet's surface charge density ?



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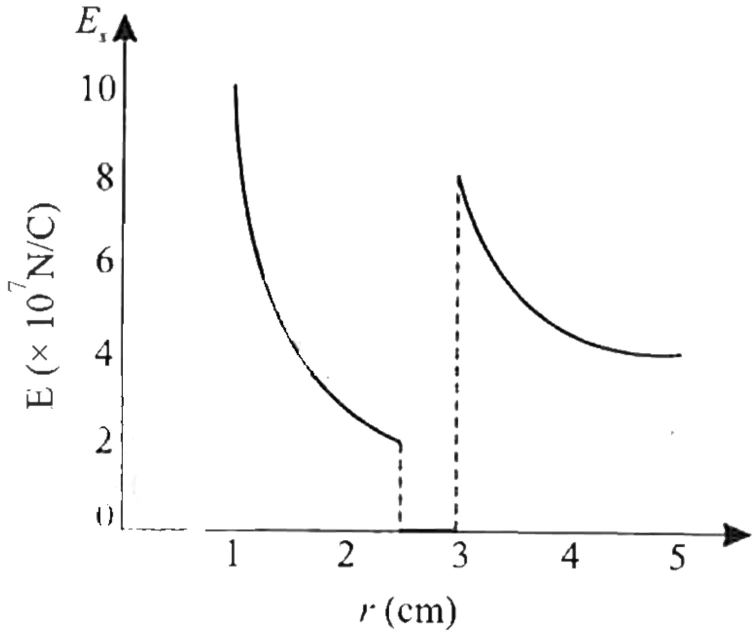
7. A charged particle is held a the centre foa sperical shell. The following figure gives the magnitude E of the electric field versus radial distance r. what is the net charge on the shell ?



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MCQ s

1. Electric flux through a surface are $10m^2$ lying in the xy plane is $\left(\text{ if } \vec{E} = \hat{i} + \sqrt{2}\hat{j} + \sqrt{3}\hat{k}N/C\right)$

A. 100

B. 141.4

C. 17.32

D. 200

Answer: c

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2. 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: d

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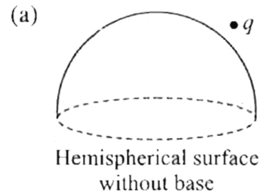
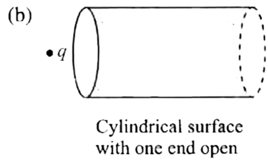
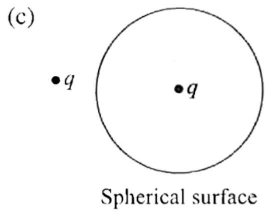
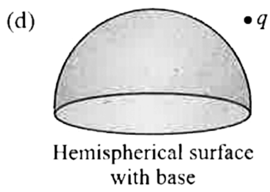
3. A point charge q is placed near hemisperical suface without base, cylindrical surface with one end open sperical surface and hemispherical surface with base as shown in the figure in (a) (b) (c) and (d) respectively In wihich of the following cases m the flux crossing through the surface is zero ?

A. 

B. 

C. 

D. 

Answer: d

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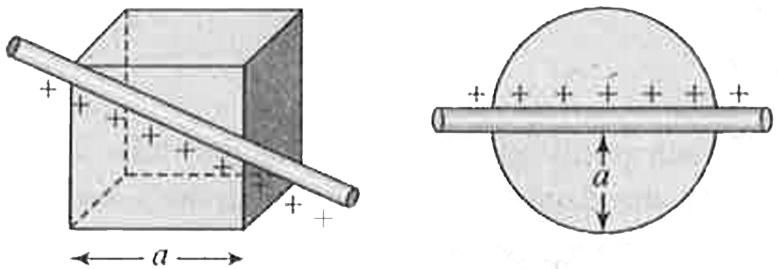
4. A linear charge having linear charge density λ penterates a cube diagonally and then it penterates a sphere diametrically as shown. What will be the ratio of flux coming out of cube and sphere ?



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

B. $\frac{2}{\sqrt{3}}$

C. $\frac{\sqrt{3}}{2}$

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

Answer: c

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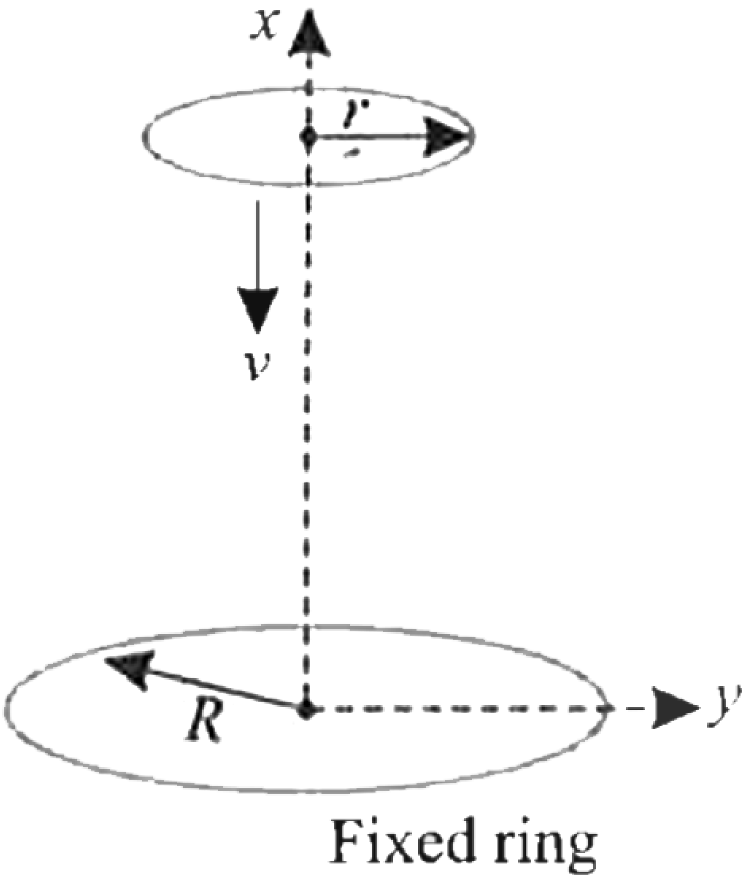
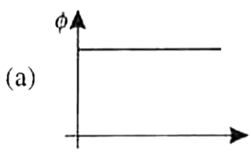
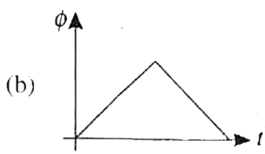
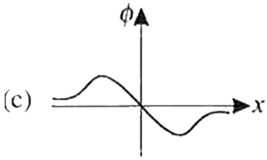
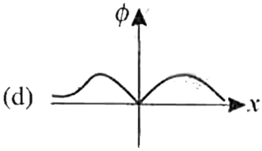
5. A ring of radius R is placed in the plane its centre at origin and its axis along the x-asis and having uniformly distributed positive charge. A ring of radius $r(< < R)$ and coaxial with the larger ring is moving along the axis with constant velcity , then the variation of electrical flux (ϕ) passing through the smaller ring with position will be best represent by :



A. 

B. 

C. 

D. 

Answer: c

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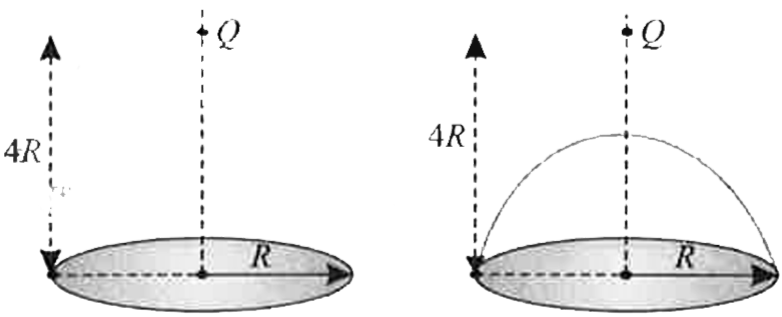
6. A positive point charge Q is placed (on the axis of disc) at a distance of 4 R . Above the centre of a disc of radius R as shown in situation I. the magnitude of electric flux through the disc is (ϕ). Now a hemis pherical shell of radius R is placed over the disc. such that it forms a closed surface as shown in situation II. The flux through the curved suface in situation II taking direction of area vector along outward normal as positive is



Situation I   Situation II

A. Zero

B. ϕ

C. $-\phi$

D. 2ϕ

Answer: c

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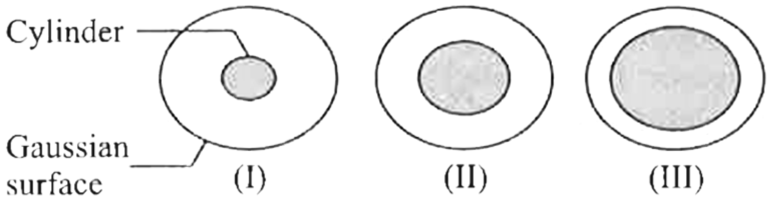
7. Figure showns. In cross section m three solid cylinders, each of length L and uniform charge Q. Concntric with each cylinder is a cylindrical Gaussion surface, with all three surfaces having the same radius. Rank the Gussion surface according to the electric field at any point on the suface, greatest first.



A. $I \rightarrow II \rightarrow III$

B. $II \rightarrow I \rightarrow III$

C. $III \rightarrow II \rightarrow I$

D. all tie

Answer: d

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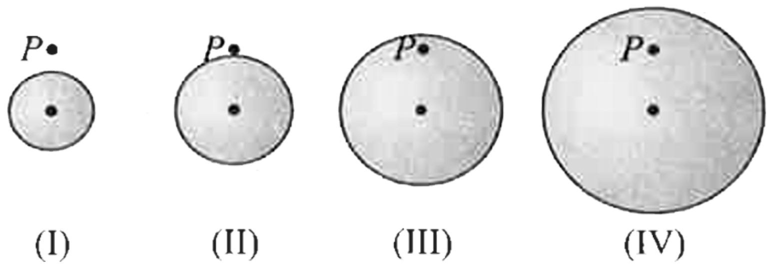
8. Figure showns four solid spheres, each with charge Q uniformly distributed through its volume. The figure also shows a point P for each sphere. All at the same distance from the centre of the sphere. Rank the spheres according to the magnitude of the electric field they produce at point P.



A. I and II tie $\rightarrow III \rightarrow IV$

B. $II \rightarrow III \rightarrow IV$

C. $III \rightarrow II \rightarrow I \rightarrow IV$

D. all tie

Answer: a

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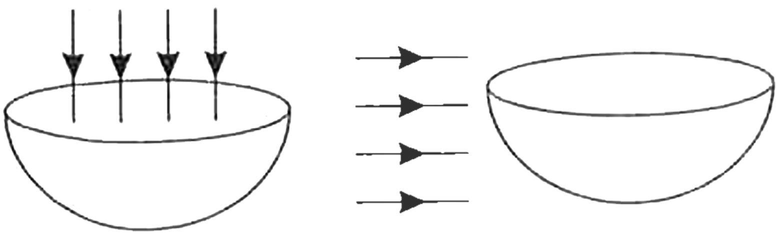
9. In the figure a hemispherical bowl of bowl of radius R is shown Electric field of intensity E is present perpendicular to the circular cross section of the hemisohere.



Situation I

Situation II

A. The magnitude of electric flux through the hemispherical surface in sittation I will be $E\pi R^2$

B. The magniude of electric flux through the hemisoherical surface in surface II will be $2E\pi R^2$

C. the magnitude of electric flux thorugh the hemisperical surface in situation II will be $\frac{E\pi R^2}{2}$

D. the magnitude of electric flux through the hermispherical surface in situation II will be zero.

Answer: b,d

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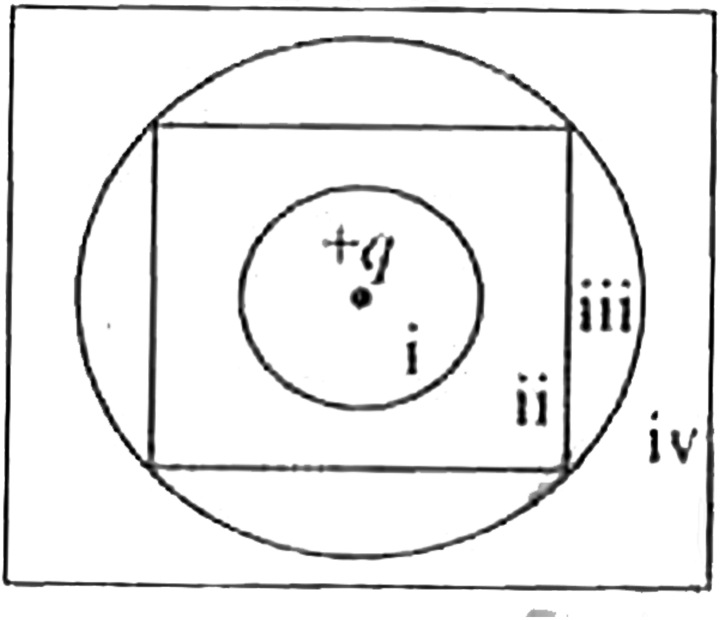
10. figure shows, in cross section, two Gaussian spheres and two Gaussian cubes that are centered on a positively charged particle on a positively charged partical . Rank greatest first, and indicate whether the manitudes are unifrom or variable along each surface.



A. net flux through all the four Gaussion surface will be equal

B. the magniude of the electric . Fields on the surface (i) and (ii) will be constant

C. the magnitude of the electric fields on the sufaces (ii) and (iv) will be variable

D. The magnitude of the electric fields on all the surfaces will be constant

Answer: a,b,c

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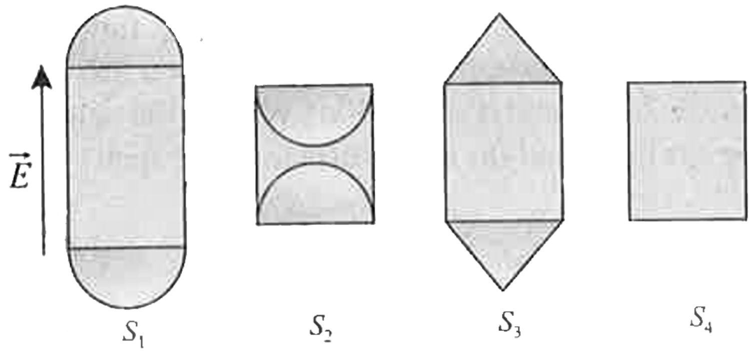
11. Figure shows four Gaussion surfaces consisting of identical cylindrical midsections but different end caps. The surfaces central axis of each . Cylindrical midsection , the end caps have these shapes, S_1 convex hemispheres S_2 concave hermisphere S_3 cones S_4e flat disks. rank the surfaces acccording to (a) the net electric flux through them and (b) the electric flux through the top end caps , greatest first.



A. net flux through all the four Gaussion surface will be equal

B. the electric flux though the top end cops will be equal

C. the electric flux through the top end cap S_1 is greatest

D. the electric flux through the top end cop S_3 is greatest

Answer: a,b

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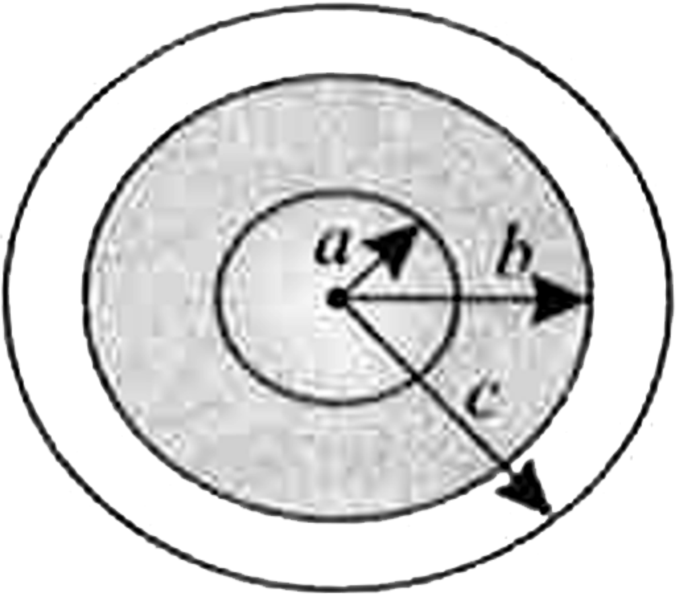
12. In figure , a solid sphere of radius a = 2.00cm is concentric with a spherical conductiosn shell of inner raedius b =2.00 a and outer radius c=2.40 a. the sphere has a net unifrom charge $q_1 = +5.00C$. The shell has a net charge $q_2 = -q_1$. Distance (a) r=0 (b) r= a/2.00 (c) r=a (d) r

= 1.50 a (e) r= 2.30a and (f) r= 3.50 a ? what si the net charge on the (g) inner and (h) outer surface of the shell ?



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13. A uniform charge density of $500nC/m^3$ is distributed throughout a spherical volume of radius 6.00cm .Consider a cubical Gussian surface with its center at the centre of the sphere. What is the elcetric flux through this cubical surface if its edge length is (a) 4.00cm and (b) 14.0 cm ?

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14. the net electric flux through each face of a die (singular of dice) has a magnitude in units of $10^3 N.m^2/C$ that is exactly equal to the number of sport N on the face (1 through 6) the flux is inward for N odd outword for N even. What is the net charge inside the die ?

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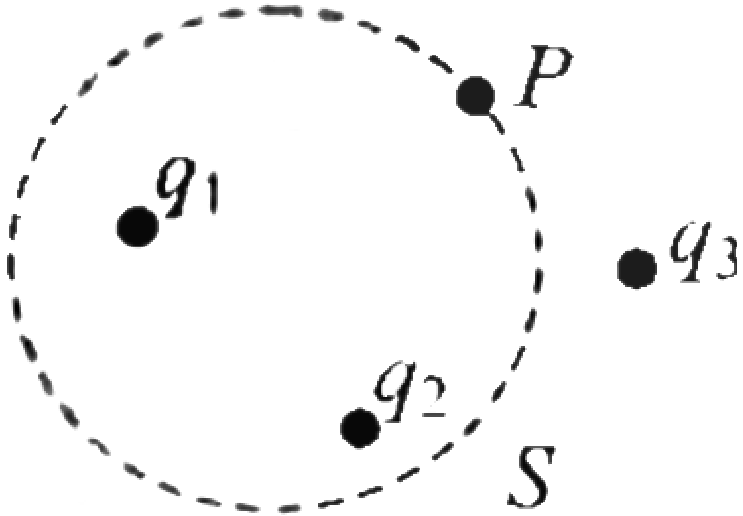
15. A Gaussian surface S encloses two charges $q_1 = q$ and $q_2 = -q$the field at p is where $\vec{E}_1, \vec{E}_2$ and $\vec{E}_3$ are the field contributed by q_1, q_2 and $q_3 at$ P respectively.



A. $\vec{E}_1 + \vec{E}_2$

B. $\vec{E}_1 + \vec{E}_2 + \vec{E}_3$

C. $\vec{E}_3$

D. $\vec{E}_1 + \vec{E}_2 - \vec{E}_3$

Answer: b

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16. The electric field in a region is radially outward with magnitude $E = A\gamma_0$. The charge contained in a sphere of radius γ_0 centered at the origin is

A. $\frac{1}{4\pi\varepsilon_0}A\gamma_0^3$

B. $4\pi\varepsilon_0 A\gamma_0^3$

C. $\frac{4\pi\varepsilon_0 A}{\gamma_0}$

D. $\frac{1}{4\pi\varepsilon_0}\frac{A}{\gamma_0^3}$

Answer: b

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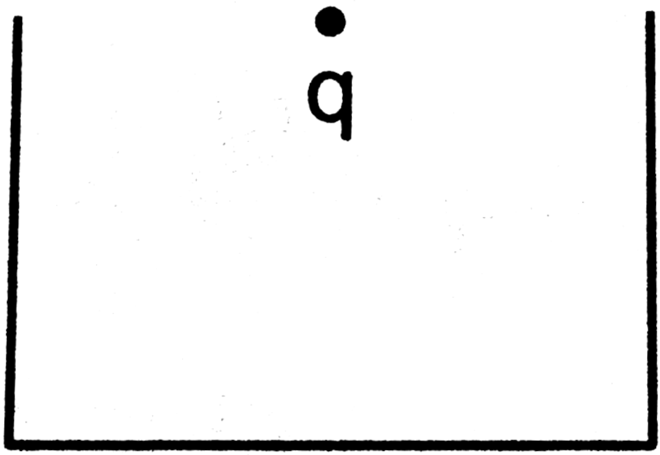
17. A charge q is placed at the centre of the open end of a cylindrical vessel . The flux of the electric field through the surface of the vessel is



A. Zero

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

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

D. $\frac{2q}{\varepsilon_0}$

Answer: c

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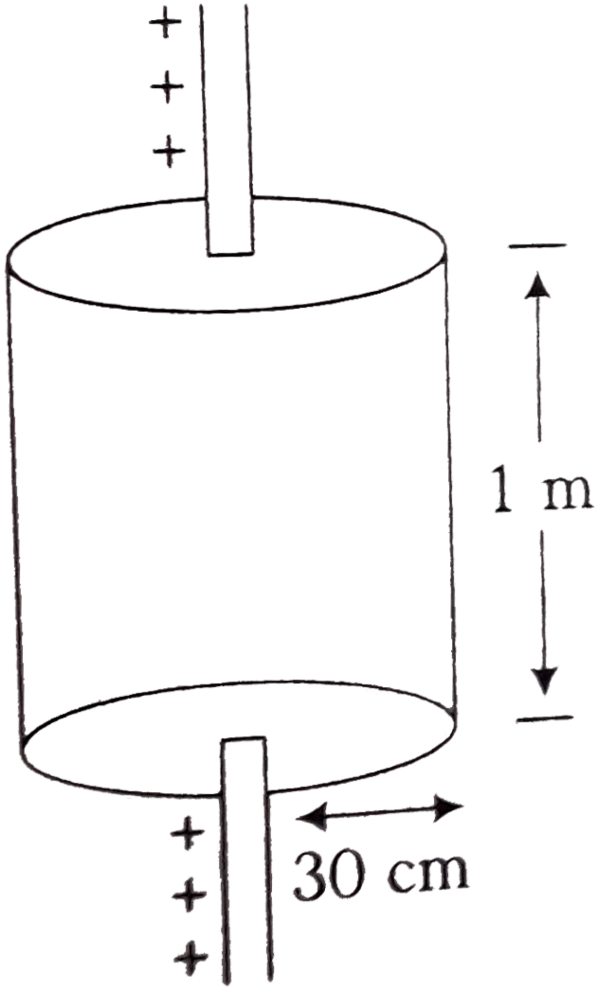
18. Electric charge is uniformly distributed along a long straight wire of radius 1 mm. The charge per centimetre length of the wire is Q coulomb. Another cylindrical surface of radius 50 cm and length 1 m symmetrically enclosed the wire as shown in the figure. The total electric flux passing through the cylindrical surface is



A. $\dfrac{Q}{\varepsilon_0}$

B. $\dfrac{100Q}{\varepsilon_0}$

C. $\frac{10Q}{(\pi\varepsilon_0)}$

D. $\frac{100Q}{(\pi\varepsilon_0)}$

Answer: b

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19. In a region of space having a spherical symmetic distribution of charge , the electric flux enclosed by a concentric spherical Gaussion surface, varies with radius r as $\phi = \begin{cases} \frac{\phi_0 r^2}{R^3}, r \leq R\phi_0, & < R \end{cases}$ where R and ϕ_0 are the constants.

A. $E = \frac{\phi_0}{4\pi r^2}$,for $r \leq R$

B. $E = \frac{\phi_0}{4\pi r^2}$,for $r > R$

C. $E = \frac{\phi_0 r}{4\pi r^2}$,for $r \leq R$

D. $E = \frac{\phi_0 r}{4\pi r^2}$,for $r > R$

Answer: b

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20. In a region of space the electric field in the x-direction and proportional to xi.e., $\overrightarrow{E} = E_0 x \hat{i}$. Consider an imaginary cubical volume of edge a with its parallel to the axes of coordinates. The charge inside this volume will be

A. Zero

B. $\varepsilon_0 E_0 a^3$

C. $\frac{1}{\varepsilon_0} E_0 a^3$

D. $\frac{1}{6}\varepsilon_0 E_0 a^3$

Answer: b

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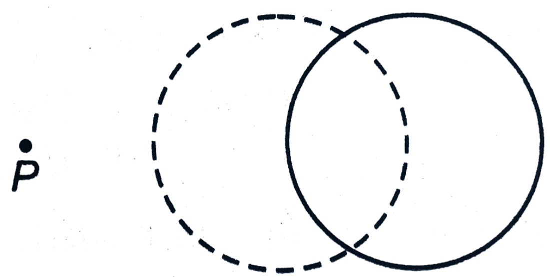
21. Figure shows a closed dotted surface which intersects a conduccting uncharged shere. If a positive charge is placed at the point P, the flux of the electric field through the closed surface



A. will remain zero

B. will become postive

C. will become negative

D. will become undefined

Answer: c

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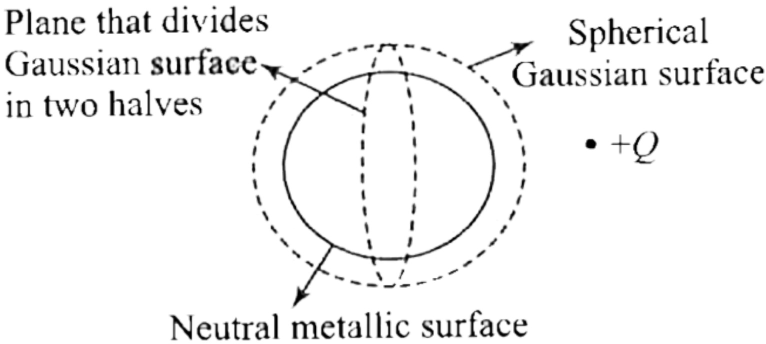
22. figure shows a neutral metallic sphere with a point charge +Q placed near its surface. Electrostatic equilibrium conditions exist on metallic sphere. Mark the correct statement :



A. Net flux through Gaussian surface due to charge Q is zero

B. Net flux through Gaussian surface due to charges appearing on the outer surface of metallic sphere must be zero

C. if point chage Q is displaced a little towards metallic sphere, magnitude of net flux through right hemisperical closed Gaussian surface increases.

D. If point charge Q is displaced towards metallic sphere, charge distribution on outer surface of sphere will change

Answer: a,b,c,d

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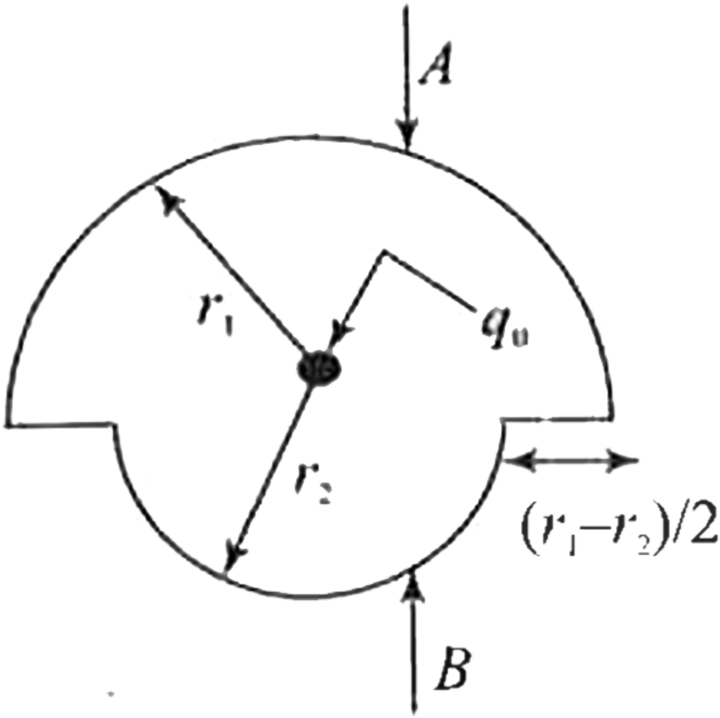
23. A and B are semi - spherical surfaces of radius r_1 and $r_2 (r_1 < r_2) with E_1$ and E_2 as the electric fields a the their surfaces. Charge q_0 is placed as shown. What is the condition which may be statisfied ?



A. $\frac{\phi 1}{\phi 2}=1$

B. $r_1^2 r_1^2=E_1 E_2$

C. $\frac{r 1}{\sqrt{E_2}}=\frac{r 2}{\sqrt{E_2}}$

D. $r_1 \sqrt{E_2}=r_2 \sqrt{E_1}$

Answer: a,c

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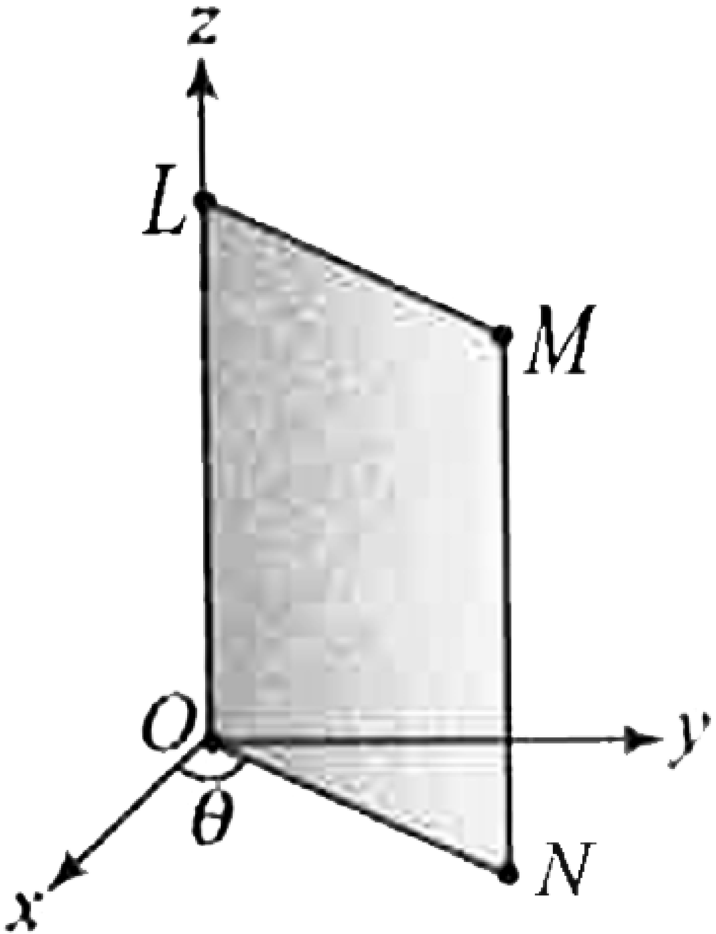
24. the electric field intensity at all points is space is given by $\overrightarrow{E} = \sqrt{3}\hat{i} - \hat{j}$ volts/meter. A square frame LMNO of side 1 meter is shown in the figure. The point N lies in x-y plane. The initial angle between line ON and x -axis is

$\theta = 60^\circ$

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



A. 0 volt/metre

B. 1 volt/metre

C. 2 volt/ metre

D. 4 volt / metre

Answer: c

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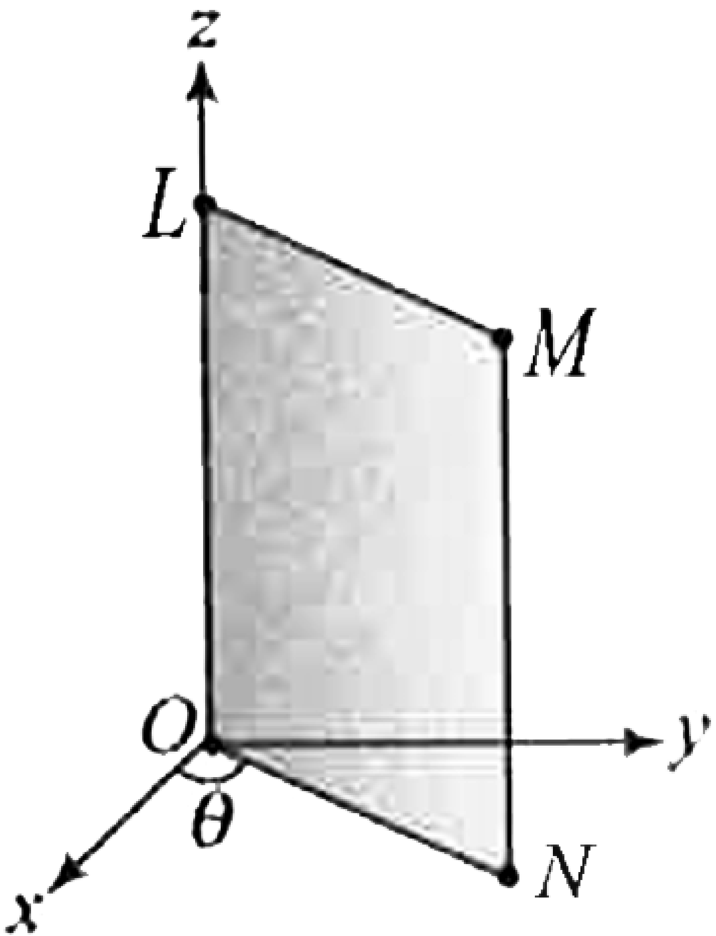
25. the electric field intensity at all points is space is given by $\overrightarrow{E} = \sqrt{3}\hat{i} - \hat{j}$ volts/meter. A square frame LMNO of side 1 meter is shown in the figure. The point N lies in x-y plane. The initial angle between line ON and x -axis is $\theta = 60^\circ$

The work done by electric field in taking a point charge

$1\mu C$ from origin O to point M is



A. $0\mu J$

B. $1\mu J$

C. $2\mu J$

D. $4\mu j$

Answer: d

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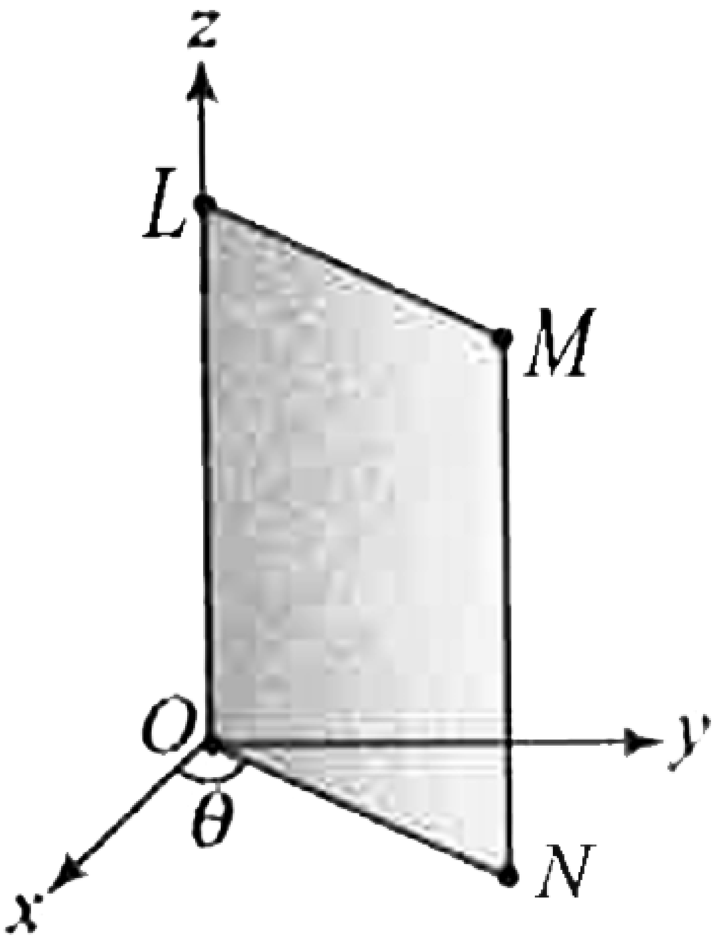
26. the electric field intensity at all points is space is given by $\overrightarrow{E} = \sqrt{3}\hat{i} - \hat{j}$ volts/meter. A square frame LMNO of side 1 meter is shown in the figure. The point N lies in x-y plane. The initial angle between line ON and x -axis is $\theta = 60^\circ$

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



A. the magnitude of electric flux increase from initial

value as $\theta$is increased.

B. The magnitude of electric flux increses from initial value asθ is decresad.

C. The magnitude of electric flux increases or decrease from initial value as θ is changed .

D. The magnitude of electric flux will decrease from initial value as θ is changed .

Answer: a

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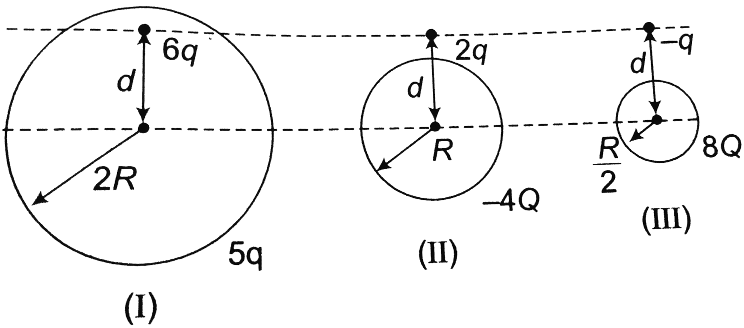
27. Figure, shown above, shows three situations involving a charged particle and a uniformly charged spherical shell. The charges and radii of the shells are indicated in the figure. If F_1, F_2 and F_3 are the magnitudes of the force on the particle due to the shell in situations (I),(II) and (III) then



A. $F_3 > F_2 > F_1$

B. $F_1 > F_2 = F_3$

C. $F_3 = F_2 > F_1$

D. $F_1 > F_2 > F_3$

Answer: c

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28. There are three concentric thin spheres of radius $a, b, c(a > b > c)$. The total surface charge densities on their surfaces are $\sigma, -\sigma, \sigma$ respectively. The magnitude of the electric field at r (distance from centre) such that $a > r > b$ is:

A. 0

B. $\frac{\sigma}{\varepsilon_0 r^2}(b^2 - c^2)$

C. $\frac{\sigma}{\varepsilon_0 r_2}(a^2 + b^2)$

D. none of these

Answer: b

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29. The electric field inside a sphere having charge density related to the distance from the centre as$\rho = \alpha r$ (α is a constant) is :

A. $\frac{\alpha r^3}{4\varepsilon_0}$

B. $\frac{\alpha r^2}{4\varepsilon_0}$

C. $\frac{\alpha r^2}{3\varepsilon_0}$

D. none of these

Answer: A

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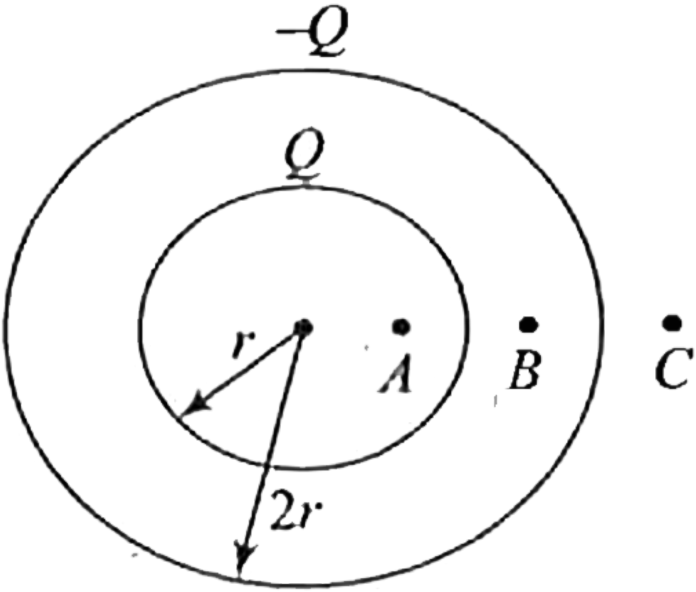
30. consider two thin unifromly charged concentric shells of radii r and 2r charges Q and -Q respectively , as shown.

Three points A,Band C are marked at distances $\frac{r}{2}, \frac{3r}{2}$ and $\frac{5r}{2}$ respectively from their common centre. If $E_A E_B$ and E_C are magniudes of the electric fields at points A, Band C respectivly ,then



A. $E_A > E_B > E_C$

B. $E_C > E_B > E_A$

C. $E_B > E_A = E_C$

D. $E_B > E_A > E_C$

Answer: c

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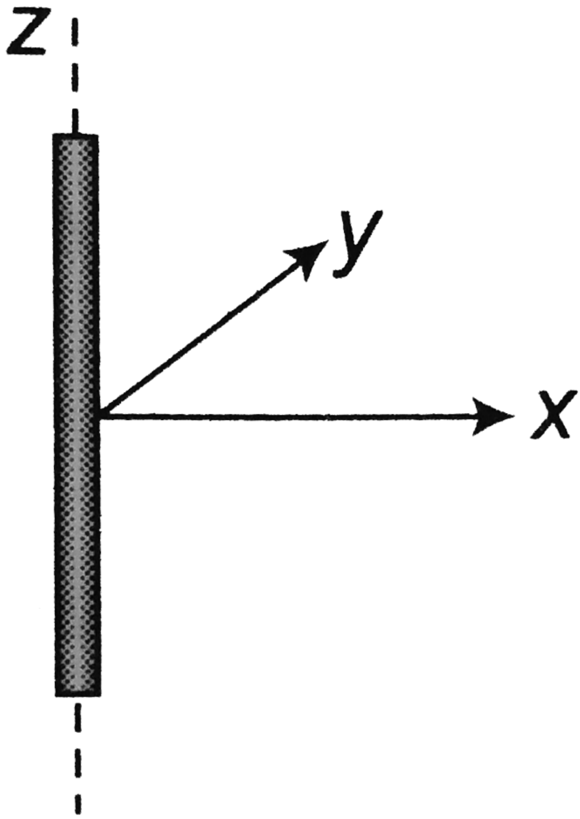
31. An infinitely long wire is kept along z-axis from $z = -\infty$ to $z = \infty$, having uniform linear charge density $\frac{10}{9} nC/m$. The electric field at point $(6cm, 8cm, 10cm)$

will be



A. $\left(120\hat{i} + 160\hat{j} + 200\hat{k}\right) V / m$

B. $200\hat{k} V / m$

C. $\left(160\hat{i} + 120\hat{j}\right) V / m$

D. $\left(120\hat{i} + 160\hat{j}\right) V / m$

Answer: d

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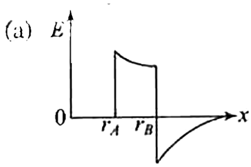
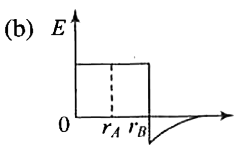
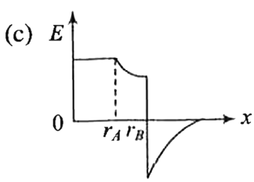
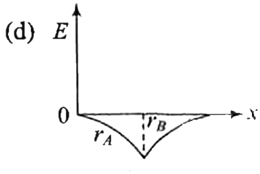
32. Two conentric conducting thin spherical shells A and B having radii r_A and $r_B (r_B > r_A)$ are charged to Q_A and $-Q_B (|Q_B| > Q_A \mid)$. The electrical field along a line, (passing through the centre) is

A. 

B. 

C. 

D. 

Answer: a

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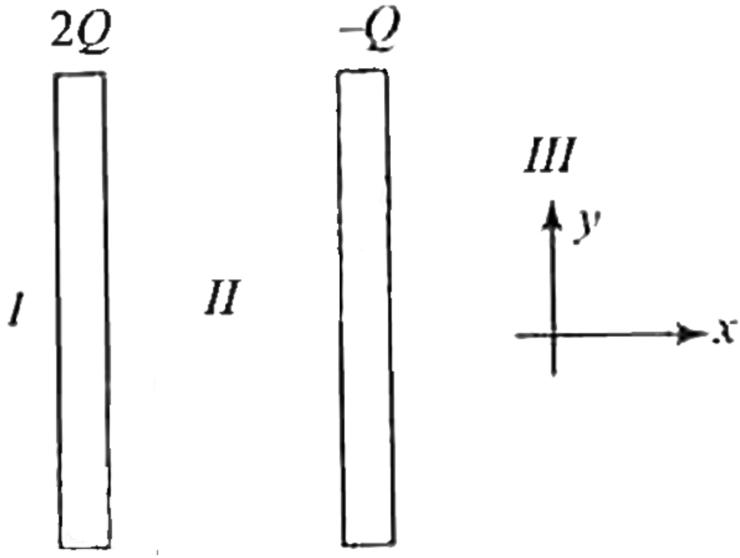
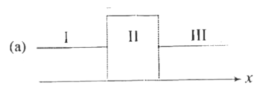
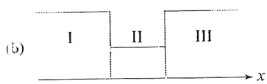
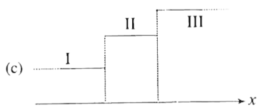
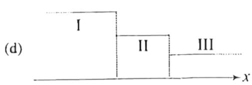
33. two large conducting thin plates are placed parallel to each other. They carry the charges as shown. The variation of magnitude of eclectric field in space due to this system is best given by



A. 

B. 

C. 

D. 

Answer: a

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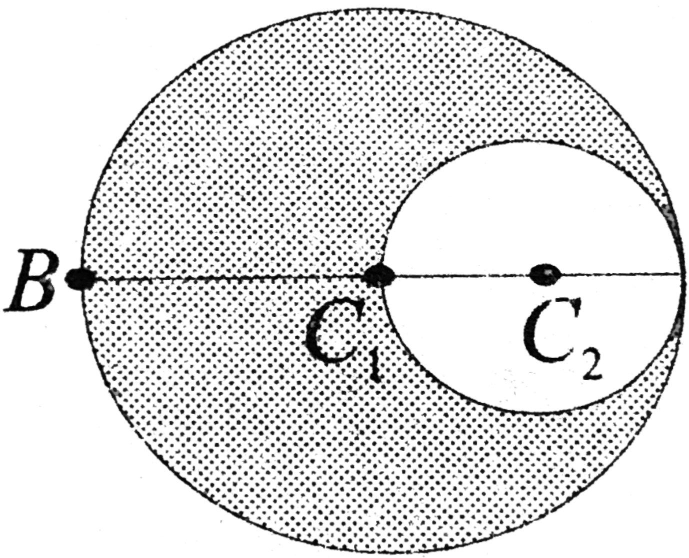
34. A positively charge sphere of radius r_0 carries a volume charge density ρ. A spherical cavity of radius $r_0/2$ is then scooped out and left empty. C_1 is the center of the sphere and C_2 that of the cavity. What is the direction and magnitude of the electric field at point B?



A. $\frac{17pr_0}{54\varepsilon_0}$ left

B. $\frac{17pr_0}{54\varepsilon_0}$ right

C. $\frac{pr_0}{6\varepsilon_0}$ left

D. $\frac{pr_0}{6\varepsilon_0}$ right

Answer: a

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35. The absolute charge on an electron is -

A. $\sigma\phi$

B. $\frac{\sigma\phi}{4\pi}$

C. $\frac{\sigma\phi}{2\pi}$

D. $\frac{\sigma\phi}{3\pi}$

Answer: a

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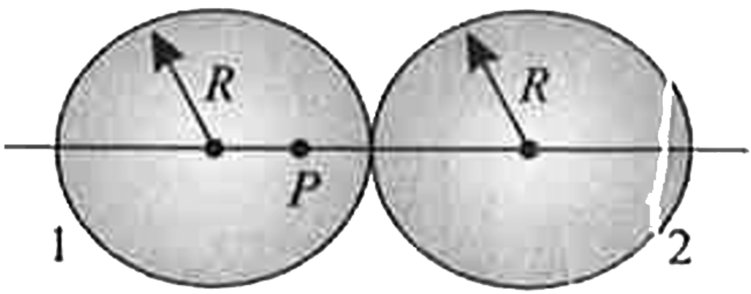
36. figure shows, in cross section, two solid spheres with uniformaly distributed charge throughout their volumes. Each has radius R. point P lies on a line connecting the centres of the spheres, at radial distance r/2.00 from the centre of sphere 1 . If the net electric field at point P is zero what is the ratio q_2 / q_1 of the total charges ?



A. $\frac{9}{8}$

B. $\frac{6}{5}$

C. $\frac{2}{5}$

D. $\frac{8}{9}$

Answer: a

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37. A very long uniformly charged cylinder (radius R) has a surface charge density σ . A very long uniformaly charged line charge(linear charge density λ) is placed along the ctlinder axis. If electric field intensity vector outside the cylinder is zerom then :

A. $\lambda = R\sigma$

B. $\lambda = -R\sigma$

C. $\lambda = 2\pi R\sigma$

D. $\lambda = -2\pi R\sigma$

Answer: d

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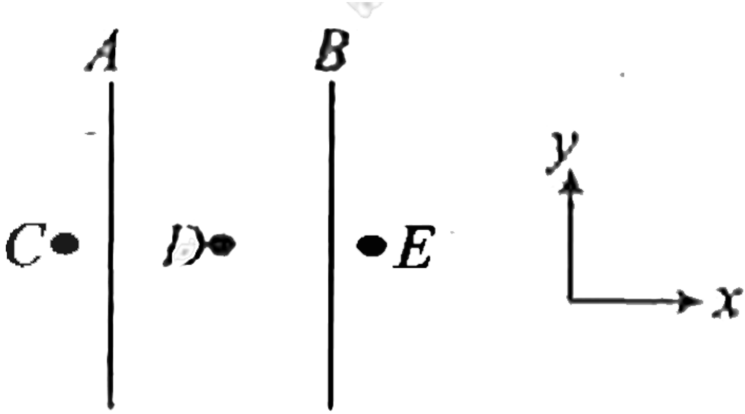
38. Two infinte plane sheets A and B are shown in the figure the surface charge densities on A and B are $(2/\pi) \times 10^{-9} C/m^2$ and $(-1/\pi) \times 10^{-9} C/m^2$ rospectively .C,D, E are three points where electric fields (in

N/C) are E_C, E_D and E_E repectively.



A. $\overrightarrow{E}_C = 18\hat{i}$

B. $\overrightarrow{E}_D = 54\hat{i}$

C. $\overrightarrow{E}_D = 18\hat{i}$

D. $\overrightarrow{E}_E = 18\hat{i}$

Answer: b,d

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