# PHYSICS

## BOOKS - RESNICK AND HALLIDAY PHYSICS (HINGLISH)

## GAUSS' LAW

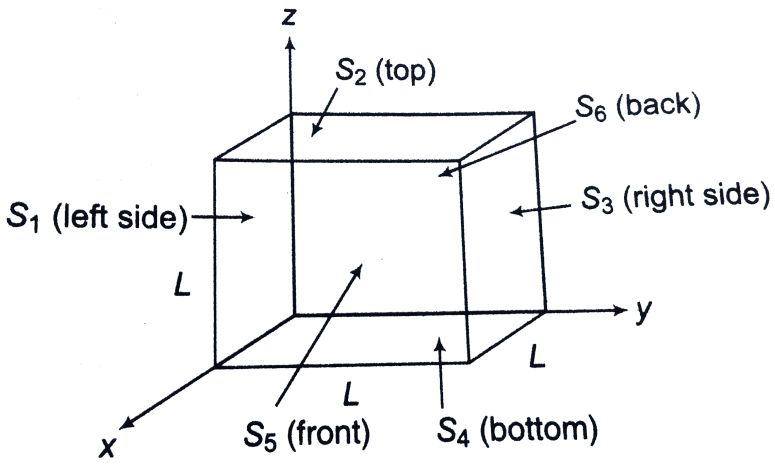
### SAMPLE PROBLEM

**1.** 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.

Watch Video Solution

**2.** A cube has sides of length L. It is placed with one corner atAthe origin as shown in figure. The electric field is uniform and given by

$E = -B\hat{i} + C\hat{j} - D\hat{k}$, where B, C and D are positive constants.



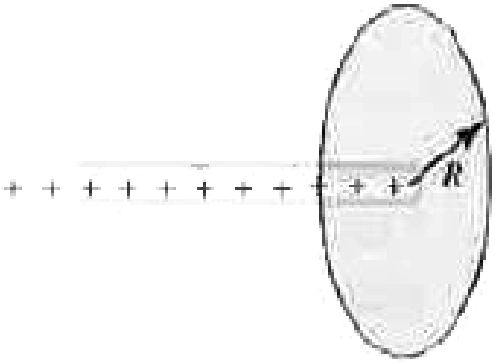

(a) Find the electric flux through each of the six cube faces $S_1, S_2, S_3, S_4$ and $S_5$ and $S_6$.

(b) Find the electric flux through the entire cube.

Watch Video Solution

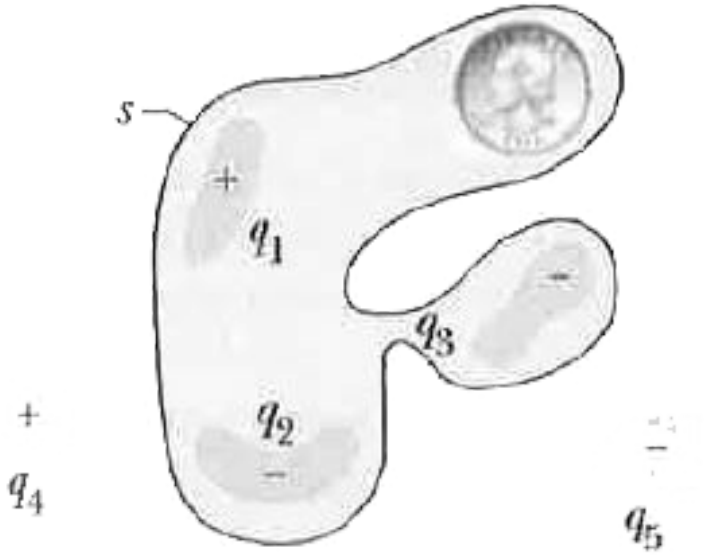
**3.** Calculation the flux through the flat disk held perpendicular to the end of a semi-infinite wire of charge per unit length l. The radius of the disk is

R



View Text Solution

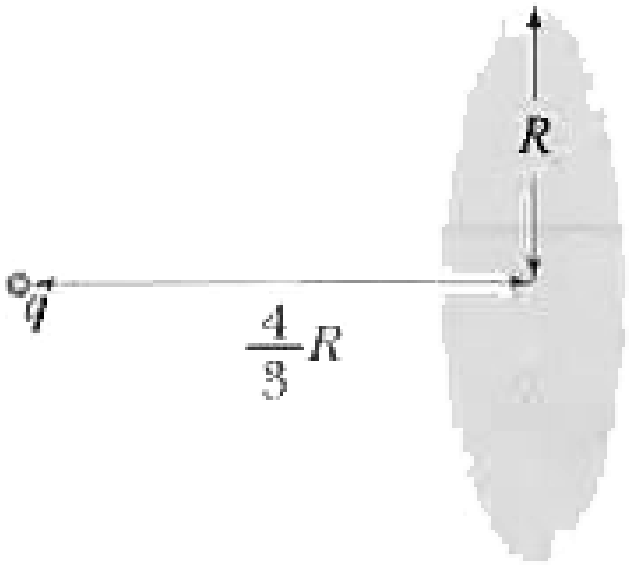
**4.** shows five charged lumps of plastic and an electrically neutral coin. The cross sectio of a Gaussian surface S is indicated. What is the net electric flux through the surface if $q_1 = q_4 + 3.1nC, q_2 = q_5 = -5.9nC$ and $q_3 = -3.1nC$ ?




Five plastic objects,each with an electric charge, and a coin, which has no net charge, A Gaussian surface, shown in cross section, encloses three of the plastic objects and the coin.

View Text Solution

**5.** Finding flux due to a point charge through a disk. The line joining the charge to the center of the disk is perpendicular to the disk.




View Text Solution

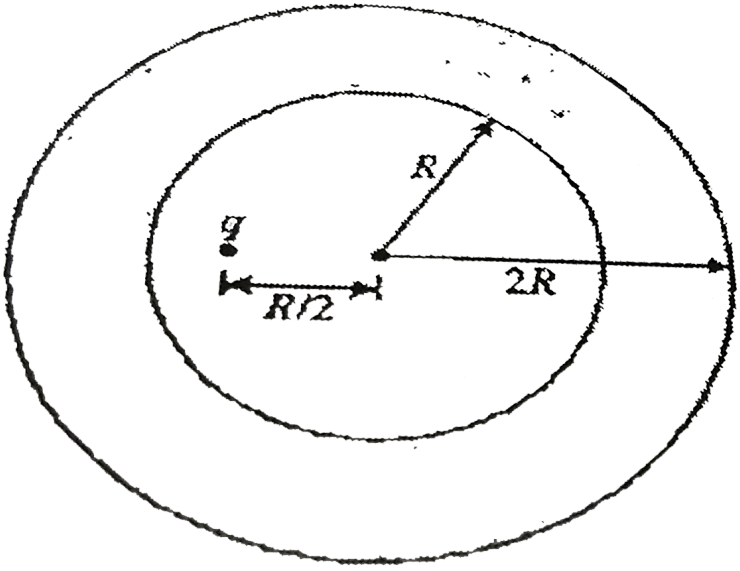
**6.** shows, in cross section, a plastic, spherical shell with uniform charge $Q = -16e$ and radius $R = 10cm$. A particle with charge $q = +5e$ is at the center. What is the electric field (magnitude and direction) at (a) point $P_1$ at radial distance $r_1 = 6.00cm$ and (b) point $P_2$ at radial distance $r_2 = 12.0cm$ ?

Watch Video Solution

**7.** किसी आवेशित संधारित पर नेट आवेश कितना होता हैं?

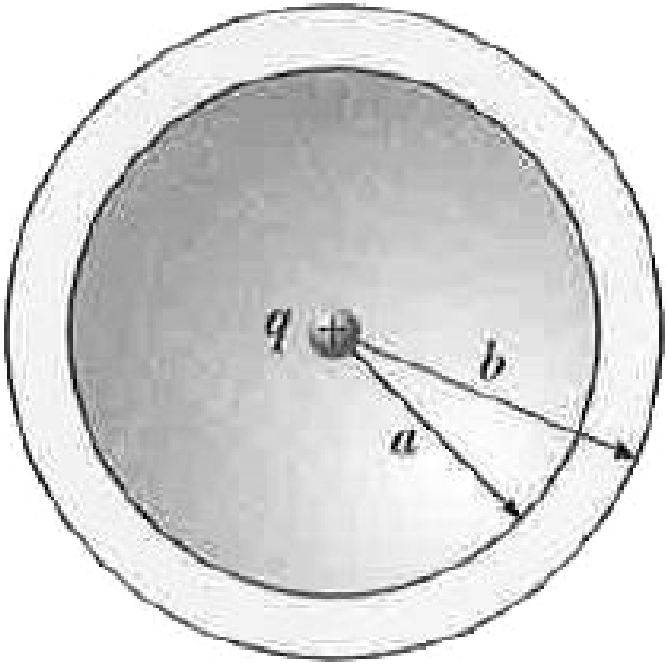
Watch Video Solution

**8.** Figure shows a cross-section ofa spherical metal shell of inner radius R and out radius ZR. A point charge q is ·located at a distanceR/2 from the centre of the shell. If the shell is electrically neutral, then which of the following statements is/are correct :



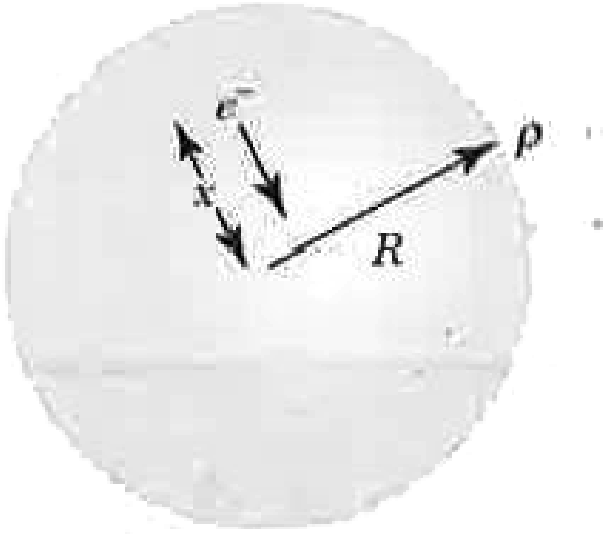

Watch Video Solution

**9.** a nonconducting spherical shell of inner radius $a = 2.00$ cm and outer radius $b = 2.40$ cm has (within its thickness) a positive volume charge density $\rho = A/r,$ where A is a constnat and r is the distance from the center of the shell. In addition, a small ball of charge $q = 45.0$ fC is located at that center. What value should A have if the eletric field in the shell $(a < b < c)$ is to be uniform ?




View Text Solution

**10.** An electron is releaed from the surface of a uniformly and positively charged sphere (volume charge density r, fig) Show that the electron will exceute SHM and find its time period




View Text Solution

**11.** Upward streamer in a lightning storm. The woman in was standing on a lookout platform high in the Sequoia National Park when a large storm cloud moved overhead. Some of the conduction electrons in her body were driven into the ground by the cloud's negatively charged base

leaving her positively charged. You can tell she was highly charged because

her hair strands repelled one another and extended away from her along the electric field lines produced by the charge on her.

Lightning did not strike the woman, but she was in extreme danger because that electric field was on the verge of causing electrical breakdown in the surrounding air. Such a breakdown would have occurred along a path extending away from her in what is called an upward streamer. an upwars stremer. An upward streamer is dangerous because the resulting ionization of molecules in the air suddenly frees a tremendous number of electrons from those molecules. Had the women in develpoed an upward streamer, the free electrons in the air would have moved to neutral ize her producing a large, perhaps fatal, charge flow through her body . That charge flow is dangerous because it could have interfered with or even stopped her breathing (which is obviously necessary for oxygen) and the steady beat of her heart (which is obviously necessary for the blood flow that carries the oxygen). The charge flow could also have caused burns.

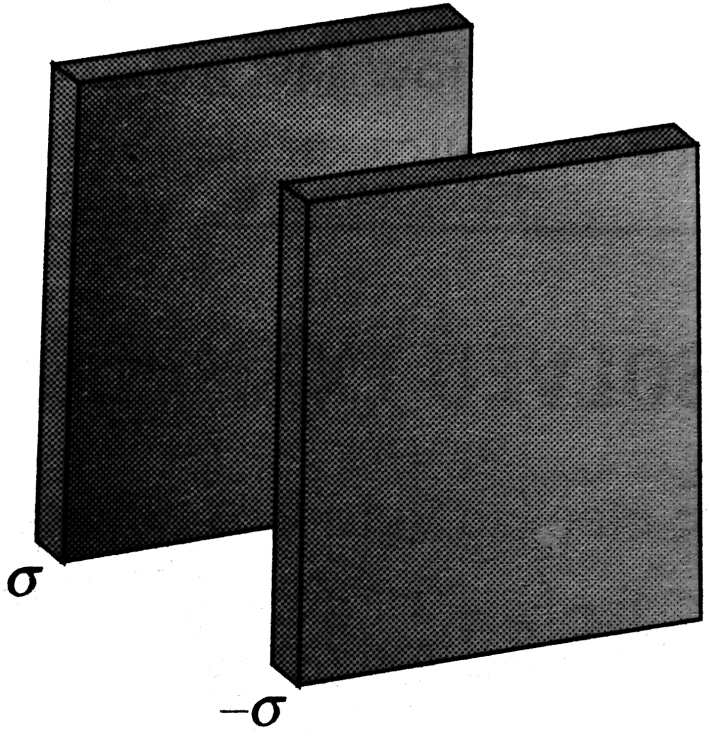
Let's model her body as a narrow vertical cylinder of height L =1.8m and

radius $R = 0.10m$ Assume that charge Q was uniformly distributed along the cylinder and that electrical breakdown would have occured if the electric field magnitude along her body had exceeded the critical value $E_c = 2.4MN/C$. What value of Q would have put the air along

her body on the verge of breakdown ?

View Text Solution

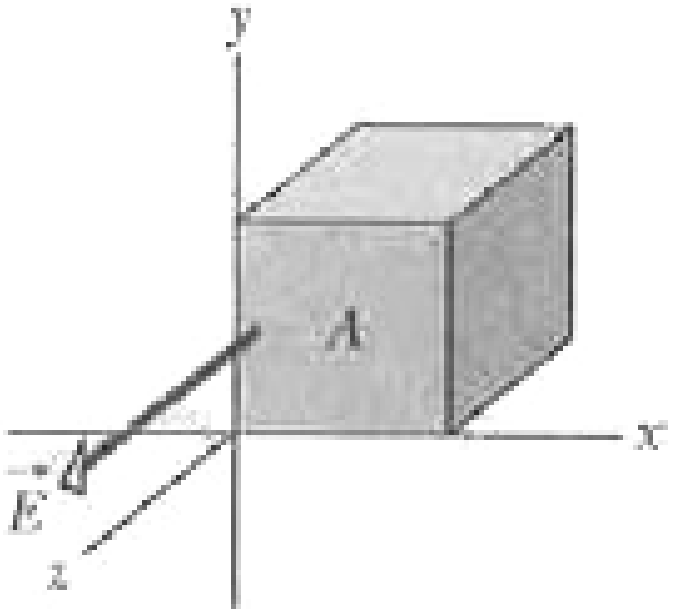
**12.** Two infinite, non-conducting sheets of charge are parallel to each other, as shown in figure. The sheet on the left has a uniform surface charge density $\sigma$, and the one on the right has a uniform charge density $-\sigma$. Calculate the electric field at points (a) to the left of, (b) in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




Watch Video Solution

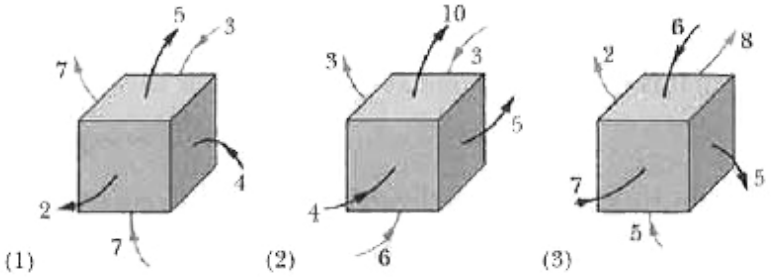
CHECKPOINT

**1.** The figure here shows a Gaussian cube of facwe area A immersed in a uniform electric field $\vec{E}$ that hass the positive direction of the z axis. In terms of E and A, what is the flux though (a) the front face (which is in the xy plane), (b) the rear face, (c ) the top face, and (d) the whole cube ?




View Text Solution

**2.** The figure shows three situations in which a Gaussian cube sits in an electric field. The arrows and the values indicate the directions of the field lines and the magnitudes (in $N - m^2/C$) of the flux through the six sides of each cube . (The lighter arrow are for the hidden faces.) In which situation does the cube enclose(a) a positive net charge, (b) a negative net charge, and (c ) zero net charge ?



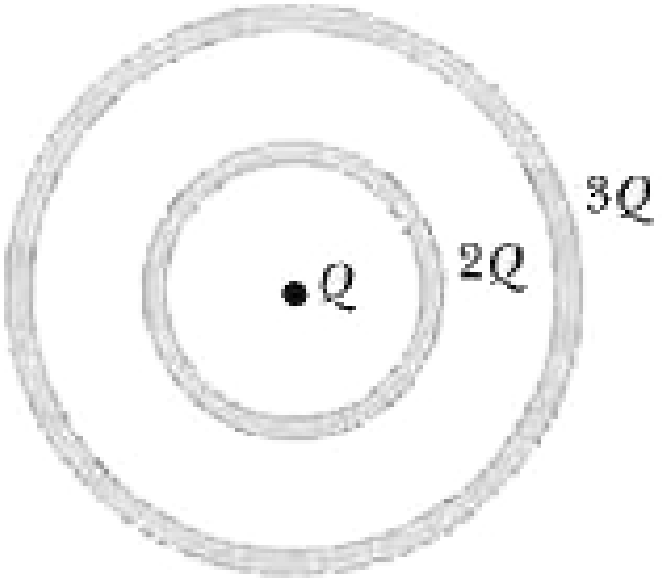

View Text Solution

**3.** If net flux through a Gaussian surface is zero, then find whether the following statements are correct or not.

The net charge inside the surface is zero.

Watch Video Solution

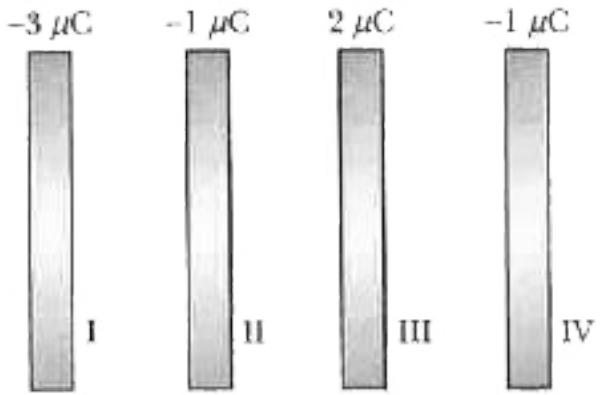
**4.** As shown in the gigure, a charge of Q is kept in the inner cavity and a charge of 2Q is imparted to the inner shell. A charge of 3Q is imparted to the outermost shell. (a) Find charge at each of the surfaces. (b) Find $\vec{E}$ in the first annular region and outside.




Watch Video Solution

**5.** Four large charged conducting sheets kept parallel to each other. Find the charge on each of the eight faces and electric field in region I,II,III IV

as shown in the figures below.



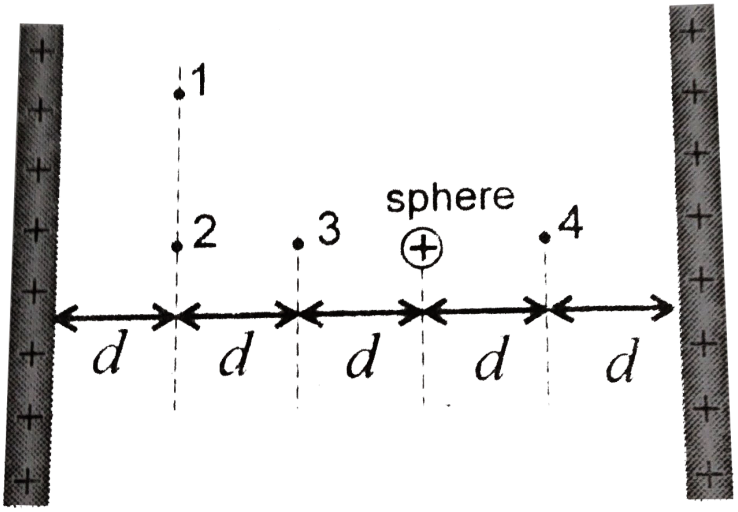

View Text Solution

**6.** Consider the charges q,q and -q placed at the vertices of an equilateral triangle of each side l. What is the force on each charge ?

Watch Video Solution

**7.** The figure shows two large, closely placed, parallel, nonconducting sheets with identical (positive) uniform surface charge densities, and a sphere with a uniform (positive) volume charge density. Four points

marked as 1,2,3, and 4 are shown in the space in between. If $E_1, E_2, E_3,$ and $E_4$ are magnitude of net electric fields at these points, respectively, then



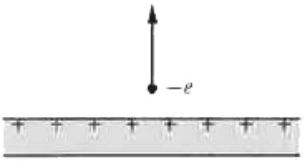

Watch Video Solution

## PROBLEMS

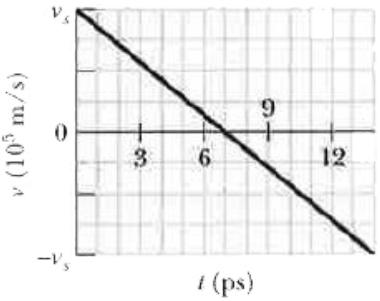
**1.** An infinite line charge produces a field of $7.182 \times 10^8 N/C$ at distance of 2 cm. the linear charge density is

Watch Video Solution

**2.** an electron is shot directly away from a uniformly charged plastic sheet, at speed$v_3 = 1.6x10^5$m/s. The sheet is nonconducting, flat, and very large. Figure 23-41b gives the electron's vertical velocity component v versus time t until the return to the launch point. What is the sheet's surface charge density?




(a)




(b)

Watch Video Solution

**3.** A conducting sphere of radius 10 cm has an unknown charge. If the electric field 20 cm from the centre of the sphere is $1.5 \times 10^3 N/C$ and points radially inward, what is the net charge on the sphere?

Watch Video Solution

**4.** A spherical conducting sheel of inner redius $s_1$ and outer radius $r_2$ has a charge Q. (a) A charge q is placed at the centre of the shell. What is the surface charge density on the inner and outer surfaces of the shell ?

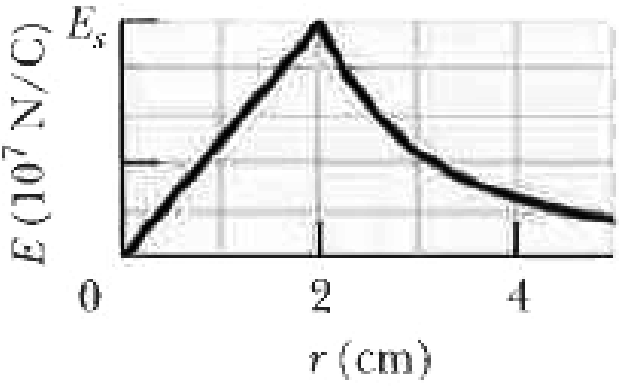
Watch Video Solution

**5.** A metal spherical shell has an inner radius $R_1$ and outer radius $R_2$. A charge Q is placed at the center of the spherical cavity. What will be surface charge density on (i) the inner surface, and (ii) the outer surface ?

Watch Video Solution

**6.** gives the magnitude of the electric ficld inside and outside a sphere with a positive charge distributed uniformly throughout its volume. The scale of the vertical axis is set by $E_x = 10 \times 10^7$ N/C. (a) What is the

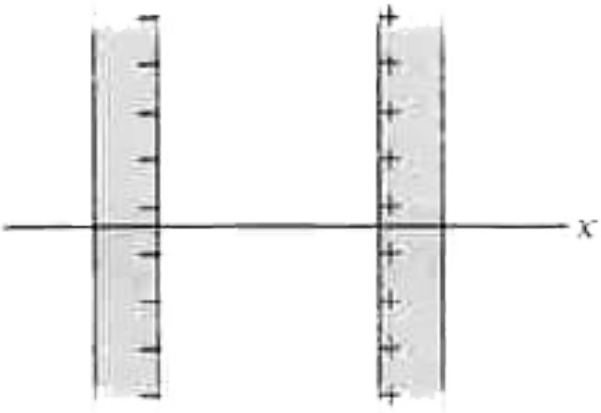
charge on the sphere? (b) What is the field magnitude at r = 8.0 m?




View Text Solution

**7.** two large, thin metal plates are parallel and close to each other. On their inner faces, the plates have excess surface charge densities of opposite signs and magnitude $2.31 \times 10^{-22} \frac{C}{m} 2.$ In unit-vector notation, what is the electric field at points (a) to the left of the plates,

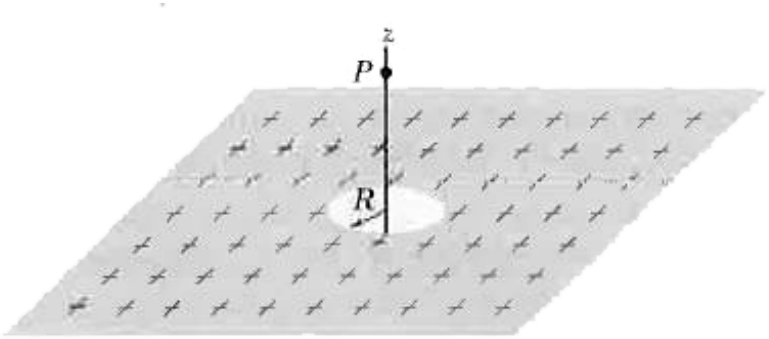
(b) to the right of them, and (c) between them?




View Text Solution

**8.** a small circular hole of radius R=1.30 cm has been cut in the middle of an infinite, flat, nonconducting surface that has uniform charge density $\sigma = 4.50p\frac{C}{m^3}$. . A z axis, with its origin at the hole's center, is perpendicular to the surface. In unitvector notation, what is the electric

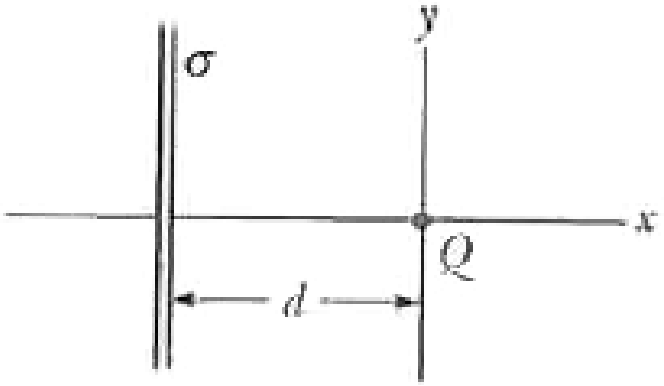
field at point Pat z = 2.56 cm?




View Text Solution

**9.** shows a very large nonconducting sheet that has a uniform surface charge density of $\sigma = -2.00\mu C/m^2$ it also shows a particle of charge $Q = 8.00\mu C$, at ore 2 Problem 9. distance d from the sheet. Both are fixed in place. If d=0.200 m, at what (a) positive and (b) negative coordinate on the x axis (other than infinity) is the net electric field $\vec{E}_{\neq t}$ of the sheet and particle zero? (c) If d = 0.950 m, at what coordinate on

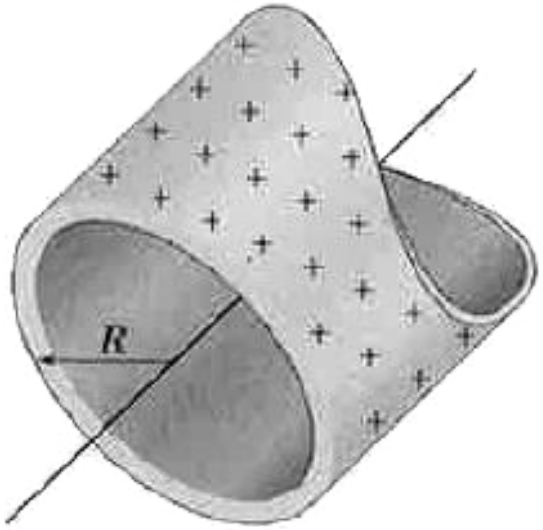
the x axis is $\int_e \_ ( \neq t) \_ 0$ ?




View Text Solution

**10.** shows a section of a long, thin-walled metal tube of radius R=2.50 cm, with a charge per unit length of $\lambda = 2.00xx10 - 8$ C/m. What is the magnitude E of the electric field at radial distance (a) r = R/2.00 and (b) r

= 2.00R? © Graph E versus r for the range r = 0 to 2.00R.

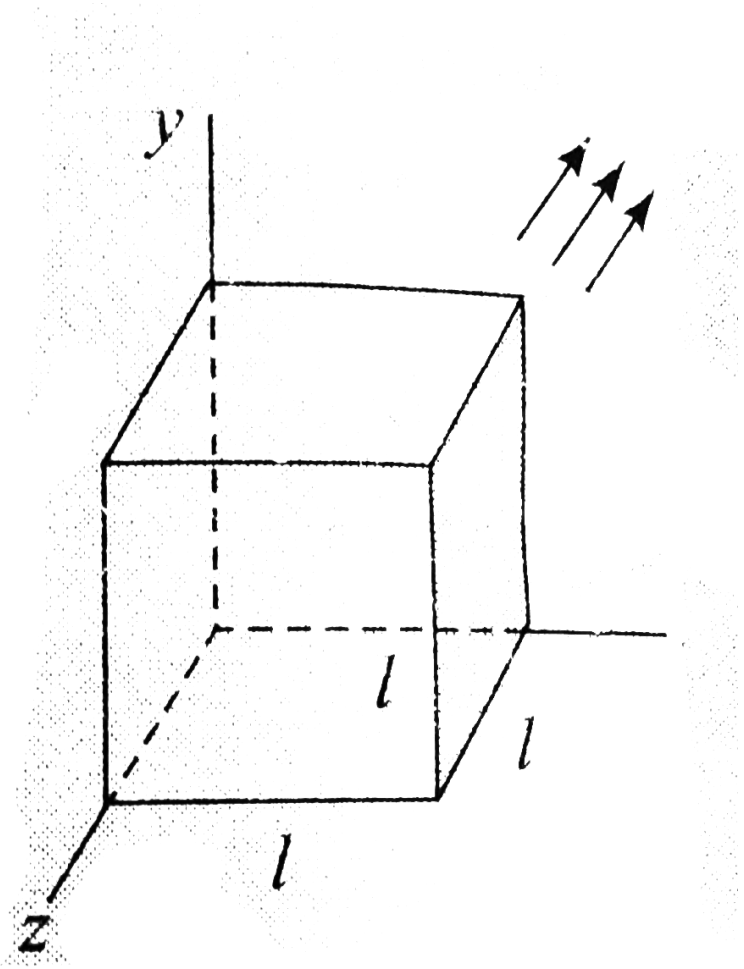



View Text Solution

**11.** A cube of edge length $l = 2.50cm$ is positioned as shown in Fig. 3.20. A uniform magnetic field given by $\overrightarrow{B} = \left(5.00\hat{i} + 4.00\hat{j} + 3.00\hat{k}\right)T$ exists throughout the region.

(a) Calculate the flux through the shaded face.

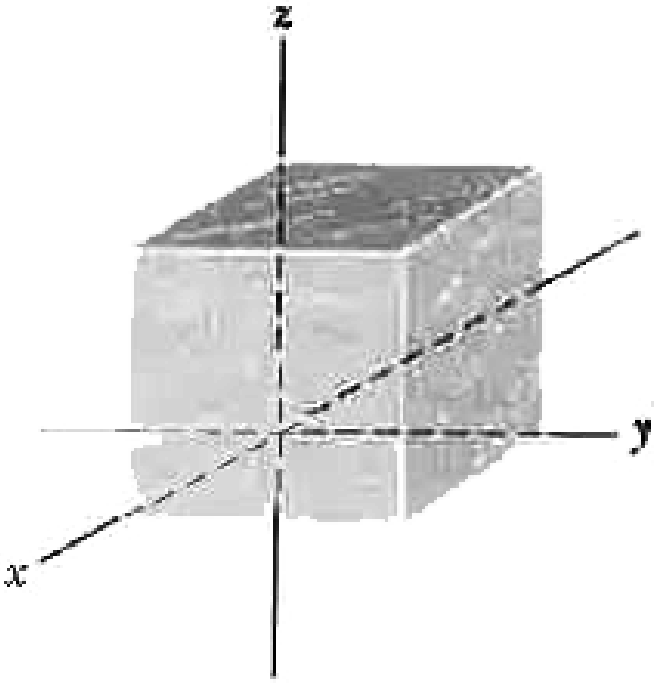
(b) What is the total flux through the six faces ?




Watch Video Solution

**12.** At each point on the surface of the cube shown in Fig. 23-47, the electric field is parallel to the z axis. The length of each edge of the cube

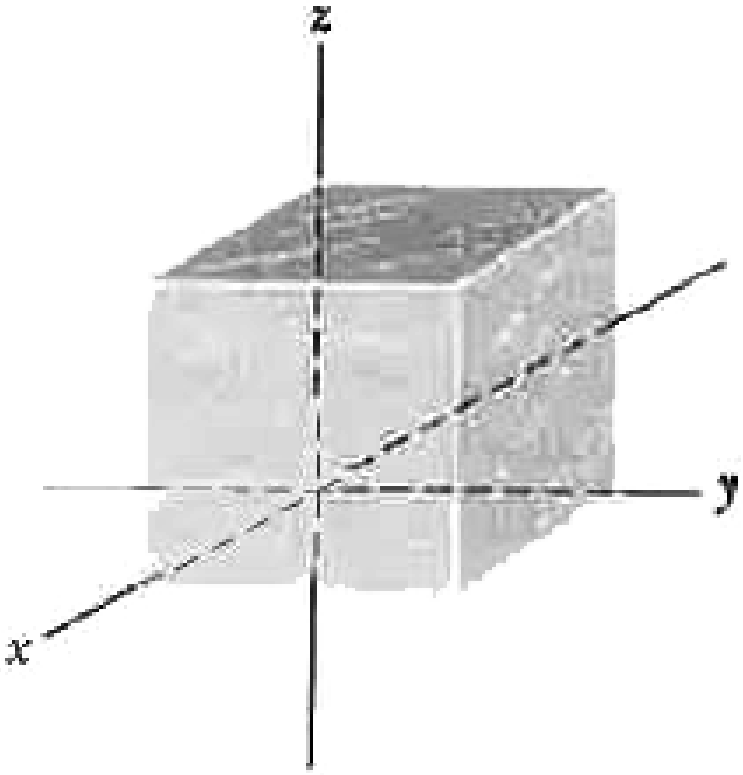
is 4.0 m. On the top face of the cube the field is $\vec{E} = -34\hat{k}$ N/C, and on the bottom face it is $\vec{E} = +20\hat{k}$ N/C Determine the net charge contained within the cube.




View Text Solution

**13.** shows a Gaussian surface in the shape of a cube with edge length 5.60 m. What are (a) the net flux $\phi$ through the surface and (b) the net charge $q_{exc}$ enclosed by the surface if $\vec{E} = \left(3.00y\hat{j}\right)$ N/C with y in meters? What

are (c )$\phi$ and $(d)9_{cnc}$ if $\vec{E} = \left[ -17.0\hat{i} + \left(6.00 + 3.00y\hat{j}\right)\right.$ N/C?




View Text Solution

**14.** a proton is a distance d/2 directly above the center of a square of side d. What is the magnitude of the electric flug through the square ?

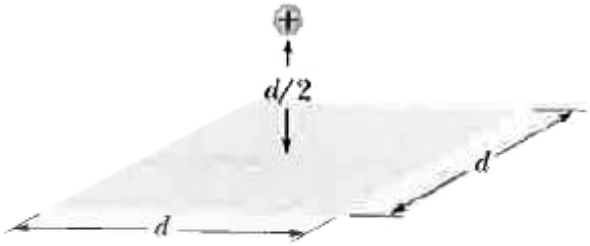
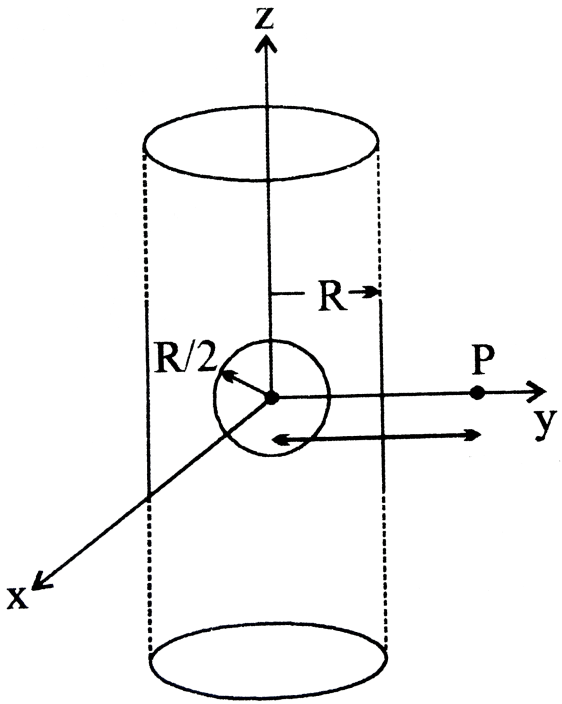



Figure 23-48 Problem 14.

View Text Solution

**15.** An infinitely long solid cylinder of radius $R$ has a uniform volume charge density $\rho$. It has a spherical cavity of radius $R/2$ with its centre on the axis of cylinder, as shown in the figure. The magnitude of the electric field at the point $P$, which is at a distance $2R$ form the axis of the

cylinder, is given by the expression $\frac{23rR}{16ke_0}$ . The value of $k$ is .

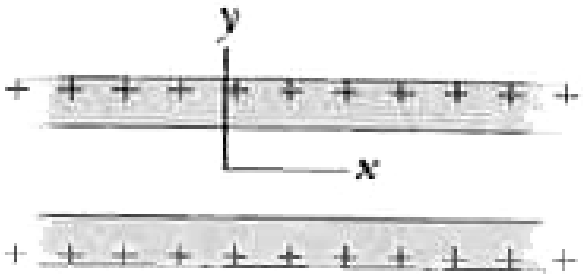



Watch Video Solution

**16.** Electric field intensity at a point due to an infinite sheet of charge having surface charge density $\sigma$ is $E$.If sheet were conducting electric intensity would be

Watch Video Solution

**17.** show cross section through two large, parallel, nonoconducting sheets with identical distrbutions of positive charge with surface charge density $\sigma = 2.31 \times 10^{-27} C/m^2$. In unit-vector notation, what is $\vec{E}$ at points (a) above the sheets, (b) between them, and (c ) below them ?

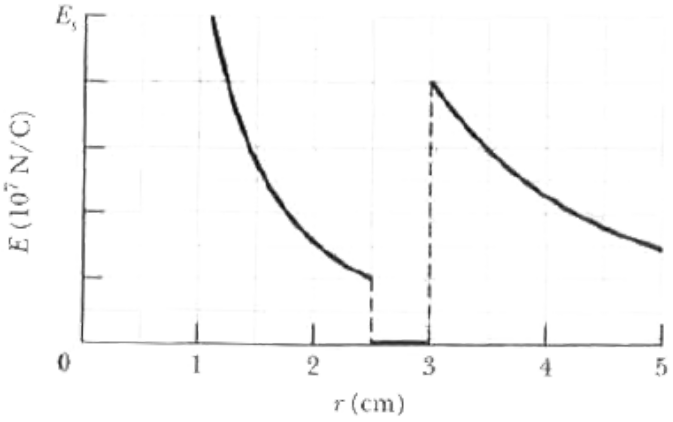



View Text Solution

**18.** A small non-conducting ball of mass $m$=1mg and charge $q = 2 \times 10^{-8}$ C hangs from an insulating thread that makes an angle $\theta = 30^{\circ}$ with vertical uniformly charged non-conducting sheet.Considering the gravitational force on the ball and assuming that the sheet extends for vertically and into out of the page.Calculate surface charge density of sheet.

Watch Video Solution

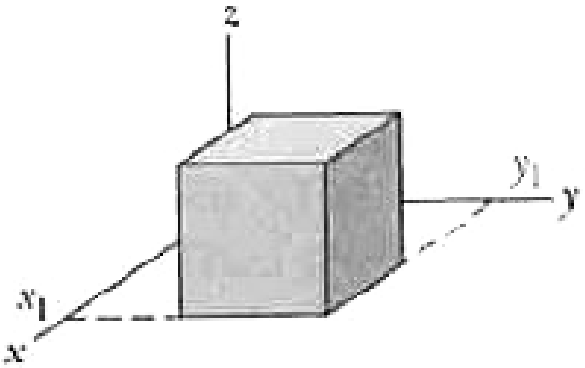
**19.** A charge particle is held at the center of a spherical shell. Gives the magnitude E of the electric field versus radial distance r. The scale of the vertical axis is set by $E_x = 5.0 \times 10^7 N/C$. Approximately, what is the net charge on the sheel ?




View Text Solution

**20.** shows a close Gaussian surface in the ssape of a cuibe of edge length $2.00m$, with ne corneer at $x_1 = 5.00m, y_1 = 4.00m$. The cube lies in a region where the electric field vector is given by

$\vec{E} = +23.0\hat{i} - 2.00\hat{j} - 16.0\hat{k}N/C$, with y in meters. What is the net charge contained by the cube ?

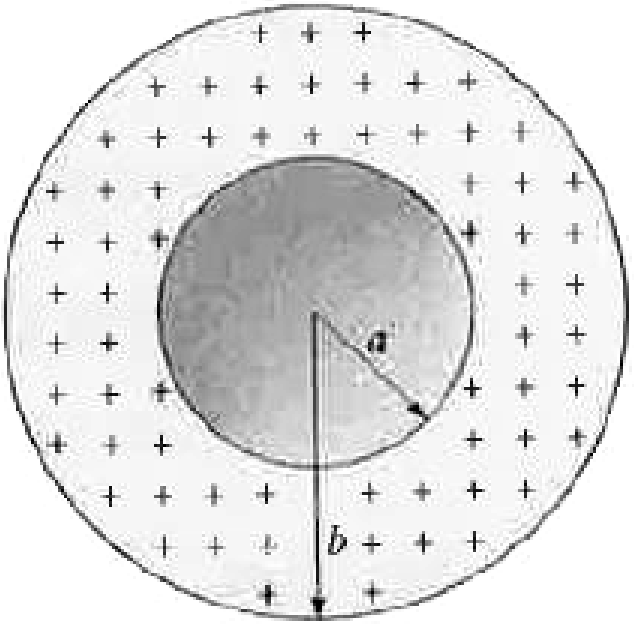



View Text Solution

**21.** Two charge conceptric spherical shell have radii $10.0cm$ and $15.0cm$. The charge on the inner shell is $7.50 \times 10^{-8}C$, and that on the outer shell is $6.33 \times 10^{-8}C$. Find the electric field (a) at $r = 12.0cm$ and $(b) at r = 20.0$ cm.

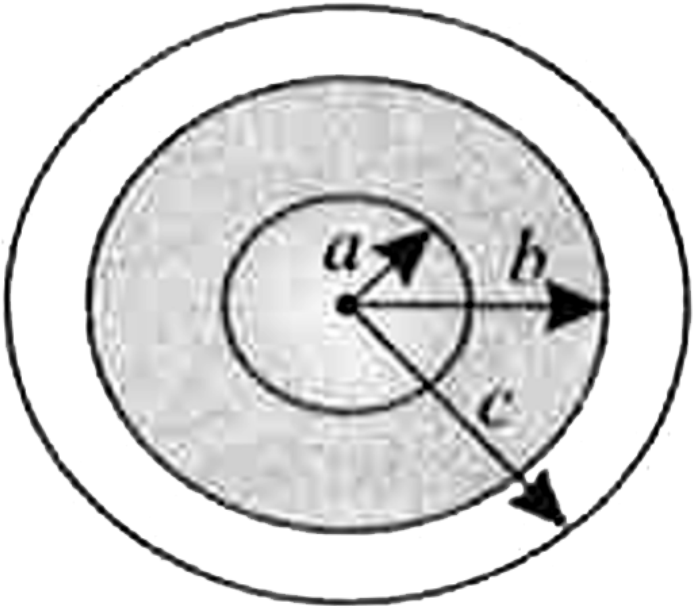
Watch Video Solution

**22.** show a spherical shell with uniform volume charge density $\rho = 1.56nC/m^3$, inner radius $a = 10.0cm$ and outer radius $b = 2.00a$. What is the magnitude of the electric field at radial distance (a) $r = 0, (b)r = a/2.00(c)r = a, (d)r = 1.50a, (e)r = b,$ and $(f)r = 3.00b$ ?



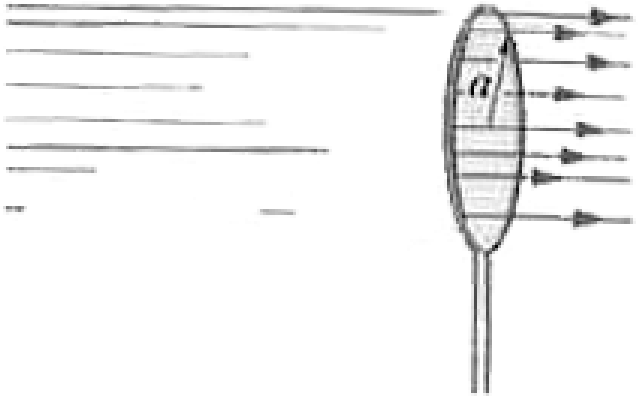

View Text Solution

**23.** In figure , a solid sphere of radius a = 2.00cm is concentric with a spherical conduction shell of inner radius b =2.00 a and outer radius c=2.40 a. the sphere has a net uniform 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 ?




Watch Video Solution

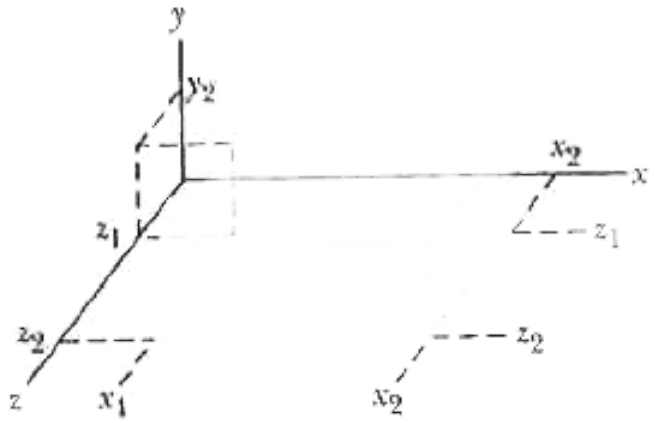
**24.** a butterflay net is in a uniform electric field of magnitude $E = 4.5mN/C.$ The rim a circle of radius $a = 11cm,$ is aligned perpendicular to the field. The net contains no net charge. Find the electric flux through the netting.




View Text Solution

**25.** The box-like Gaussian surface encloses a net charge of $+32\varepsilon_0$ C and lies in an electric field given by $\vec{E} = \left[(10.0 + 2.00x)\hat{i} - 3.00\hat{j} + bz\hat{k}\right] N/C,$ with x and z in meters and b a constant. The bottom face is in the xz plane, the top face is in the horzontal plane passing through $y_2 = 1.00m,$ For

$x_1 = 1.\ 00m, x_2 = 4.\ 00m, z_1 = 1.00m,$ and $z_2 = 3.\ 00m,$ what is b ?




View Text Solution

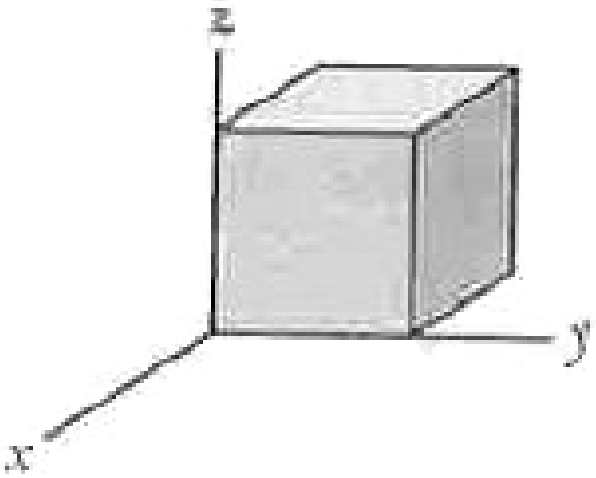
**26.** A uniformly charged conducting sphere of 2.4 m diameter has a surface charge density of $180.0\mu C/m^2$ (ii) Find the charge on the sphere. (ii) what is the total flux leaving the surface of the sphere ?

Watch Video Solution

**27.** A point charge q is placed at one corner of a cube of edge a. The flux through each of the cube faces is

Watch Video Solution

**28.** shows a closed Gaussian surface in the spape of a cube of edge length $1.50m$. It lies in a region where the nonuniform electric field is given by $\vec{E} = (3.00 + 4.00)\hat{i} + 6.00\hat{j} + 7.00\hat{k}N/C$, with x in meters. What is the net charge contained by cube ?




View Text Solution

**29.** When identical point charges are placed at the vertices of a cube of edge length $'a'$ each of them experiences a net force of magnitude $F$.

Now these charges are placed on the vertices of another cube of edge length $'b'$. What will be magnitude of the net force on any of the charges? These cubes are simply geometrical constructs and not made by any matter.

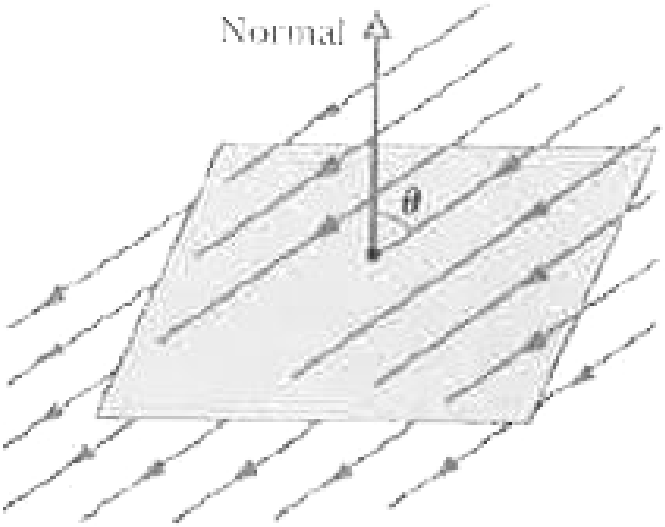
Watch Video Solution

**30.** The electric field near the surface of the earth is $300V/m$. The surface density of charge on the earth's surface is

Watch Video Solution

**31.** The square surface shown measure $6.8mm$ on each side. It is immersed in a uniform electric field with magnitude $E = 1800$ N/C and with field lines at an angle of $\theta = 35^\circ$ with a normal to the surface, as shown. Take that normal to be directed "outward," as though the surface were one face of a box (a) Calculate the electric flux through the surface. (b) If the angle is raduced by a few degres, does the flux increase,

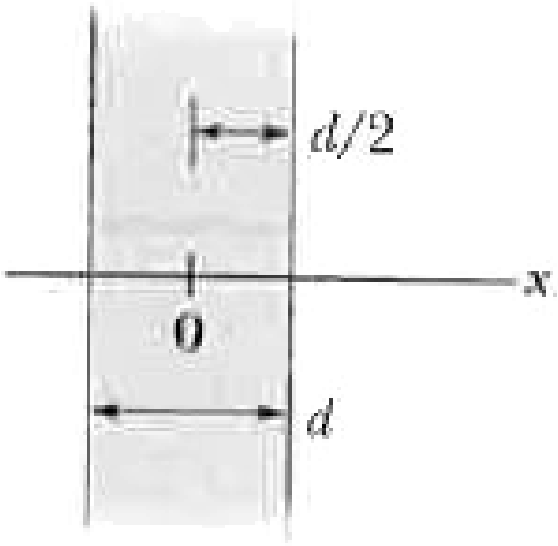
decreases, or remain the same ?




View Text Solution

**32.** shows a cross section through a very large nonconducting slab of thickness $d = 9.40$ mm and uniform volume charge density $\rho = 1.89 fC/m^3$. The origin of an x axis is at the slab's center. What is the magnitude of the slab's electric field at an x coordinate of (a) 0, (b)

$2.00mm$, $(c) 4.70mm$, and $(d) 26.0mm$ ?




View Text Solution

**33.** shows two nonconducting spherical shell fixed in place. Shell 1 has uniform surface charge density $+6.0\mu Clm^2$ on its outer surface and radius $3.0cm$, shall 2 has uniform surface charge density $+4.0\mu C/m^2$ on its unter surface and radius $2.0cm$, the shell centers are separated by $L = 12cm$. In unit vector notatio, what is the net electric field at

$x = 2.0cm$ ?

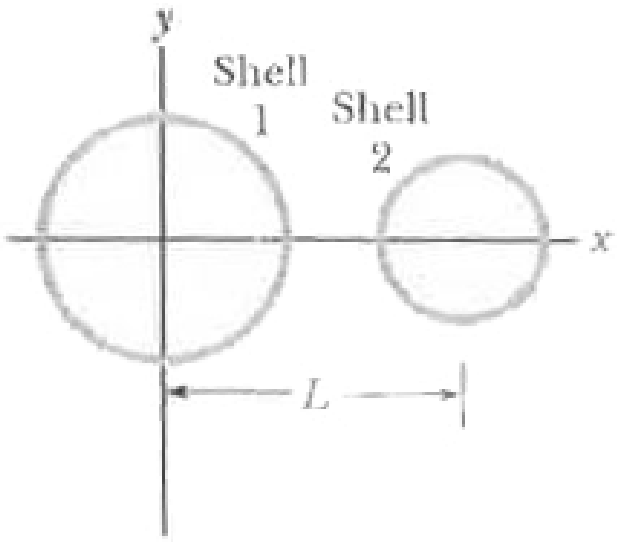



Figure 23-63 Problem 36.

View Text Solution

**34.** Flux and nonconducting shells. A charged particae is suspended at the center of two concentric spherical sheels that are very thin and made of nonconducting material. Shows a cross section. Gives the net flux $\phi$ through a Gaussian sphere centered on the particle, as a function of the radius r of the sphere. The scale of the vertical axis is set by $\phi_s = 10 \times 10^5 N.m^2/C$ (a) What is the charge of the central particle ?

What are the net charge of (b) shell A and (c ) shell B ?

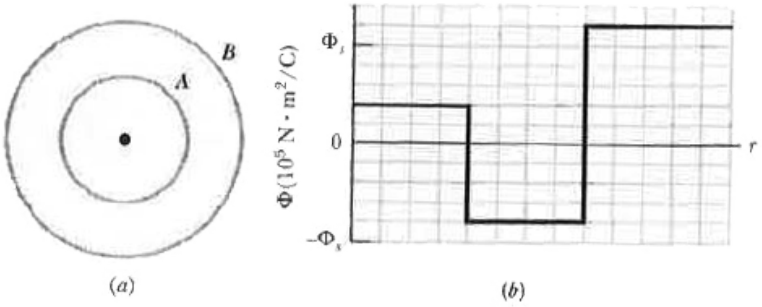
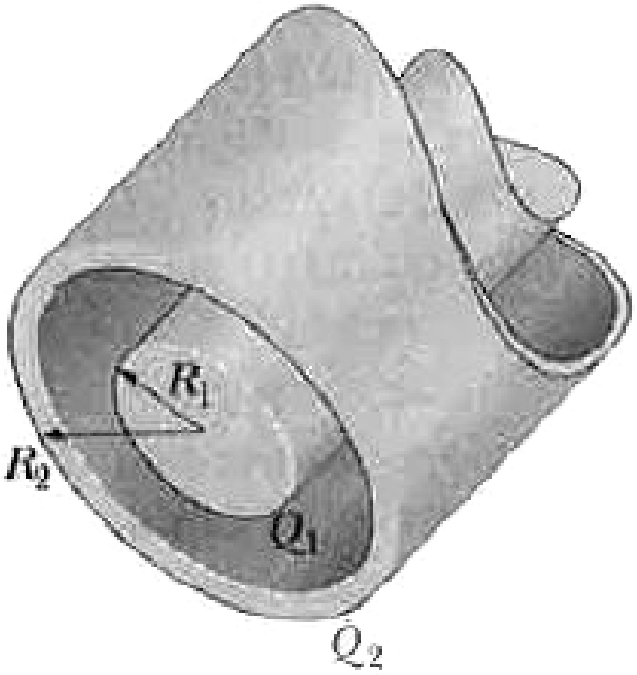



Figure 23-65 Problem 38.

View Text Solution

**35.** is a section of a condiucting rod of radius $R_1 = 1.30$ mm and length $L = 11.0$ m inside a thin-walled coaxial conducting cylinderical shell of radus $R_2 = 10.0R_1$and the (same) length L. The net charge on the rod is $Q_1 = -5.22 \times 10^{-13}C$, that on the shell is $Q_1 = -2.00Q_1$. What are the (a) magnitude E and (b) direction (radially inward or outward) of the electric field at radial distacne $r = 2.00R_2$ ? What are (c ) E and (d) the direction at $r = 5.00R_1$ ? What is the charge on the (e) interior and

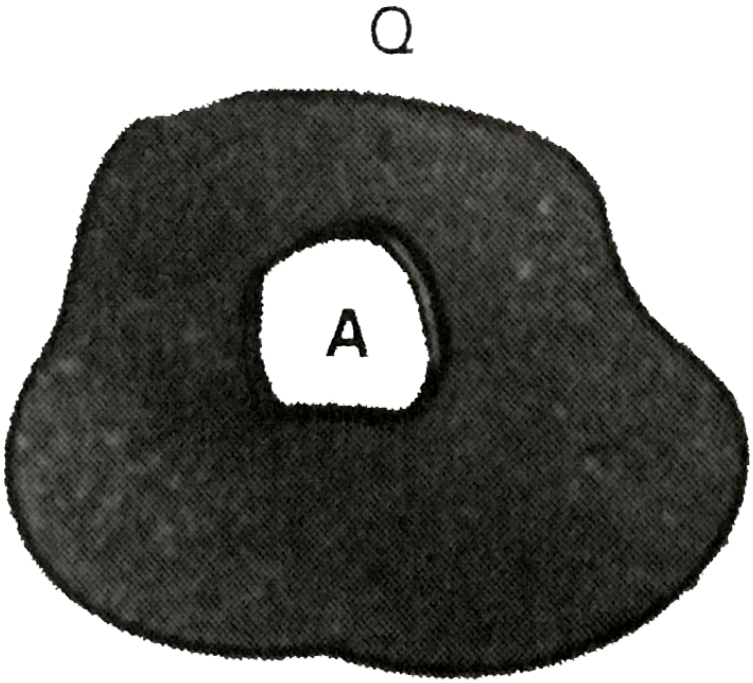
(f) exterior surface of the shell ?




View Text Solution

**36.** A conductor A with a cavity as shown in Fig. is given a charge Q. Show that the entire charge must appear on the outer surface of the

conductor.




Watch Video Solution

**37.** A metal sphere centered at the origin has a radius R and a net charge Q. The electric field at the point $x = 5R$ is $E_0$. The sphere is replaced by a different metal sphere centered at the origin with radius 2R and a net charge $Q_0$, The field at $x = 5R$ is still $E_0$. What is the ratio of $Q$ and $Q_0$ ?

Watch Video Solution

**38.** 10 सेमी भुजा तथा नगण्य मोटाई की वर्गाकार चालक प्लेट के पृष्ठ पर 20 मिक्रोकुलोम आवेश एकसामान रूप से विपरत है। (A) प्लेट के केंद्र से 1 मिमी दुरी दुरी पर वैधुत क्षेत्र की तीव्रता ज्ञात कीजिए।

(B) प्लेट को बिंदु आवेश मानकर 10 मीटर दुरी पर वैधुत क्षेत्र की तीव्रता ज्ञात कीजिए।

Watch Video Solution

**39.** An electron is fired directly towards the center of a large metal plate that has excess negative charge with surface charge density $= 2.0 \times 10^{-6} C/m^2$. If the initial kinetic energy of electron is 100 eV and if it is to stop due to repulsion just as it reaches the plate, how far from the plate must it be fired ?

Watch Video Solution

**40.** When a metal slab is placed between the charged identical , parallel plates , the potential difference between the plates

Watch Video Solution

**41.** Three identical metal plates with large surface areas are kept parallel to each as shown in figure (30-E8). The leftmost plate is given a charge Q, the rightmost a chrge _2Q and the middle one remains neutral. Finde the charge appearing on the outer surface of the rightmost plate.

Watch Video Solution

**42.** If a cavity is made as shown in the uniformaly charged sphere find the electric field at an arbitary point inside the cavity.

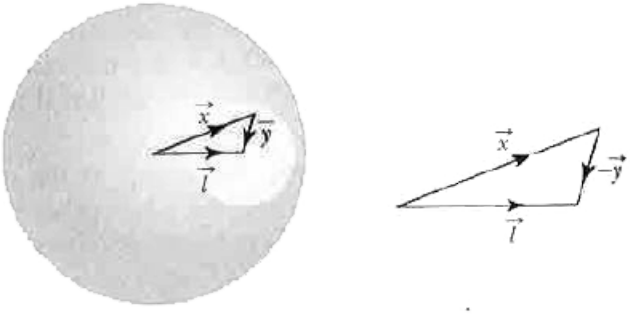


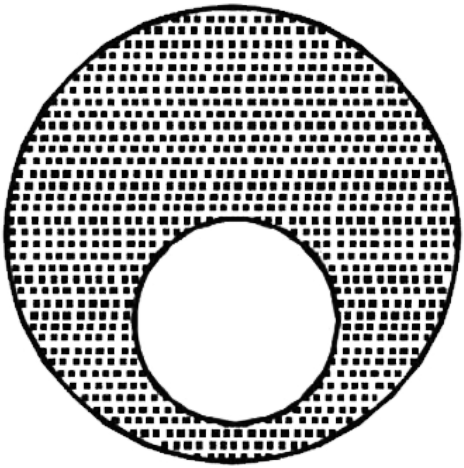

Figura 23-67 Problem 46.

View Text Solution

## PRACTICE QUESTIONS (SINGLE CORRECT CHOICE TYPE)

**1.** A spherical portion has been removed from a solid sphere having a charge distributed uniformly in its volume as shown in the figure. The

electric field inisde the emptied space is



A. Zero everywhere

B. Non zero and uniform

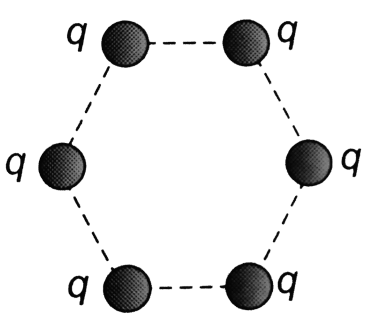
C. Non-uniform

D. Zero only at its centre

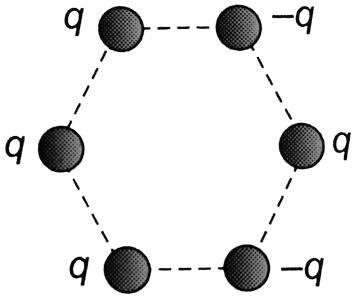
**Answer: A**

Watch Video Solution

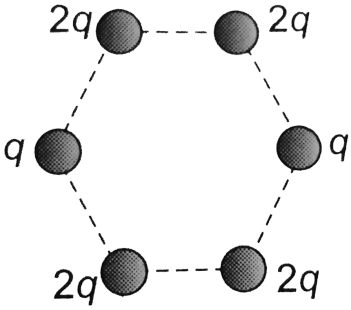
**2.** Figure below show regular hexagons with charges at the vertices. In which of the following cases the electric field at the centre is not zero



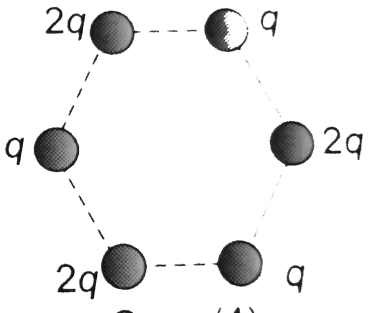

Case (1)




Case (2)




Case (3)




Case (4)

A. Inside a uniformly charged spherical shell.

B. In a spherical acvity inside a uniformly charged sphere.

C. In front of anite sheet of uniform surface charge density.

D. At a distance x from a point charge q.

**Answer: D**

Watch Video Solution

**3.** For a given surface the Gauss's law is stated as $\oint \vec{E} . d\vec{A} = 0$. From this we can conclude that

A. E is necessarily zero on the surface .

B. E is perpendicular to the surface at every point.

C. The total flux through the surface is zero.

D. The flux is only going out of the surface.

**Answer: C**

Watch Video Solution

**4.** If the uniform electric field is $3 \times 10^3 \hat{i} NC^{-1}$, then the flux of this field through a square of 10 cm on a side whose plane is parallel to the y-z-

plane is?

A. $30N.\ m^2/C$

B. $40N.\ m^2/C$

C. $50N.\ m^2/C$

D. $60N.\ m^2/C$

**Answer: A**

Watch Video Solution

**5.** A cubical guassian surface encloses 24 C of charge. The electric flux through each surface of the cube is

A. zero $N.\ m^2/C$

B. $4.0 \times 10^5 N.\ m^2/C$

C. $1.6 \times 10^5 N.\ m^2/C$

D. $3.1 \times 10^5 N.\ m^2/C$

**Answer: B**

Watch Video Solution

**6.** If the electric flux entering and leaving an enclosed surface respectively is $\phi_1$ and $\phi_2$, the electric charge inside the surface will be

A. $(\phi_1 + \phi_2)\varepsilon_0$

B. $(\phi_1 - \phi_2)\varepsilon_0$

C. $\frac{\phi_1 + \phi_2}{\varepsilon_0}$

D. $\frac{\phi_1 - \phi_2}{\varepsilon_0}$

**Answer: B**

Watch Video Solution

**7.** A uniformly charged conducting sphere of 2.4 m dimeter has a surface charge density of $80.0\mu C/m^2$. What is the total electric flux leaving the

surface of the sphere?

A. $1.6 \times 10^6 N.m^2/C$

B. $3.2 \times 10^8 N.m^2/C$

C. $4.8 \times 10^8 N.m^2/C$

D. $6.4 \times 10^8 N.m^2/C$

**Answer: A**

Watch Video Solution

**8.** Which of the following is true for electric flux through a Gaussian surface ?

A. $8.5 \times 10^9 N.m^2/C$

B. $1.3 \times 10^7 N.m^2/C$

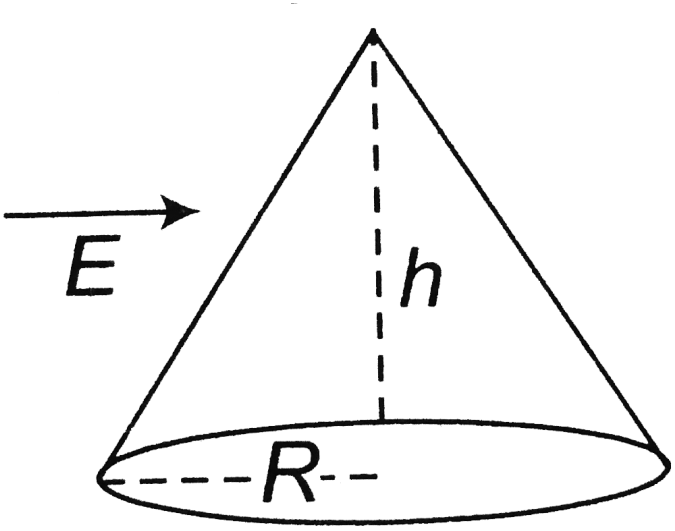
C. $7.2 \times 10^5 N.m^2/C$

D. $6.8 \times 10^8 N.m^2/C$

**Answer: A**

Watch Video Solution

**9.** A cone lies in a uniform electric field $E$ as shown in figure. The electric flux entering the cone is




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

B. $her$

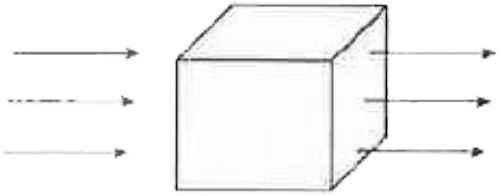
C. $2RhR$

D. $4EhR$

**Answer: B**

Watch Video Solution

**10.** A cubical Gaussian surface is placed in a uniform electric field as shown in the figure to the right . The length of each edge of the cube is $1.\ 0m.$ The uniform electric field has a magnitude of $5.0 \times 10^8 N/C$ and passes through the left and right sides of the cube perpendicular to the surface. What is the total electric flux that passes through the cubical Gaussian surface ?



A. $5.0 \times 10^8 N.\ m^2/C$

B. $2.5 \times 10^6 N.\ m^2/C$

C. zero $N.\ m^2/C$

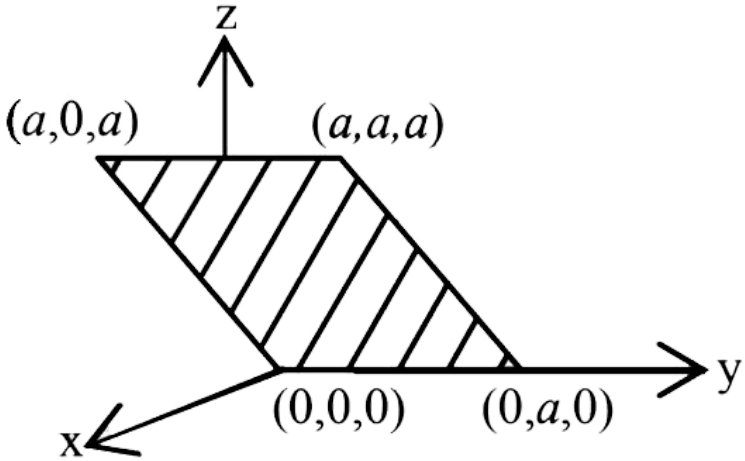
D. $3.0 \times 10^9 N.\ m^2/C$

**Answer: C**

Watch Video Solution

**11.** Conisder an electric field $\vec{E} = E_0\hat{x}$ where $E_0$ is a constant .

The flux through the shaded area (as shown in the figure) due to this field is




A. $2E_0a^2$

B. $\sqrt{2}E_0a^2$

C. $E_0a^2$

D. $\frac{E_0 a^2}{\sqrt{2}}$

**Answer: C**

Watch Video Solution

**12.** A plane surface of area $200 cm^2$ is kept in a uniform electric field of intensity 200 N/C. if the angle between the normal to the surface and field is $60^\circ$, the electric flux through the surface is

A. $1.56 \times 10^6 N.m^2/C$

B. $1.42 \times 10^5 N.m^2/C$

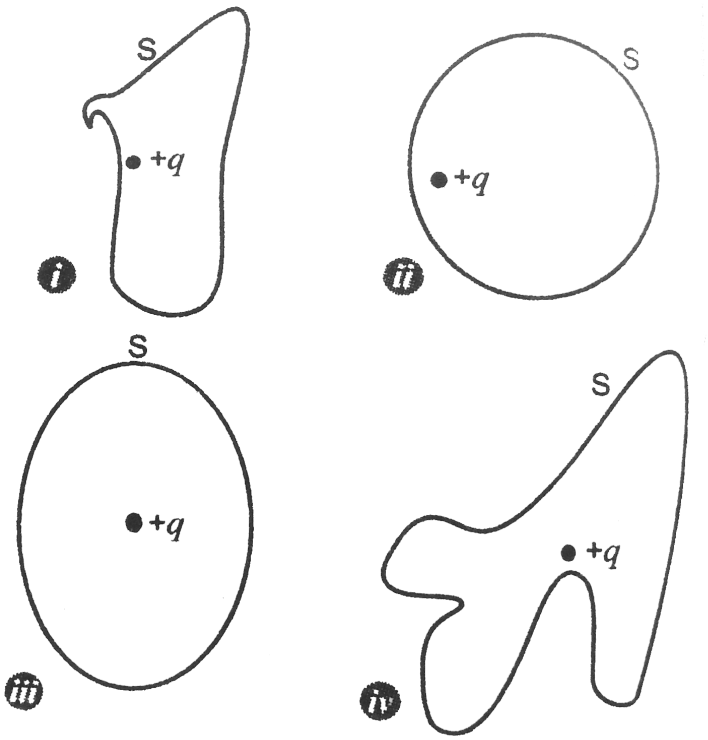
C. $6.60 \times 10^5 N.m^2/C$

D. $5.49 \times 10^4 N.m^2/C$

**Answer: C**

Watch Video Solution

**13.** The electric flux through the surface




A. $46N.m^2/N$

B. $220N.m^2/C$

C. $92N.m^2/C$

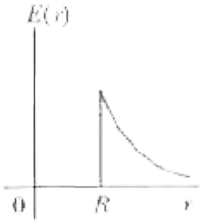
D. $35N.m^2/C$

**Answer: D**

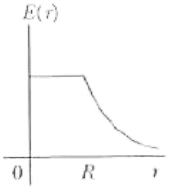
Watch Video Solution

**14.** A thin spherical shell of radius R has charge Q spread uniformly over its surface. Which of the following graphs most closely represents the electric field E(r) produced by the shell in the range $0 \leq r < \infty$, where r is the distance from the centre of the shell?

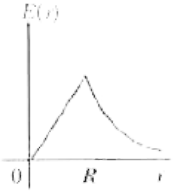
A.

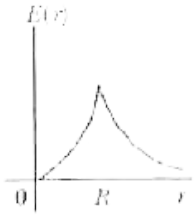



B.




C.






D.

**Answer: A**

Watch Video Solution

**15.** Let there be a spherically symmetric charge distribution with charge density varying as $\rho(r) = \rho\left(\frac{5}{4} - \frac{r}{R}\right)$ upto $r = R$, and $\rho(r) = 0$ for $r > R$, where r is the distance from the origin. The electric field at a distance r(rltR) from the origin is given by

A. $\frac{\rho_0}{4\varepsilon_0}\left(\frac{r}{3} - \frac{r^2}{4R}\right)$

B. $\frac{\rho_0}{\varepsilon_0}\left(\frac{r}{3} - \frac{r^2}{4R}\right)$

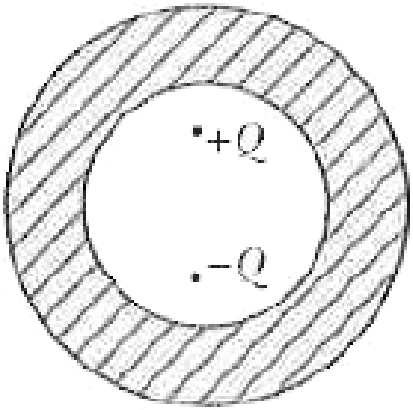
C. $\frac{\rho_0}{3\varepsilon_0}\left(\frac{r}{3} - \frac{r^2}{4R}\right)$

D. $\frac{\rho_0}{12\varepsilon_0}\left(\frac{\frac{r}{3} - r^2}{4R}\right)$

**Answer: B**

Watch Video Solution

**16.** Shown in the figure are two point charges $+Q$ and $-Q$ inside the cavity of a spherical shell. The charges are kept near the surface of the cavity on opposite sides of the center of the shell. If $\sigma_1$ is the surface charge on the inner surface and $Q_1$ net charge on it and $\sigma_2$ the surface charge on the outer surface and $Q_2$ net charge on it then




A. $\sigma_1 \neq 0, Q_1 \neq 0$
$\sigma_2 \neq 0, Q_2 \neq 0$

B. $\sigma_1 \neq 0, Q_1 = 0$
$\sigma_2 \neq 0, Q_2 = 0$

C. $\sigma_1 \neq 0, Q_1 = 0$
$\sigma_2 = 0, Q_2 = 0$

D. $\sigma_1 = 0, Q_1 = 0$
$\sigma_2 = 0, Q_2 = 0$

**Answer: D**

Watch Video Solution

**17.** A uniformly charged conducting sphere of 2.4 m dimeter has a surface charge density of $80.0\mu C/m^2$. What is the total electric flux leaving the surface of the sphere?

A. $2.89 \times 10^5 N/C$, radially inward

B. $9.38 \times 10^5 N/C$, radially outward

C. $6.49 \times 10^5 N/C$, radially outward

D. $1.30 \times 10^6 N/C$, radially inward

**Answer: A**

Watch Video Solution

**18.** Consider three different closed surfaces, Surface A is a sphere of radius R, Surface B is a sphere of radius 2R, and surface C is a cube with side length R. At the geometric center of each closed surface is a small ball that is completely enclosed by the surface and carries electrical charge +q. Assuming that there are no other charged objects inside any of the surfaces, rank the surfaces based on the field line flux through them, from largest to smallest.

A. $A > B > C$

B. $A > C > B$

C. $B > C > A$

D. All are equal

**Answer: D**

Watch Video Solution

**19.** एक लम्बे सीधे तार में $3.5A$ विद्युत धारा प्रवाहित हो रही है | तार से 20 cm पर स्थित किसी बिंदु पर चुम्बकीय क्षेत्र का परिमाण ज्ञात कीजिए |

A. $1.9 \times 10^{10} N/C$

B. $6.1 \times 10^{13} N/C$

C. $4.8 \times 10^{-7} N/C$

D. $1.5 \times 10^{6} N/C$

**Answer: C**

Watch Video Solution

**20.** Two spherical shells have a common center. A charge of $-1.6 \times 10^{-6}$ C is spread uniformaly over the inner shell, which has a radius of $0.050m$. A charge of $+5.1 \times 10^{-6} C$ is spread uniformly over the outer shell, which has a radius of $0.15m$. Find the magnitude and direction of the electric field at distacne (measured from the common center) of $0.20m$.

A. $7.9 \times 10^5 N/C$, radially outward

B. $5.9 \times 10^5 N/C$, radially inward

C. $3.2 \times 10^5 N/C$, radially outward

D. zero N/C

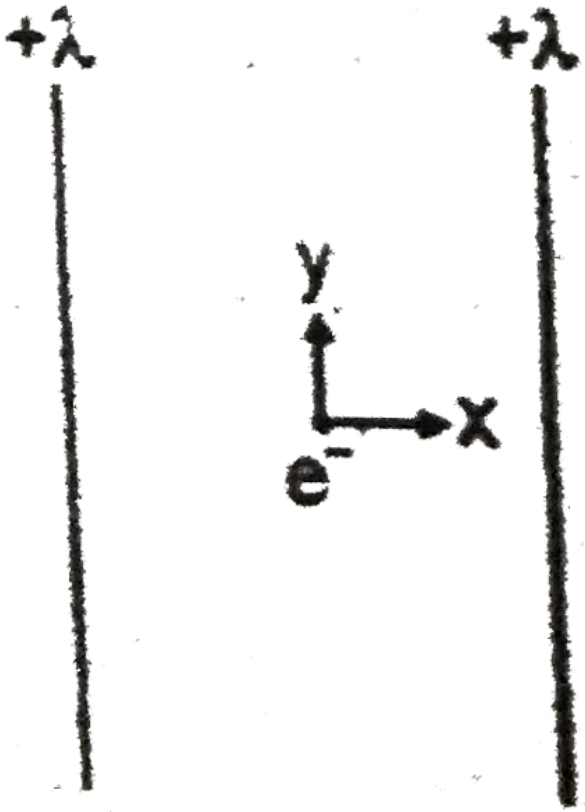
**Answer: A**

Watch Video Solution

## PRACTICE QUESTIONS (MORE THAN ONE CORRECT CHOICE TYPE)

**1.** An electron is placed just in the middle between two long fixed line charges of charge density $+\lambda$ each. The wires are in the xy plane (do not

consider gravity)




A. The equilibeium of the electron will be unstable along x direction.

B. The equlibrium of the electron will be lneutral along y diraction.

C. The equlibrium of the electron will be stable along z direction.

D. The equlibrium of the electron will be stable along y direction.

**Answer: A::B::C**

Watch Video Solution

**2.** A non conducting solid sphere of radius R is uniformly charged. The magnitude of electric field intensity due to the sphre at a distance r from its centre

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

B. Decreases as r increases for $0 < r < R$

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

D. Is discontinuous at $r = R$

**Answer: A::C**

Watch Video Solution

## PRACTICE QUESTIONS (LINKED COMPREHENSION)

**1.** A sphere of charges of radius R carries a positive charge whose volume chasrge density depends only on the distance r from the ball's centre as $\rho = \rho_0\left(1 - \frac{r}{R}\right)$, where$\rho_0$ is constant. Assume epsilon as theh permittivity of space.

The magnitude of the electric field as a functiion of the distance r outside the balll is given by

A. $E = \frac{\rho_0 R^3}{8\varepsilon r^2}$

B. $E = \frac{\rho_0 R^3}{12\varepsilon r^2}$

C. $E = \frac{\rho_0 R^3}{16\varepsilon r^2}$

D. $E = \frac{\rho_0 E^3}{24\varepsilon r^2}$

**Answer: B**

Watch Video Solution

**2.** A sphere of charges of radius R carries a positive charge whose volume chasrge density depends only on the distance r from the ball's centre as

$\rho = \rho_0\left(1 - \frac{r}{R}\right)$, where $\rho_0$ is constant. Assume epsilon as theh permittivity of space.

The value of distance $r_m$ at which electric field intensity is maximum is given by

A. $r_m = \frac{R}{3}$

B. $r_m = \frac{3R}{2}$

C. $r_m = \frac{2R}{3}$

D. $r_m = \frac{4R}{3}$

**Answer: C**

Watch Video Solution

**3.** A sphere of charges of radius R carries a positive charge whose volume chasrge density depends only on the distance r from the ball's centre as $\rho = \rho_0\left(1 - \frac{r}{R}\right)$, where $\rho_0$ is constant. Assume epsilon as theh permittivity of space.

the maximum electric field intensity is

A. $\frac{\rho_0 R}{9\varepsilon}$

B. $\frac{\rho_0 \varepsilon}{9R}$

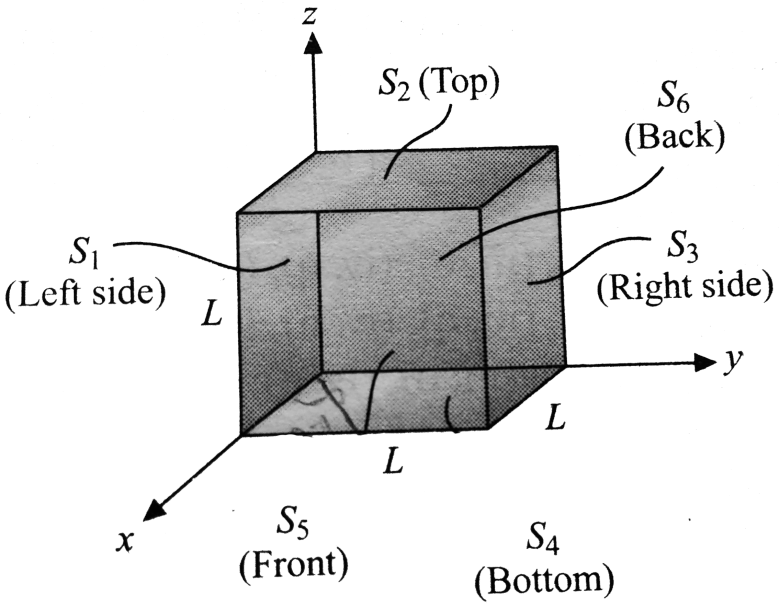
C. $\frac{\rho_0 R}{3\varepsilon}$

D. $\frac{\rho_0 R}{6\varepsilon}$

**Answer: A**

Watch Video Solution

**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 $37^\circ$ measured from the $+x$ - axis toward the $+y$- axis .




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 $S_2$

**Answer: C**

Watch Video Solution

**5.** 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 $37^\circ$ measured from the $+x$ - axis toward the $+y$ - axis .

Electric flux passing through surface $S_1$ is

A. $-24N.\, m^2/C$

B. $24N.\, m^2/C$

C. $32N.\, m^2/C$

D. $-32N.\, m^2/C$

**Answer: A**

Watch Video Solution

**6.** 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 $37^\circ$ measured from the $+x - a\xi s$

toward the $+y-a\xi s$ .

Electric flux passing through surface $S_6$ is

A. $-24N.\ m^2\ /C$

B. $24N.\ m^2\ /C$

C. $32N.\ m^2\ /C$

D. $-32N.\ m^2\ /C$

**Answer: D**

Watch Video Solution

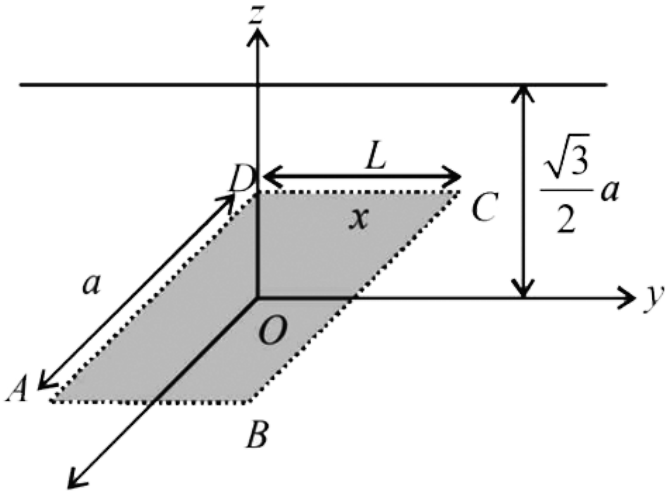
## PRACTICE QUESTIONS (INTEGER TYPE)

**1.** A parallel plate capacitor of capacitance $3\mu F$ has total charge $+15\mu C$ on one plate and total charge $-15\mu C$ on the other plate. The separation

between the plates is 1mm. The electric field between the plates has magnitude: (in N/C)

Watch Video Solution

**2.** An infinity long uniform line charge distribution of charge per unit length $\lambda$ lies parallel to the y-axis in the $y-z$ plane at $z=\frac{\sqrt{3}}{2}$ a(see figure). If the magnitude of the flux of the electric field through the rectangular surface ABCD lying in the $x-y$ plane with its centre at the origin is $\frac{\lambda L}{\neq \psi lon_0}$ ($\varepsilon_0 =$ permittivity of free space), then the value of n is




Watch Video Solution

**3.** A system consits of a ball of radus $R$ carrying spherically symmetric charge and the surrounding space filled with a charge of volume density $\rho = \alpha / r$ , wehre $\alpha$ is a constant, $r$ is the distance from the centre of the ball. Find the ball's the charge at whcih the magnitude of the electric field strength vector is independent of $r$ outside the ball. How high is this strength ? The permittives of the ball and the surrounding space are assumed to be equal to unity.

Watch Video Solution