**Chapter23**
**Guass' Law**

**Flux**

Q1. For the electric field:E = (24 i + 30 j + 16 k) N/C,where i, j, and k are the unit vectors in the directions of x, y, and z, respectively, the electric flux through a 2.0 $m^2$ portion of the yz-plane is:Ans:48 $Nm^2/C$.
Q2. When a piece of paper is held with one face perpendicular to a uniform electric field, the electric flux is 48 $Nm^2/C$. When the plane of the paper makes 30 degrees with the direction of the electric field the electric flux through it is:Ans: 24 $Nm^2/C$

**Flux of an Electric Field**

Q3. An infinitely long line has a charge density of 7.6 nano-C/m. Calculate the electric flux through a spherical surface of radius R = 7.7 cm whose center, C, lies on the line charge as shown in Figure 3. Ans: 132 $(Nm^2)/C$

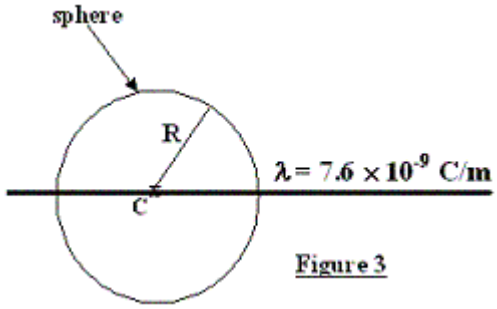

Figure 3

m major2-001-Q0ajor2-001-Q0
Q4. If a rectangular area is turned in a uniform electric field from a position where the maximum electric flux goes through it to a position where only half the maximum flux goes through it, what is the turned angle?Ans:60 degrees

**Gauss' Law**

Q5. A point charge Q= 6 micro-C is placed at the center a rectangular box with dimensions a=b= 0.4 m and c= 0.6 m. Find the total electric flux through the surface of the box.Ans: $6.78\times10^5$ $Nm^2/C$
Q6. Charges q and Q are placed on the x axis at x= 0 and x= 2.0 m, respectively. If q= -40 pico-C and Q= +30 pico-C, determine the net electric flux through a spherical surface of radius 1.0 m centered on the origin.Ans:-4.5 $Nm^2/C$

**Gauss' Law and Coulomb's Law**

Q7. The electric field everywhere on the surface of a hollow sphere of radius 11 cm is measured to be equal $3.8\times10^4$ N/C and points radially inward towards the center of the sphere. How much charge is enclosed by this surface?Ans:$-5.1\times10^{-8}$ C.
Q8. A positive point charge q sits at the center of a hollow spherical shell. The shell, with radius R and negligible thickness, has net charge -2q. The electric field strength outside the spherical shell (at r>R) will be:Ans:$kq/r^2$ radially inwards.

**A Charged Isolated Conductor**

Q9. A point charge (q= -10.0 micro-C) is at the center of a metallic sphere that has a radius of 20.0 cm. The electric field 0.500 m away from the center of the sphere is found to be -432 kV/m. What is the charge density on the metallic sphere?Ans: -4.00 micro-C/$m^2$
Q10. A spherical conducting shell of inner radius $r_1$ and outer radius $r_2$ has a net charge of 2 micro-C. If a point charge of -4.0 micro-C is placed at the geometrical center of the spherical shell, what is the charge on the outer surface of the spherical shell? Ans:-2.0 micro-C

**Applying Gauss' Law: Cylindrical Symmetry**

Q11. Consider an infinitely long line of charge density 2.0 micro-C/m lying along the x-axis as shown in Figure 4. What is the ratio of electric field strength at point A to that at point B?Ans:0.50

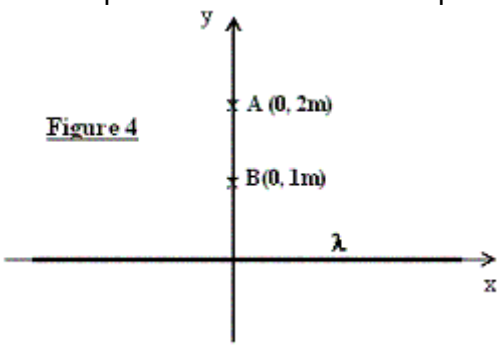

Figure 4

Q12. An infinite line of charge produces an electric field of $6.0\times10^4$ N/C at a perpendicular distance of 2.5 m from its axis. Calculate the linear charge density.Ans:$8.3\times10^{-6}$ C/m.

**Applying Gauss' Law: Planar Symmetry**

Q13. Two infinite non-conducting parallel surfaces carry uniform charge densities of 0.20 nano-C/$m^2$ and -0.60 nano-C/$m^2$. What is the magnitude of the electric field at a point between the two surfaces?Ans:45 N/C
Q14. Figure 4 shows cross-sections through two large, parallel non-conducting sheets with identical distributions of negative charge. The surface charge density for each sheet is $7.00\times10^{-15}$ C/$m^2$. What is the electric field at point A ? Ans:$7.91\times10^{-4}$ N/C downward

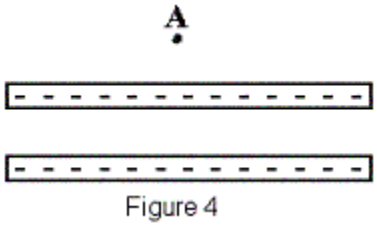

Figure 4

**Applying Gauss' Law: Spherical Symmetry**

Q15. Which one of the graphs shown in Figure 2 represents the variation of the magnitude of the electric field with the distance from the center of a solid charged conducting sphere of radius R in electrostatic equilibrium? Ans: #5

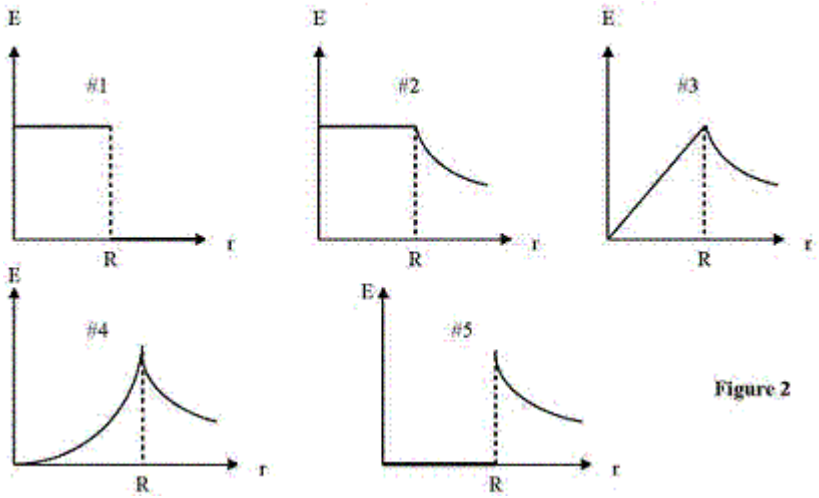


Figure 2

Q16. Two conducting spheres are far apart. The smaller sphere carries a total charge of 4 micro-C, and the larger sphere carries a total charge of 2 micro-C. The larger sphere has a radius that is twice that of the smaller sphere. After the two spheres are connected by a thin conducting wire, the charges on the smaller and larger spheres, respectively, are:Ans:2 micro-C and 4  micro-C