Chapter B - Problems

Blinn College - Physics 2426 - Terry Honan

Problem B.1

A disk with a 12 cm radius is rotated through all possible orientations in a uniform electric field. If it is found that the maximum electric flux is $300\,\mathrm{N\cdot m^2/C}$ then what is the magnitude of the electric field?

Problem B.2

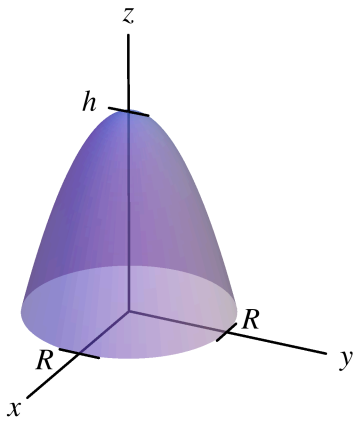
A flat surface of area A sits in an electric field of $\vec{E} = \langle a, b, 0\rangle$. (This field is in the xy-plane.) What is the flux through the surface if it sits

(a) in the yz-plane?

(b) in the xz-plane?

(c) in the xy-plane?

Problem B.3



Consider the truncated paraboloid shown. What is the flux through the paraboloid due to the electric fields:

(a) $\vec{E} = \langle a, 0, 0\rangle$?

(b) $\vec{E} = \langle 0, b, 0\rangle$?

(c) $\vec{E} = \langle 0, 0, c\rangle$?

(d) $\vec{E} = \langle a, b, c\rangle$?

Problem B.4

A point charge Q sits above an infinite horizontal plane. What is the flux of the charge through the plane?

Problem B.5

A point charge Q sits at the center of a cube with sides of length ℓ. What is the electric flux through one face of the cube?

Problem B.6

(a) An insulating sphere with a 12 cm radius has a uniform charge of 216 μC. What is the charge inside spherical Gaussian surfaces of radius 4 cm, 6 cm and 15 cm?

(b) A conducting sphere with a 12 cm radius has a net charge of 216 μC. What is the charge inside spherical Gaussian surfaces of radius 4 cm, 6 cm and 15 cm?

Problem B.7

A 12 m long line with a uniform charge of 3 μC. Consider a tube of radius 8 cm and of length 2 cm; adding 8 cm radius disks to each end makes it a closed surface. Take this to be our Gaussian surface. Take the line to be the central axis of the tube and the center of the line to be the center of the tube.
(a) What is the total charge enclosed by the Gaussian surface?
(b) Using the assumptions that 2 cm and 8 cm are both much less than 12 m, find the electric field at the surface of the tube.

Problem B.8

Consider the general case of spherical symmetry where there is a charge distribution given by $\rho(r)$, where r is the radial distance from some origin.
(a) Find a general expression for the electric field as a function of postion in terms of an integral over the charge density.
(b) For the case of $\rho(r) = a/r$ find the field as a function of position.

Problem B.9

What is the magnitude of the electric field a perpendicular distance of 6 cm from the surface of a large uniformly charged plane with a charge per area of 9 $\mu C/m^2$?

Problem B.10

Consider a disk in the xy-plane of radius R with a uniform charge Q. Take z to be the perpendicular distance above the center of the disk.

(a) What is the electric field just above (a small z value $z \ll R$) this surface?

(b) What is the field at a large perpendicular distance z ($z \gg R$) above the disk?

Problem B.11

A long straight conducting rod of radius R is give a charge per length of λ.

(a) What is the electric field as a function of r, the perpendicular distance from the center? Give answers for both possible cases: $r < R$ and $r > R$.

(b) If $R = 5\,\text{cm}$ and $\lambda = 30\,\text{nC/m}$, then what is the electric field magnitude at $r = 3\,\text{cm}$, $10\,\text{cm}$ and $100\,\text{cm}$? What is the surface charge density (charge per area) on the conductor?

Problem B.12

The electric field at the surface of a conducting sphere is $300\,N/C$.

(a) What is the surface charge density (charge per area) on the conductor?

(b) If the total charge on the conductor is $2\,\text{nC}$, then what is the radius of the sphere?

Problem B.13

A solid insulating sphere of radius a has a uniform charge Q. This sits inside of a hollow conducting sphere with and inside radius b and outside radius c. The conductor is given a net charge of q. (All spherical surfaces are concentric.)

(a) What is the electric field as a function of position? Give answers for all cases: $r < a$, $a < r < b$, $b < r < c$ and $r > c$.

(b) Specify the distribution of charge by giving the charge densities. If the charge is spread over a volume then give its volume density ρ and if it is over a surface give its surface density σ.