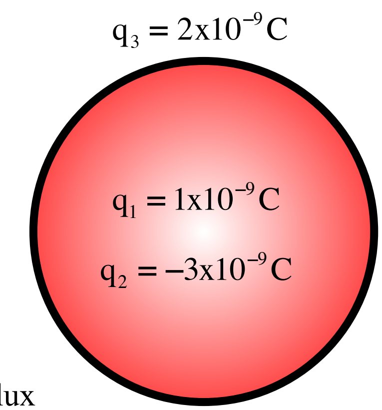
24-Series Problem

24.1) The maximum electric flux through a 40.0 cm diameter circular hoop is $5.20\text{x}10^{5}\,\text{N}\bullet\text{m}^{2}/\text{C}$. How big is the electric field?

24.6) Assuming the two charges superimposed on the sphere are *inside* the sphere, determine the net electric flux through the charged sphere shown to the right.



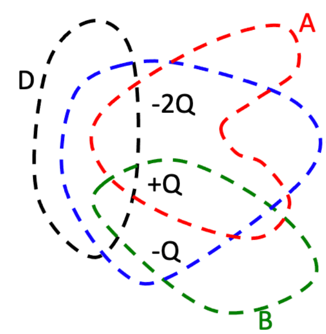
24.7) A 10.0 cm radius insulator (non-conductor) has a $10\ \mu\text{C}$ charge at its center. A 1.00 mm radius hole is drilled into the sphere. What is the electric flux through the hole?

24.9) A submarine carries the following charges: $5.00\ \mu\text{C}$, $-9.00\ \mu\text{C}$, $27.0\ \mu\text{C}$ and $-84\ \mu\text{C}$.

a.) What is the net electric flux through the sub's hull?

b.) Is the net flux into or out of the hull? That is, are there more field lines moving into the hull or out of the hull?

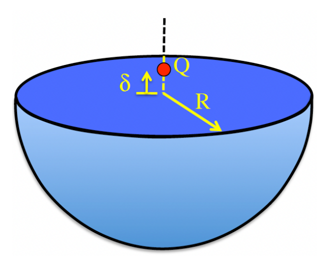
24.11) There are four closed surface which intersect the page along the dotted lines shown to the right. There are also three charges in the plane of the page. Determine the electric flux through each surface.



24.17.) A point charge Q is positioned above the face of a hemisphere of radius R.

a.) Determine the electric flux through the curved surface.

b.) Determine the electric flux through the flat face.



24.23) A flat, horizontal sheet has a charge density of $\sigma = 9.00\ \mu\text{C/m}^{2}$. Assuming the sheet is large, what is the electric field just above the middle of the sheet?

24.27) A 14.0 cm radius spherical shell (thin) has a uniformly distributed charge of $32.0\ \mu\text{C}$ on its surface.

a.) Derive an expression for the E-fld at *r = 10 cm*, then calculate that value. Show any Gaussian surface used.

b.) Derive an expression for the E-fld at $r = 20\ cm$, then calculate that value. Show any Gaussian surface used.

24.29) 2.00 μC of charge are uniformly distributed over a straight, 7.00 meter long filament. Coaxially surrounding the filament is a 10.0 cm radius, 2.00 cm long cylinder.

a.) Derive an expression for the electric field at the surface of the cylinder, then calculate its value.

b.) Derive an expression for the total electric flux through the cylinder, then calculate its value.

24.33) Consider a long cylinder of radius R with charge shot uniformly throughout its volume. Assuming the volume charge density is ρ, derive an expression of the E-fld a distance r units from the axis, where r < R. (Draw any Gaussian surface used in this problem.)

24.35) A uniform linear charge density of 30.0 nC/m is placed on a long, straight metal rod whose radius is R = 5.00 cm. Assuming all distances are measured perpendicular to the rod's axis:

a.) Derive an expression (show your Gaussian surface), then calculate the E-fld at r = 3.00 cm.

b.) Derive an expression (show your Gaussian surface), then calculate the E-fld at r = 10.0 cm.

c.) Derive an expression (show your Gaussian surface), then calculate the E-fld at r = 100 cm.

24.37) Q's worth of charge is placed on an isolated metal sphere of radius *a*. According to Gauss's Law, the electric field just outside its surface is $k\frac{Q}{a^2}\hat{r}$. Very close to the surface, the surface looks like that of a flat sheet of charge. In that region, is the electric field equal to σ/ε_o or $\sigma/2\varepsilon_o$? Justify your response.

24.39) Compare the electric fields generated just above the center of the upper surface of a glass plate upon which Q's worth of charge has been uniformly spread, and an aluminum plate of the same area on which Q's worth of charge has been placed.

24.43) A hollow conducting cylinder has a wire coaxially placed down its axis. If the cylinder's net linear charge density is 2λ while the wire's charge density is λ, use Gauss's Law to:

a.) Determine the charge per unit length on the inside surface of the cylinder?

b.) Determine the charge per unit length on the outside surface of the cylinder?

c.) Derive an expression for the E-fld a distance *r* units from the central axis, where *r* is outside the cylinder.

24.44) A total charge of $4.00 \text{x} 10^{-8}$ C is placed on a thin, square, metal plate whose dimensions are 50.0 cm x 50.0 cm.

a.) What is the charge density on each side of the square? (For the rest of the problem, you may assume that this density is uniform.)

b.) Derive an expression for the E-fld just above the plate.

c.) Derive an expression for the E-fld just below the plate.