1.

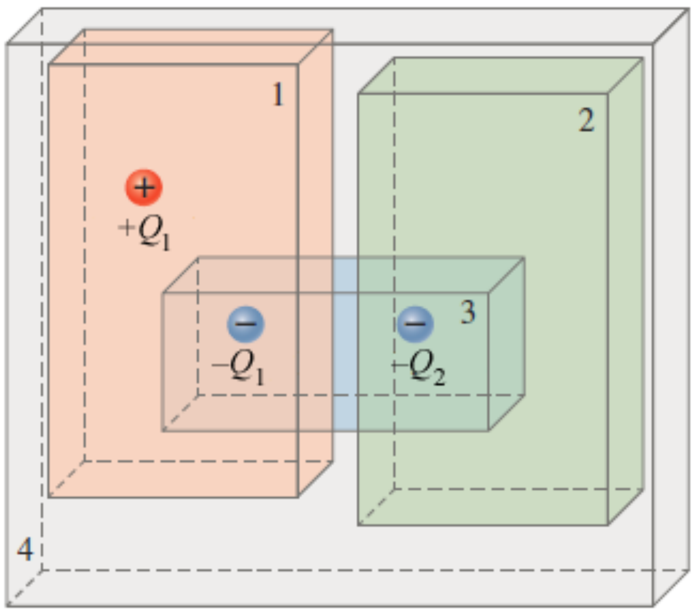
What is the net electric flux through each of the four surfaces shown in the figure below? (Assume $Q_1 = 23.6\ \mu C$ and $Q_2 = 47.2\ \mu C$.)

$\Phi_{E,1}$ = [ ] $N \cdot m^2/C$

$\Phi_{E,2}$ = [ ] $N \cdot m^2/C$

$\Phi_{E,3}$ = [ ] $N \cdot m^2/C$

$\Phi_{E,4}$ = [ ] $N \cdot m^2/C$



2.

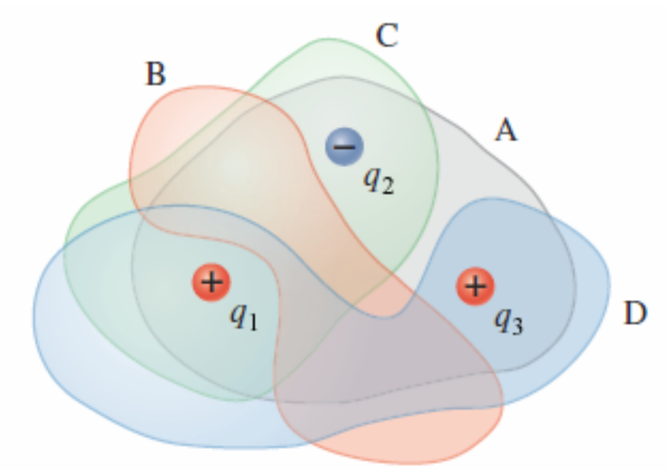
The colored regions in the figure below represent four three-dimensional Gaussian surfaces A through D. The regions may also contain three charged particles, with q_1 = +5.40 nC, q_2 = −5.40 nC, and q_3 = +8.60 nC, that are nearby as shown. What is the electric flux through each of the four surfaces? *Note*: A charge is within a region if it is located inside the perimeter shown for that region.

$\Phi_{E,\text{ A}}$ = ______ N · m^2/C

$\Phi_{E,\text{ B}}$ = ______ N · m^2/C

$\Phi_{E,\text{ C}}$ = ______ N · m^2/C

$\Phi_{E,\text{ D}}$ = ______ N · m^2/C



3.

A spherical shell of radius 1.60 m contains a single charged particle with q = 16.0 nC at its center.

(a) What is the total electric flux through the surface of the shell?

______ N · m^2/C

(b) What is the total electric flux through any hemispherical portion of the shell's surface?

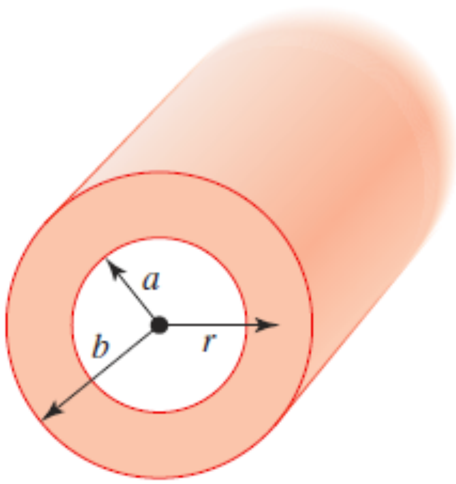
______ N · m^2/C

4.

The figure below shows a very long tube of inner radius *a* and outer radius *b* that has uniform volume charge density ρ. Find an expression for the electric field between the walls of the tube—that is, for $a < r < b$. (Use any variable or symbol stated above along with the following as necessary: ε_0.)

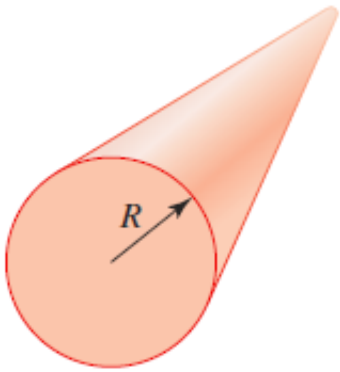
$\vec{E}$ =

$\hat{r}$



5.

The figure below shows a very long, thick rod with radius *R*, uniformly charged throughout.



Find an expression for the electric field inside the rod $(r < R)$. (Use the following as necessary: r, R, λ for the linear charge density of the rod, and ε_0.)

$\vec{E}$ =

$\hat{r}$

Use the equation,

$$\vec{E} = \frac{1}{2\pi\varepsilon_0}\frac{\lambda}{r}\hat{r}$$

to check your solution at the surface, where $r = R$. (Use the following as necessary: R, λ, and ε_0.)

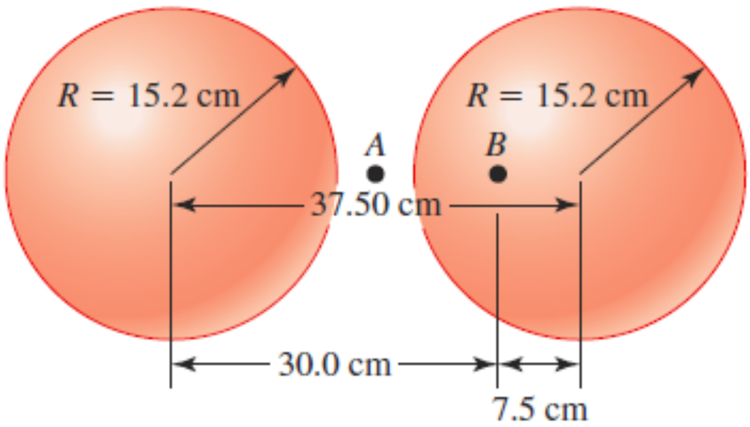
$\vec{E}(r = R)$ =

$\hat{r}$

6.

Two uniform spherical charge distributions (see figure below) each have a total charge of 17.5 mC and radius R = 15.2 cm. Their center-to-center distance is 37.50 cm. Find the magnitude of the electric field at point *B*, 7.50 cm from the center of one sphere and 30.0 cm from the center of the other sphere.

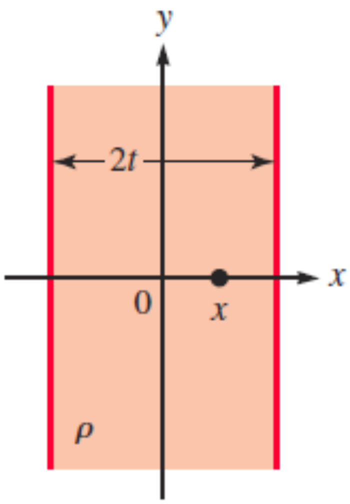
[ ] N/C



PART 2

1.

A very large, flat slab has uniform volume charge density ρ and thickness $2t$. A side view of the cross section is shown in the figure below.



(a) Find an expression for the magnitude of the electric field inside the slab at a distance x from the center. (Use any variable or symbol stated above along with the following as necessary: ε_0.)

E =

(b) If $\rho = 7.70\ \mu\text{C/m}^3$ and $2t = 8.00$ cm, calculate the magnitude of the electric field at $x = 1.50$ cm.

N/C

2.

A solid sphere of radius R has a spherically symmetrical, nonuniform volume charge density given by $\rho(r) = A/r$, where r is the radial distance from the center of the sphere in meters, and A is a constant such that the density has dimensions M/L^3. (Use the following as necessary:, A, r, R, and ε_0.)

(a) Calculate the total charge in the sphere.

$Q =$

(b) Using the answer to part (a), write an expression for the magnitude of the electric field outside the sphere—that is, for some distance $r > R$.

$E =$

(c) Find an expression for the magnitude of the electric field inside the sphere at position $r < R$.

$E =$