Class 5 – 341 – hand out

(8) Gauss: total flux = $\frac{\text{enclosed charge}}{\varepsilon_0}$ ← 8.85×10^{-12}

according to table:

S_1: $\frac{4\,nC}{\varepsilon_0} = 452\ \frac{N}{C}m^2$

S_2 $\frac{-7.8\,nC}{\varepsilon_0} = -881\ \frac{N}{C}m^2$

$S_3 = \frac{-3.8\,nC}{\varepsilon_0} = 429\ \frac{N}{C}m^2$

$S_4 = \frac{6.4\,nC}{\varepsilon_0} = 723\ \frac{N}{C}m^2$

$S_5 = \frac{-1.4\,nC}{\varepsilon_0} = 158\ \frac{N}{C}m^2$

(34) since $E_y = 0$ & $\hat{n} = \pm\hat{j}$ on S_1 & S_3 $\Rightarrow \Phi_1 = \Phi_3 = 0$

for S_4: $\hat{n} = -\hat{k}$ & $z = 0 \rightarrow E_z = 0 \Rightarrow \Phi_4 = 0$

for S_6: $\hat{n} = -\hat{i}$ & $x = 0 \rightarrow E_x = 0 \Rightarrow \Phi_6 = 0$

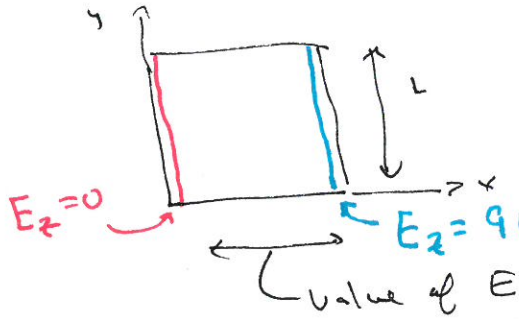
for S_5 $\hat{n} = +\hat{i}$ & $x = L = .3 \rightarrow E_x = (-5)(.3) = -1.5\ \frac{N}{C}$ ↑ same for all parts of S_5

$\Phi_5 = E_x \cdot L^2 = -1.5(.3)^2 = .135\ \frac{N}{C}m^2$

for S_2 $\hat{n} = +\hat{k}$ & $z = L = .3 \rightarrow E_z = (3)(.3) = .9\ \frac{N}{C}$

$\Phi_2 = E_z \cdot L^2 = (.9)(.3)^2 = .081\ \frac{N}{C}m^2$

(36) $\vec{E} = (964 \cdot x)\hat{k}$ & $\hat{n} = \hat{k}$ so $\vec{E}\cdot\hat{n} = 964x$



$\Phi = \int_0^L \int_0^L 964x\,dx\,dy$ (inner integral → L)

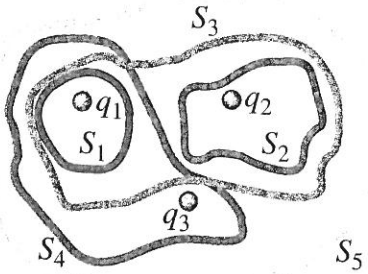
$= \int_0^L 964Lx\,dx$

$= 964L\frac{x^2}{2}\Big|_0^L = 964\frac{L^3}{2}$

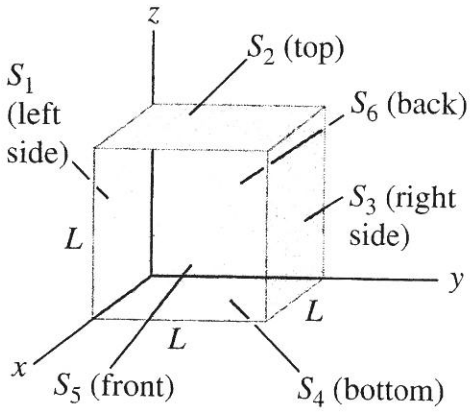
$= 20.7\ \frac{N}{C}m^2$

22.8 • The three small spheres shown in **Fig. E22.8** carry charges $q_1 = 4.00\text{ nC}$, $q_2 = -7.80\text{ nC}$, and $q_3 = 2.40\text{ nC}$. Find the net electric flux through each of the following closed surfaces shown in cross section in the figure: (a) S_1; (b) S_2; (c) S_3; (d) S_4; (e) S_5. (f) Do your answers to parts (a)–(e) depend on how the charge is distributed over each small sphere? Why or why not?

Figure E22.8



Surface	What it encloses
S_1	q_1
S_2	q_2
S_3	q_1 and q_2
S_4	q_1 and q_3
S_5	q_1 and q_2 and q_3



22.34 •• A cube has sides of length $L = 0.300\text{ m}$. One corner is at the origin (Fig. E22.6). The nonuniform electric field is given by $\vec{E} = (-5.00\text{ N/C}\cdot\text{m})x\hat{\imath} + (3.00\text{ N/C}\cdot\text{m})z\hat{k}$. (a) Find the electric flux through each of the six cube faces S_1, S_2, S_3, S_4, S_5 and S_6. (b) Find the total electric charge inside the cube.

22.36 •• **CALC** In a region of space there is an electric field $\vec{E}$ that is in the z-direction and that has magnitude $E = [964\text{ N/(C}\cdot\text{m)}]x$. Find the flux for this field through a square in the xy-plane at $z = 0$ and with side length 0.350 m. One side of the square is along the $+x$-axis and another side is along the $+y$-axis.