Problem 22.1,4,6,32,54 from MasteringPhysics with minor clarifications.

22.1 - Electric Flux through a Flat Sheet

A flat sheet of paper of area $A = 0.105\text{m}^2$ is oriented so that the normal to the sheet is at an angle of $\phi = 61.0°$ to a uniform electric field of magnitude $E = 13.0$ N/C.

Part A

Find the magnitude of the electric flux through the sheet.

Part B

Does the answer to part (A) depend on the shape of the sheet?

Part C

For what angle ϕ between the normal to the sheet and the electric field is the magnitude of the flux through the sheet largest?

Part D

For what angle ϕ between the normal to the sheet and the electric field is the magnitude of the flux through the sheet smallest?

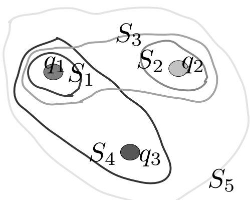
22.4 - Electric Flux through a Flat Sheet

A flat sheet is in the shape of a rectangle with sides of length a=0.400m and b=0.600m. The sheet is immersed in a uniform electric field of magnitude E=79.0 N/C that is directed at θ=20° from the plane of the sheet (not the normal).

Part A

Find the magnitude of the electric flux through the sheet.

22.6 - Electric Flux



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

The three small spheres shown in the figure carry charges q_1, q_2, and q_3.

Part A

Find the net electric flux through the closed surface S_1 shown in cross section in the figure.
Use ϵ_0 for the permittivity of free space.

Part B

Find the net electric flux through the closed surface S_2 shown in cross section in the figure.

Part C

Find the net electric flux through the closed surface S_3 shown in cross section in the figure.

Part D

Find the net electric flux through the closed surface S_4 shown in cross section in the figure.

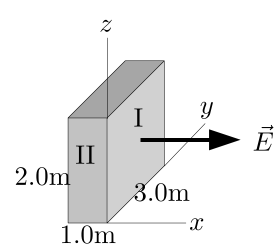
Part E

Find the net electric flux through the closed surface S_5 shown in cross section in the figure.

Part F

Do your answers to parts (a) through (e) depend on how the charge is distributed over each small sphere?

22.32 - Electric Field



The electric field $\vec{E}$ in the figure is everywhere parallel to the x-axis, so the components E_y and E_z are zero. The x-component of the field E_x depends on x but not on y and z. At points in the yz-plane (where x=0), E_x=125 N/C.

Part A

What is the electric flux, Φ_E, through surface I in the figure?

Part B

What is the electric flux through surface II?

Part C

The volume shown in the figure is a small section of a very large insulating slab 1.0m thick. If there is a total charge -24.0 nC within the volume shown, what is the magnitude of $\vec{E}$ at the face opposite surface I?

Part C

If there is a total charge -24.0 nC within the volume shown, what is the direction of $\vec{E}$ at the face opposite surface I?

22.54 - Uniformly Charged Slab

A slab of insulating material has thickness $2d$ and is oriented so that its faces are parallel to the yz-plane and given by the planes $x = d$ and $x = -d$. The y and z-dimensions of the slab are very large compared to d and may be treated as essentially infinite. The slab has a uniform positive charge density ρ.

Part A

Using Gauss's law, find the magnitude of the electric field due to the slab at the points $0 \leq x \leq d$.

Part B

What is the direction of the electric field due to the slab at the points $0 \leq x \leq d$?

Part C

Using Gauss's law, find the magnitude of the electric field due to the slab at the points $x \geq d$.

Part D

What is the direction of the electric field due to the slab at the points $x \geq d$?