Fall 2021

Homework 2

A flat sheet is in the shape of a rectangle with sides of lengths 0.400 m and 0.600 m. The sheet is immersed in a uniform electric field of magnitude 90.0 N/C that is directed at 20o from the plane of the sheet (**Fig. E22.2**). Find the magnitude of the electric flux through the sheet.



It was shown in Example 21.10 (Section 21.5) that the electric field due to an infinite line of charge is perpendicular to the line and has magnitude *E* = λ/2πεor. Consider an imaginary cylinder with radius *r* = 0.250 m and length *l* = 0.400 m that has an infinite line of positive charge running along its axis. The charge per unit length on the line is λ = 3.00 μC/m. (a) What is the electric flux through the cylinder due to this infinite line of charge? (b) What is the flux through the cylinder if its radius is increased to *r* = 0.500 m? (c) What is the flux through the cylinder if its length is increased to *l* = 0.800 m?

The three small spheres shown in **Fig. E22.8** carry charges *q*1 = 4.00 nC, *q*2 = -7.80 nC, and *q*3 = 2.40 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 .



A charged paint is spread in a very thin uniform layer over the surface of a plastic sphere of diameter 12.0 cm, giving it a charge of -49.0 μC. Find the electric field (a) just inside the paint layer; (b) just outside the paint layer; (c) 5.00 cm outside the surface of the paint layer.

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The electric field at a distance of 0.145 m from the surface of a solid insulating sphere with radius 0.355 m is 1750 N/C. (a) Assuming the sphere’s charge is uniformly distributed, what is the charge density inside it? (b) Calculate the electric field inside

the sphere at a distance of 0.200 m from the center.

A conducting spherical shell with inner radius *a* and outer radius *b* has a positive point charge *Q* located at its center. The total charge on the shell is -3*Q*, and it is insulated from its surroundings (**Fig. P22.44**). (a) Derive expressions for the electric-field magnitude *E* in terms of the distance *r* from the center for the regions *r* < *a*, *a* < *r* < *b*, and *r* > *b*. What is the surface charge density (b) on the inner surface of the conducting shell; (c) on the outer surface of the conducting shell? (d) Sketch the electric field lines and the location of all charges.

