Homework No. 03 (Spring 2022)

PHYS 203B-001: COLLEGE PHYSICS

Department of Physics, Southern Illinois University–Carbondale

Due date: Wednesday, 2022 Feb 2, 10:00am, on D2L

Instructions

- To the extent to which you depend on resources to complete this homework is a measure of how much extra work you need to put in to master the related concepts.
- Describe your thought process in detail and organize it clearly. Make sure your answer has the correct units and the right number of significant digits.
- After completion, scan the pages as a single PDF file, and submit the file on D2L (Assesments → Assignments).

Problems

1. (**10 points.**) The drawing shows an edge-on view of a planar surface of area $2.0\,\mathrm{m}^2$. Given $\theta = 30°$. The electric field vector $\vec{\mathbf{E}}$ in the drawing is uniform and has a magnitude of $3.0 \times 10^2\,\mathrm{N/C}$. Determine the electric flux across the planar surface.

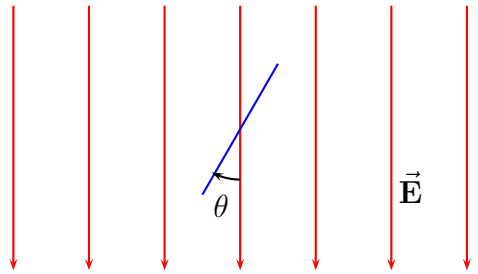

Figure 1: Problem 1.

Solution

2. (**10 points.**) Consider a uniform electric field $\vec{\mathbf{E}} = E_0\hat{\mathbf{x}}$. A cube, of edge length $L = 10.0\,\mathrm{cm}$, is placed in this electric field with one of the faces perpendicular to the field. Find the electric flux across each of the six faces of the cube. Find the total flux across the total surface of the cube.

Solution

3. (**10 points.**) Consider a perfectly conducting sphere of radius $R = 7.0\,\text{cm}$ with charge $Q = 1.0\,\mu\text{C}$ on the surface.

   (a) Determine the electric flux through the surface of a (Gaussian) sphere of radius 5.0 cm, concentric with respect to the conducting sphere.

   (b) Determine the electric flux through the surface of a (Gaussian) sphere of radius 9.0 cm, concentric with respect to the conducting sphere.

   (c) Determine the electric flux through the surface of a (Gaussian) cube of side length 9.0 cm, with center shared with the conducting sphere.

   Solution

4. (**10 points.**) Charges are placed on the $z = 0$ plane such that it forms a square lattice of

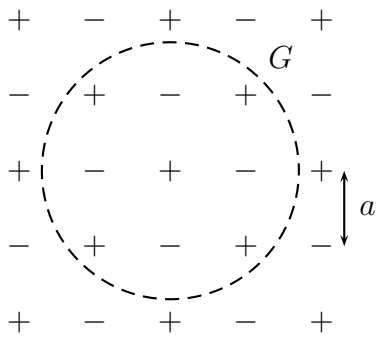

Figure 2: Problem 4

length a that extends to infinity in the plane. Refer Figure 2. The charge on each lattice point has a magnitude of $17.7 \times 10^{-12}\,\text{C}$. Determine the electric flux through the surface G of a sphere of radius $R = 1.7\,a$ shown in Figure 2.

Solution