Physics 217 Problem Set #2

Due Tuesday, 9 September 2025, in Box.

Submit your solutions by uploading an electronic, or at least legibly-scanned, pdf copy to your personal PHYS 217 Box folder. Note that cell-phone pictures are not usually legible, nor produced in pdf.

Please make your filename descriptive of the file's contents. Nathan, for example, may submit this homework as **`nmangus2_hw2.pdf`**, if he were taking the class instead of teaching it.

Submission, completeness, and correctness will be noted for problems with numbers not bearing asterisks and will add to your Class-Participation grade. You will start these problems in Workshop. You may collaborate with classmates on their solution, inside or outside of class. List in your solutions the names of the classmates with whom you collaborated.

Problems marked with an asterisk will be graded in detail and comprise part of your Homework grade. These are solo efforts; you may not collaborate with classmates on their solution.

1-8. Griffiths problems 1.16, 1.32, 1.35, 1.39, 1.40, 1.51, 1.52, and 2.4. On 2.4, show also that Coulomb's law for point sources is recovered at large distances away from the square loop.

9* a. Using integration by parts, show that $x\frac{d}{dx}\left(\delta(x)\right) = -\delta(x)$.

b. Show for the step function $\Theta(x) = \begin{cases} 1 & x > 0 \\ 0 & x \le 0 \end{cases}$ that $\frac{d}{dx}\Theta(x) = \delta(x)$.

10* An $L \times L$ square with edges along x and y has charge density $\sigma(x,y) = Ax\left(x^2 + y^2 + L^2\right)^{3/2}$, where A is a positive constant. Find $\boldsymbol{E}(0,0,L)$.

11* A hemispherical shell of radius R sits like a bowl, with its rim in the x-y plane centered on the origin, and its apex at $z < 0$.

a. It carries uniform charge density σ_0. Find the electric field $\boldsymbol{E}$ at its center.

b. While you were doing part a, I switched the hemisphere for another one the same size, but with charge density $\sigma = \sigma_0 \sin^2\theta \sin 2\varphi$. Find the electric field $\boldsymbol{E}$ at the center of the new hemisphere.

c. Why don't these results depend on R?

12* a. A circular disk with radius S has charge density $\sigma = \sigma_0 \sin^2\varphi$. Calculate the electric field a distance z from its center, along its axis.

b. Check the result at $z \gg S$, and verify recovery of Coulomb's law for a point charge.