Due date: Wednesday, Sept. 20

Griffiths reading:
- Review 1.2.1-4 and 1.3.1-2, and study 1.3.4 (divergence theorem)
- 2.2.1-2 (Gauss’s Law)
- 1.5 (Delta functions)

Warning: If you have Griffiths 3rd Edition, the problem numbers may not apply to your copy of the book. There is a translation table posted on the website. This applies to all homework sets. No credit will be given for doing the wrong problem number.

1. [3 points] Warm-up on divergence:
   (a) Compute the divergence of \( \mathbf{v}(\mathbf{r}) = x^2(z^2 - y^2) \mathbf{x} + (3xyz^2 - yx^3) \mathbf{y} + 5y^2z \mathbf{z} \).
   (b) Compute the divergence of \( \mathbf{v}(\mathbf{r}) = s^2z \mathbf{s} - sz^2 \mathbf{z} \) (working in cylindrical coordinates).
   (c) Compute the divergence of \( \mathbf{v}(\mathbf{r}) = \mathbf{r}/r^3 \) (working in spherical coordinates).


3. [7 points] An infinitely long line charge of uniform density \( \lambda \) lies along the \( z \) axis, piercing a sphere of radius \( R \) centered on the origin. According to Eq. (2.9), the electric field is then
   \[ \mathbf{E} = \frac{1}{2\pi \varepsilon_0} \frac{\lambda}{s} \hat{s} \]
   in cylindrical coordinates.
   (a) Calculate the electric flux passing out through the surface of the sphere.
   **Hint:** Show that \( \mathbf{E} \cdot \hat{r} = \sin \theta \), and then calculate the flux by working in spherical coordinates.
   (b) Does this agree with the expectation based on Gauss’s Law?

4. [5 points] Griffiths 1.44 and 1.45 (evaluate integrals with delta functions).