Problem Set 3

Physics 110A, UC Berkeley, Spring 2021

Due Tuesday, 2/16, at 11:59PM

Problem 1

For a region $\mathcal{V}$ enclosing the origin, evaluate the integral

$$J = \int_{\mathcal{V}} \frac{\hat{\mathbf{r}}}{r^2} \cdot \nabla f\left(\mathbf{r}\right) d\tau,$$

assuming that f vanishes on the boundary of $\mathcal{V}$.

Problem 2

Find the electric field a distance z above the center of a flat circular disk of radius R that carries a uniform surface charge σ. What does your formula give in the limit $R \to \infty$? Also check the case $z \gg R$.

Problem 3

Find the charge density corresponding to the electric field $\mathbf{E} = ay\hat{\mathbf{y}}$ (in Cartesian coordinates), and the charge density corresponding to the electric field $\mathbf{E} = (1/3)\, ar\hat{\mathbf{r}}$ (in spherical coordinates). Compare your answers. Why does the same charge density give two different fields? *Hint*: refer to Griffiths problem 2.12 and 2.17.

Below are selected optional problems from Griffiths. We do not collect your work, but you are encouraged to do as many practice problems as you can.

- Problem 2.1
- Problem 2.6
- Problem 2.9
- Problem 2.10
- Problem 2.18
- Problem 2.20
- Problem 2.21
- Problem 2.22
- Problem 2.28
- Problem 2.29