
This assignment is not at the Jackson level; it is meant to bring everyone up to speed before we start graduate problems.

1. Consider a uniform sphere of charge Q and radius R centered at the origin.
 - (a) What is the scalar volume charge density field $\rho(\vec{r})$ everywhere?
 - (b) What is the electric field $\vec{E}(\vec{r})$ everywhere?
 - (c) What is the scalar potential (voltage) field $V(\vec{r})$ everywhere with the convention that $V = 0$ infinitely far from the sphere?
 - (d) What is the scalar potential (voltage) field $V(\vec{r})$ everywhere with the convention that $V = 0$ on the surface of the sphere?
 - (e) Show how to recover the electric field given either voltage field above.
 - (f) How much energy is required to assemble the sphere from empty space? Perform this calculation in two different ways: one using the electric field and one using the voltage and the charge density. (Of course, the answers should agree.)
2.
 - (a) Find the scalar volume charge density field $\rho(\vec{r})$ that results in this electric field inside a sphere of radius R : $\vec{E}(\vec{r}) = E_0\hat{r}$, where E_0 is a constant.
 - (b) What is the total charge in the sphere?
 - (c) What is the electric field outside the sphere?