

PHY 712 – Problem Set # 26

Continue reading Chapter 9 of **Jackson**.

1. Suppose that you have a source with the following charge and current density distributions:

$$\rho(\mathbf{r}, t) = \frac{2Dze^{-r^2/R^2}}{R^5\pi^{3/2}}e^{-i\omega t}.$$
$$\mathbf{J}(\mathbf{r}, t) = \hat{\mathbf{z}}\frac{-i\omega De^{-r^2/R^2}}{R^3\pi^{3/2}}e^{-i\omega t}.$$

In this expression, the constant D denotes the dipole moment, R is a length parameter, and ω is the (constant) harmonic frequency.

- (a) Show that this source is consistent with the continuity equation.
- (b) Find the scalar and vector potentials $\Phi(\mathbf{r}, t)$ and $\mathbf{A}(\mathbf{r}, t)$ for distances $r \gg R$.
- (c) Find the electric and magnetic fields $\mathbf{E}(\mathbf{r}, t)$ and $\mathbf{B}(\mathbf{r}, t)$ for distances $r \gg R$.
- (d) Find the time averaged Poynting vector for this source.