



**Problem 5:** Radiation from a dipole antenna: Observed at  $R_1$  (on the ground), and  $R_2$  (at the height  $h$  of the tower.)

Physics 3034 – Spring 2024: Due April 19.

### Homework 07 – Rev A

**SPN 7–01** – The D'Alembertian and Maxwell's equations.

Do Griffiths 10.1.

**SPN 7–02** – Fields from Potentials.

Do Griffiths 10.3.

**SPN 7–03** – Gauges.

Do Griffiths 10.5.

**SPN 7–04** – Larmor power formula

Beginning with equations 11.18 and 11.19, calculate (Equation 11.20 ... it's not hard.). After you have 11.20 explain how get to 11.21, then explicitly do the integration over  $\theta$  to arrive at 11.22

**SPN 7–05** – Dipole Radiation.

A dipole antenna of length  $d$  (shown in blue in the figure) has a maximum dipole moment of  $p_0$ . It is transmitting at frequency  $f$ . It is mounted atop a tower of height  $h$ . You observe it from the ground at a location  $R_1$  a distance  $s$  from the tower base and receive an average power per unit area  $\langle S_1 \rangle$ .

- What power  $\langle S_2 \rangle$  will you receive at the point  $R_2$  which is at the same height  $h$  as the tower?
- What Electric field will you measure at  $R_2$ ? (give magnitude and direction in terms of cartesian coordinates)
- What Magnetic field will you measure at  $R_2$ ? (give magnitude and direction in terms of cartesian coordinates)
- What is the direction of electric and magnetic fields at  $R_1$  (in cartesian coordinates)
- How about direction and magnitude of  $\vec{A}$ ?
- If  $f = 100 \text{ MHz}$ ,  $s = 300 \text{ m}$ ,  $h = 100 \text{ m}$ ,  $q = 1 \text{ } \mu\text{C}$  and the received power at  $R_2$  is ten  $\text{Watts}/\text{m}^2$ , express answers to  $a$ ,  $b$ , and  $c$  numerically.
- What is the separation between the charges in the dipole? What is the maximum current going into the transmitter? (you should get numbers).