1. Assume a dipole is 10 cm long, and 1 mm in diameter, is operating at 100 MHz, and is made of copper. In the small dipole approximation,
   a. What is the radius of the reactive near field?
   b. What is the radius of the radiating near field?
   c. What is the radiation resistance?
   d. What is the ohmic loss resistance?
   e. What is the efficiency?
   f. What is the directivity?
   g. What is the gain?
   h. What is the reactance?

2. If an antenna has an input power of 1 Watt, and produces a maximum radiation intensity of 10 W/sr, what is the directivity? If it has an efficiency of 50%, what is the gain?

3. If an 100% efficient antenna has a maximum radiation intensity of 5 W/sr when the total power of 1 Watt, what is the beam solid angle? What portion of the sphere does this correspond to? What is the directivity in this case?

4. Sketch the current distribution for an ideal dipole and for a short dipole. What is the difference between the two models in the radiation resistance and loss resistance?

5. Assuming a beam having each polarization listed below reflects from a metal surface. What is the polarization of the reflected beam, assuming the incident beam is:
   a. Vertical?
   b. Horizontal?
   c. Left-hand circular?
   d. Right-hand circular?

6. Answer parts a-h from question 1 assuming the same wire is bent into a circular loop with a 10 cm diameter.

7. For a small circular loop antenna with the axis of the loop oriented along the z-axis, determine the directions of A, E, H, and S in the far field. You do not need the sign, just the orientation of these vectors.

8. If a quarter-wavelength monopole is attached to a 50 Ohm transmission line, what is the reflection coefficient? What is the efficiency assuming that the antenna is lossless?

9. A ground plane is oriented in the XY plane. An isotropic antenna is located λ/4 above it. Sketch the radiation pattern in the XZ plane.

10. Next repeat question 9 assuming the antenna is a small dipole oriented along the Z.