Workshop module 2 - Physics 114, Spring 2010

1. Some modern aircraft are made primarily of composite materials (nonconductors). The U.S. Federal Aviation Administration requires that such aircraft have conducting wires imbedded into their surfaces. Why?

2. A long conducting cylinder of radius A carrying a total charge +Q is surrounded by a conducting cylindrical shell of total charge –2Q and radius B. (a) What is the appropriate Gaussian surface to use for calculating the electric fields in this system? WHY? (b) What are the regions of space that should be considered separately in order to calculate the electric fields in the system? WHY? (c) Where does the charge reside on the conductors? (d) Calculate the electric fields in all space inside and surrounding this system.

3. When a high voltage power line falls on your car, you are safe as long as you stay in the car; but if you step out, you may be electrocuted. Why? Is the inside of a car a safe place to be during a thunderstorm? Why or why not?

4. A conducting spherical shell with inner radius A and outer radius B has a positive charge of magnitude +2Q distributed evenly in its interior. The total charge on the shell is –3Q, and it is insulated from its surroundings That is to say, we have a spherical region with radius A that has a charge of +2Q spread evenly throughout which is surrounded by a conducting shell (inner radius A and outer radius B) holding a net charge of -3Q. (a) Where does the charge reside on the conducting shell? (b) Calculate the electric fields everywhere for this system. (c) Graph the electric field as a function of the radius. (d) How would this problem change if the charge distributed in the interior had a volume charge density given by $\rho(r)=(C/r^2)$, where C is a constant?