Problem Sheet 3 - workshop

1. What is the approximate field strength 1 cm above an ordinary sheet of paper carrying a uniform charge density of $\sigma = 45$ nC/m^2? Use Gauss's law to derive the expression required. State the assumption that allows Gauss's law to be used here.

2. Two infinite vertical planes of charge are parallel to each other and are separated by a distance d = 4 m. Find the electric field to the left of the planes, to the right of the planes, and between the planes
   (a) when each plane has a uniform surface charge density $\sigma = +3$ μC/m^2 and
   (b) when the left plane has a uniform surface charge density $\sigma = +3$ μC/m^2 and that of the right plane is $\sigma = -3$ μC/m^2.
   Draw the electric field lines in each case.

3. In a particular region of the earth's atmosphere, the electric field above the earth's surface has been measured to be 150 N/C downward at a height of 250 m, and 170 N/C downward at a height of 400 m. Calculate the volume charge density of the atmosphere assuming it to be uniform between 250 and 400 m. (You may neglect the curvature of the earth. Why?)

Problem Sheet 2: for tutorials

These problem sheets are designed to provide problems for you to discuss in tutorials with your tutors. They should re-enforce the material we are studying in the lectures.

1. Explain to your tutor what "solid angle" is. Draw a diagram from which you can compute the area element associated with an infinitesimal solid angle.

2. Compute the area of a sphere from first principles.

3. Use your result for the surface area of a sphere to compute the volume of a sphere.

4. When a test charge $q_0 = 2$ nC is placed at the origin,
it experiences a force of 8.0×10^{-4} N in the positive y
direction.
(a) What is the electric field at the origin?
(b) What would be the force on a charge $q = -4$ nC placed at the origin?
(c) If this force is due to a charge Q on the y axis at $y = 3$ cm, what is the value of that charge?
Draw a separate diagram for each part, labelling charges and forces.