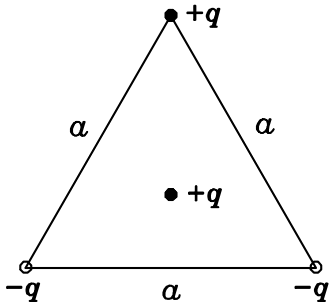
THE UNIVERSITY OF BRITISH COLUMBIA

Physics 122 Assignment # 3:

ELECTRIC CHARGE

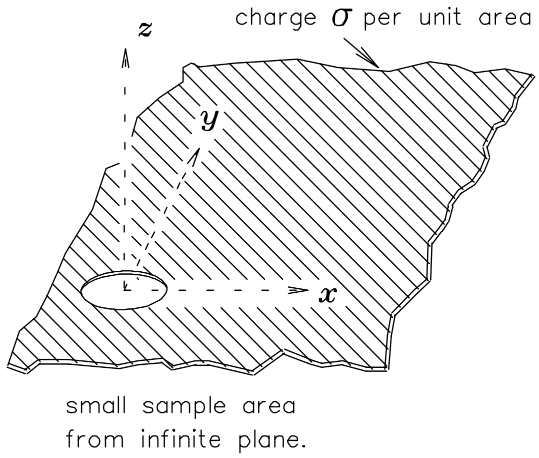
Wed. 16 Jan. 2002 — finish by Wed. 23 Jan.

1. TRIANGLE of CHARGES: Derive an expression for the *work* required to bring four charges of equal magnitude but different signs (as shown) together into an equilateral triangle of side a with one charge at the centre of the triangle. (Initially the charges are all infinitely far apart.)



2. LINES of CHARGE: An infinite line of charge with linear charge density $\lambda = 5 \times 10^{-10}$ C/m lies along the x-axis ($y = 0$, $z = 0$ and $-\infty < x < +\infty$). A second infinite line of charge with exactly the opposite charge density lies along the z axis. What are the x, y and z components of the resultant *electric field* at the point $(x, y, z) = (4, 4, 4)$ m?

3. PLANE of CHARGE: A large flat non-conducting surface carries a uniform charge density $\sigma = 4.0 \times 10^{-9}$ C/m^2. A small circular hole has been cut out of the middle of this sheet of charge, as shown on the diagram. Ignoring "fringing" of the field lines around all distant "outside" edges, calculate the *electric field* at point P a distance $z = 1.0$ m up from the centre of the hole along its axis. The radius of the hole is $R = 0.4$ m.



4. EXTRA ELECTRONS: The Earth can be regarded as a spherical conductor from the point of view of free electrons. *How many excess electrons* could the Earth hold? (Assume that only electrostatic and gravitational forces are involved.)