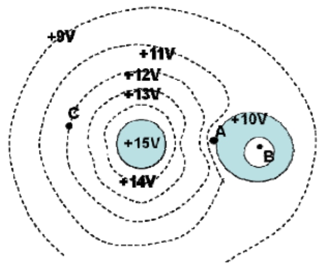
Exercise sheet #3

Problem 1. Draw some of the E-field lines between the objects in the figure below and identify the sign of the surface charge on the object at point A.



Problem 2. One of two nonconducting spherical shells of radius a carries a charge Q uniformly distributed over its surface, the other carries a charge $-Q$, also uniformly distributed. The spheres are brought together until they touch. What does the electric field look like, both outside and inside the shells? How much work is needed to move them far apart?

Problem 3. (a) A point charge q is located at the center of a cube of edge d. What is the value of $\int \mathbf{E} \cdot d\mathbf{a}$ over one face of the cube?

(b) The charge q is moved to one corner of the cube. Now what is the value of the flux of $\mathbf{E}$ through each of the faces of the cube? (To make things well defined, treat the charge like a tiny sphere.)

Problem 4. Charges $2q$ and $-q$ are located on the x axis at x = 0 and x = a, respectively.

(a) Find the point on the x-axis where the electric field is zero,and make a rough sketch of some field lines.

(b) You should find that some of the field lines that start on the $2q$ charge end up on the $-q$ charge, while others head off to infinity. Consider the field lines that form the cutoff between these two cases. At what angle (with respect to the x-axis) do these lines leave the 2q charge? Hint: Draw a wisely chosen Gaussian surface that mainly follows these lines.

Problem 5. A charged soap bubble experiences an outward electrical force on every bit of its surface. Given the total charge Q on a bubble of radius R, what is the magnitude of the resultant force tending to pull any hemispherical half of the bubble away from the other half?