Phys 742 – Assignment 4 – Due 22 Feb 96

1.

The charge density on a spherical shell of radius textita is $\sigma_0 \cos\theta$. Find the potential and the electric field, both inside and outside the shell. Use spherical harmonics (just Legendre polynomials, really).

(This problem is related to that of a conducting sphere in a uniform field, and is also good training for the next problem.)

2.

The Hydrogen atom in the $1p_0$ state has electron charge density $Az^2e^{-\alpha r}$.

(a) Find the electrostatic potential by using Coulomb's law and the expansion (3.70).

(b) Obtain the same result as in (a) by fourier-transforming the charge density, using the convolution theorem, and fourier-transforming back.

For practice, you may want to solve by these methods Jackson's problem 1.1 "in reverse" from Assignment 1. Do not forget the nucleus.

3.

Using a complex potential proportional to $\sqrt{a^2 - z^2}$, solve the problem of a slit of width $2a$ in a conducting plane having charge density σ_0 far from the slit. (Put the slit, in cross section, on the (-a, a) segment of the x axis). Find the field on the y axis and in the slit ($y = 0,\ |x| < a$). Find the charge density on the conducting plane.

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$-a$　　a

4.

Far below a conducting plane with a slit there is a uniform field E_0 perpendicular to the plane. Find the field on the y axis and in the slit ($y = 0,\ |x| < a$). How much electric flux leaks through the slit? (As above, put the slit on the (-a,a) segment of the x axis. The applied field is in the y direction).