PHYSICS 110A, WINTER 2017
ELECTRICITY AND MAGNETISM

Assignment Six, Due Friday, March 2, 5:00 pm.

[1.] A hydrogen atom acts as if it had an electrostatic potential

$$\phi(r) = \frac{q}{4\pi\epsilon_0 r}(1 + \frac{r}{a_0})e^{-2r/a_0} \ ,$$

where q is the charge on the proton and $a_0 = \hbar^2/m_e q^2 = 0.529\dot{A}$ is the Bohr radius.
(a) Find the corresponding charge density and interpret the various terms physically.
(b) Verify by *explicit* integration that your resulting charge density from part (a) indeed produces the original potential.
(c) What is the net charge inside a sphere of radius a_0? What is the electric field strength at this distance?

[2.] Solve for the potential in the region between two concentric spherical shells of radii a and b, given the potentials $V_a(\theta)$ and $V_b(\theta)$. Your objective should be to write the coefficients of an expansion of the potential as integrals involving the (unknown) functions V_a and V_b. Choose some specific form of the functions that you find particularly amusing (and not too hard!) and do the integrals.

[3.] A sphere of radius R has a potential $V(r, \theta) = V_0 \cos^2\theta$ on its surface. Determine the potential outside the sphere.

[4.] Griffiths 3-15.

[5.] Griffiths 3-21.

[6.] Griffiths 3-23.

[7.] Griffiths 3-14.