Phys 3820, Fall 2011
Problem Set #5, Hint-o-licious Hints

2. *Griffiths*, **11.3** This is certainly not hard using the completeness of the Legendre polynomials, but just do the (simple) algebra.

3. *Griffiths*, **11.6** Use (11.46) to relate δ_l and a_l but use the form

$$a_l = \frac{1}{k} e^{i\delta_l} \sin(\delta_l) = \frac{1}{k}(\cos\delta_l \sin\delta_l + i \sin^2\delta_l$$

and equate the real and imaginary parts. (Use the definition of $h_l^{(1)}$.)

4. *Griffiths*, **11.9** We want to check the relation:

$$\psi(\mathbf{r}) = -\frac{m}{2\pi\hbar^2} \int \frac{e^{ik|\mathbf{r}-bfr_0|}}{|\mathbf{r}-\mathbf{r}_0|} V(\mathbf{r}_0)\psi(\mathbf{r}_0) d^3r_0$$

where

$$\psi(\mathbf{r}) = \psi_{100}(\mathbf{r}) = \frac{1}{\sqrt{\pi a^3}} e^{-r/a}$$

Here the energy is negative, sowe have

$$k = \frac{\sqrt{2mE}}{\hbar} = \frac{i\sqrt{-2mE}}{\hbar} = i\kappa = \frac{1}{a}$$

where we've used (4.71).

One can show that the integral on the right hand side becomes after the angular integrations

$$rhs = \frac{me^2}{4\pi\epsilon_0\hbar^2\sqrt{\pi a^3}} \left(\frac{a}{r}\right) \int_0^\infty \left[e^{-|r-r_0|/a} - e^{(r+r_0)/a}\right] e^{-r_0/a}\, dr_0$$

After taking the usual care with absolute values and the integration ranges this does reduce down to $\psi_{100}(\mathbf{r})$.

5. *Griffiths*, **11.19** Use (11.47) to evaluate $f(0)$, using the fact that $P_l(1) = 1$ for all l. Use

$$e^{i\delta_l} = \cos\delta_l + i \sin\delta_l$$

and compare the result with (11.48)