D12-2 - QUANTUM MECHANICS - DUE FEBRUARY 29, 2000

IV. Spherical well

1. Consider a charged particle bound to a three-dimesional spherical well of radius a and depth V_0, *ie* $V(r) = 0$ for $r > a$ and $V(r) = -V_0$ inside the well. Determine the s-wave bound-state energies and wave functions. What condition must be met for there to be at least one bound state?

2. Sketch $u(r)$ for a well with just one barely bound state.

3. Describe this bound state wave function in the limit $E \to 0$.

4. What is the range of the ground state wave function for a weak potential with a single 'shallow' bound state ($i.e.$ $|E_0| \ll V_0$)?

5. Calculate the wave function normalization to reasonable accuracy for this shallow bound state.