J08Q.1 - Deuteron

Problem

A deuteron is a bound state of a neutron (charge 0, mass 939.5 MeV) and a proton (charge e, mass 938.2 MeV), Scattering measurements determine that the separation of the neutron and proton is about $a = 1.5$ fm and mass measurements determine that the binding energy is $E_b = 2.226$ MeV. Approximate the potential energy as a spherical square well, $V(r) = -V_0$ fro $r < a$ and $V(r) = 0$ for $r > a$. (Recall that $\hbar = 6.5817 \times 10^{-16}$ eV s.)

a)   What is the value of V_0 in MeV?

b)   Can the deuteron have an excited (but still bound!) state with angular momentum $\ell = 0$?

c)   Are there bound states with $\ell > 0$? Explain!