(6.6) How deep is the nuclear well for ^{116}Sn if the binding energy of the last nucleon is 9 MeV?

^{116}Sn has 2 neutrons in the highest energy level according to Figure 6.2 and a total of 66 neutrons and 50 protons. The last nucleon must thus be the 66:th neutron. Furthermore, the potential well is deeper for neutrons than for protons. Hence we will only regard neutrons. From Table 6.6 we can find that the last neutron belongs to the 2d level. Thus $E = k*(2*(2-1)+2) = 9$ MeV.

First definitions of constants and units:

$MeV := 10^6 \cdot 1.606177 \cdot 10^{-19} \cdot joule$ $\qquad u := 1.660540 \cdot 10^{-27} \cdot kg$

$hbar := 1.0545727 \cdot 10^{-34} \cdot joule \cdot sec$ $\qquad r_0 := 1.3 \cdot 10^{-15} \cdot m$

Then the data for the actual case:

$E := 9 \cdot MeV \qquad n := 2 \qquad l := 2 \qquad A := 116$

From these we can calculate:

$r := r_0 \cdot A^{\frac{1}{3}}$ Eqn. (4.14) gives us the nuclear radius.

$k := \frac{E}{2 \cdot (n-1) + l}$ From the eqn. given in the text above.

$M := A \cdot u$ Approximation of the atomic mass (in kg)

$k = hbar \cdot \sqrt{2 \cdot \frac{U_0}{M \cdot r^2}}$ From eqn. (6.33) with the value of k calculated above. Solve for U_0.

$U_0 := \frac{1}{2} \cdot k^2 \cdot r^2 \cdot \frac{M}{hbar^2}$ $\qquad U_0 = 283.058 \cdot MeV$