1. Obtain the S component of the coordinate dependent part of the deuteron wave function in the Lab frame solving the Schrödinger equation and using the following information:

- The nuclear potential is approximately circular well potential with the radius
  \[ a = 1.45 \text{ fm} \]
  \[ V(r) = -V_0 \text{ at } r < a \]
  \[ V(r) = 0 \text{ at } r > a \]

- The deuteron is bound system with binding energy \( E_B = 2.22 \text{ MeV} \)

Obtain also the value of \( V_0 \)

2. Compare \( V_0 \) obtained from (1) with the potential energy of electrical interaction of two stationary protons separated by the distance \( a \)

3. The deuteron wave function which has a total spin \( j = 1 \) can be expressed as follows:

\[
\Psi_{1, m_j} = \frac{u(r)}{r} \Phi_{1, m_j}^{l=0} + \frac{w(r)}{r} \Phi_{1, m_j}^{l=2}
\]

- express the spin – orbital wave functions \( \Phi_{1, m_j}^{l=0} \) and \( \Phi_{1, m_j}^{l=2} \) through the spherical wave functions \( Y_{l, m_1} \)
  
  and the spin wave function of two nucleons \( \chi_{S, m_S} \)

- express also the \( \chi_{S, m_S} \) through the spin wave functions of nucleons \( (\alpha \text{ and } \beta) \)