Chapter 35 Problem 21 [†]

Given
$L = 15\ fm = 15 \times 10^{-15}\ m$

Solution
Find the minimum energy of an alpha particle in a uranium nucleus.

Treat the nucleas as if it were a 1D infinite square well. The energy levels of an infinite square well are given by the formula

$$E_n = \frac{n^2 h^2}{8mL^2}$$

The ground-state corresponds to $n = 1$. The mass of the alpha particle is four times the mass of the proton. Therefore,

$$E_1 = \frac{(1)^2(6.63 \times 10^{-34}\ J \cdot s)^2}{8(4)(1.67 \times 10^{-27}\ kg)(15 \times 10^{-15}\ m)^2} = 3.66 \times 10^{-14}\ J$$

Converting to electron-volts gives

$$E_1 = 228\ keV$$

[†]Problem from Essential University Physics, Wolfson