882.

Problem 55.38 (RHK)

We have to calculate the Coulomb barrier height for two $^{7}\mathrm{Li}$ *nuclei, fired at each other with the same initial kinetic energy K.*

Solution:

Using the empirical relation

$R = R_0 \left(A\right)^{1/3}, R_0 = 1.2 \times 10^{-15}$ m,

we will determine the radius of $^{7}\mathrm{Li}$ nucleus.

$R_{^{7}\mathrm{Li}} = 1.2 \times \left(7\right)^{1/3}$ fm $= 2.295 \times 10^{-15}$ m.

We assume that the two nuclei of $^{7}\mathrm{Li}$ which are approaching each other with equal kinetic energy K are able to come to a stop when they are separated by $2R_{^{7}\mathrm{Li}}$.

The height of their Coulomb barrier will be

$$U_{\text{coulomb}} = \frac{(3e)^2}{4\pi\varepsilon_0 \times \left(2R_{^7\text{Li}}\right)}$$

$$= \frac{\left(8.99\times10^{9}\right)\times\left(3\times1.6\times10^{-19}\right)^2}{2\times2.295\times10^{-15}} \text{ J}$$

$$= 45.126\times10^{-14} \text{ J}$$

$$= \frac{45.126\times10^{-14}}{1.6\times10^{-13}} \text{ MeV} = 2.82 \text{ MeV}.$$

The two ^7Li nuclei will be able to overcome the Coulomb barrier height if they approach each other with kinetic energy

$$K = \frac{U_{\text{coulomb}}}{2} = 1.41 \text{ MeV}.$$