818.

Problem 54.1 (RHK)

We have to calculate the distance of closet approach for a head-on collision between a 5.30-MeV α *particle and the nucleus of a copper atom*.

Solution:

The atomic number of copper is 29. Therefore, the charge of a copper nucleus is 29 *e*. The distance of closet approach for a head-on collision between a 5.30-MeV α particle and the nucleus of a copper atom can be determined by requiring that at the distance of the closet approach the potential energy of the α particle and the nucleus of a copper atom will be equal to 5.30 MeV.

Let the distance of closet approach of the α particle and the nucleus of a copper atom be *R*.

We thus have the relation

$$\frac{29\times 2\times e^2}{4\pi\varepsilon_0 R} = 5.30\times 1.6\times 10^{-13}\ \text{J},$$

or

$$R = \frac{58\times\left(1.6\times 10^{-19}\right)^2\times 8.99\times 10^9}{5.30\times 1.6\times 10^{-13}}\ \text{m},$$

or

$$R = 1.57\times 10^{-14}\ \text{m} = 15.7\ \text{fm}.$$

In carrying out the above calculation we have used that the charge of an α particle is $2e$ and that

$$\frac{1}{4\pi\varepsilon_0} = 8.99\times 10^9\ \text{N m}^2\ \text{C}^{-2}.$$