

749.

Problem 51.15 (RHK)

A neutron, with kinetic energy of 6.0 eV, collides with a hydrogen atom in its ground state. We have to show that this collision must be elastic.

Solution:

The energy of the ground state of the hydrogen atom

$E_1 = -13.6$ eV, and the energy of the first excited state

$$E_2 = -\frac{13.6}{2^2} \text{ eV} = -3.4 \text{ eV}.$$

The energy required for exciting the hydrogen atom from its ground state to the first excited state is

$$E_2 - E_1 = (-3.4 + 13.6) \text{ eV} = 10.2 \text{ eV}.$$

As the kinetic energy of the neutron is 6.0 eV, it is not sufficient for taking the hydrogen atom from the ground state to the first excited state. Therefore, the collision cannot be inelastic and as kinetic energy of the neutron will be distributed as kinetic energy of the hydrogen atom in the ground state and the kinetic energy of the neutron, the collision will be elastic.