

Chapter 34 Problem 61 †

Given

$$E = 9.32 \mu\text{eV}$$

$$n = 225$$

Solution

Find the original state of the atom.

The energy of a Rydberg atom is given by the formula

$$E_n = \frac{-13.6 \text{ eV}}{n^2} \tag{1}$$

The final energy of the atom is then

$$E_{225} = \frac{-13.6 \text{ eV}}{225^2} = -2.686 \times 10^{-4} \text{ eV}$$

$$E_{225} = -268.6 \mu\text{eV}$$

The energy lost to get to this state was $9.32 \mu\text{eV}$. Therefore, the initial energy was

$$E_i = -268.6 \mu\text{eV} + 9.32 \mu\text{eV} = -259.28 \mu\text{eV}$$

Taking equation (1) and solving for n gives

$$n = \sqrt{\frac{-13.6 \text{ eV}}{E_n}}$$

The initial state of the Rydberg atom was then

$$n = \sqrt{\frac{-13.6 \text{ eV}}{2.5928 \times 10^{-4} \text{ eV}}} = 229$$

†Problem from Essential University Physics, Wolfson