Chapter 32 Problem 48 [†]

Given

$E_F = 11.6\ eV$
$m = 9.11 \times 10^{-31}\ kg$
$h = 6.63 \times 10^{-34}\ J \cdot s$
$1\ eV = 1.6 \times 10^{-19}\ J$

Solution

Find the density of conduction electrons in aluminum.

First convert the energy into joules

$$E_F = (11.6\ eV)\left(\frac{1.6 \times 10^{-19}\ J}{1\ eV}\right) = 1.86 \times 10^{-18}\ J$$

The density of conduction electrons is given by

$$n = \left(\frac{2^{9/2}\pi m^{3/2}}{3h^3}\right) E_F^{3/2}$$

$$n = \left(\frac{2^{9/2}\pi(9.11 \times 10^{-31}\ kg)^{3/2}}{3(6.63 \times 10^{-34}\ J \cdot s)^3}\right)(1.86 \times 10^{-18}\ J)^{3/2}$$

$$n = 1.79 \times 10^{29}\ e^-/m^3$$

[†]Problem from Essential University Physics, Wolfson