

26. (a) Combining Eqs. 42-2, 42-3 and 42-4 leads to the conduction electrons per cubic meter in zinc:

$$n = \frac{2(7.133 \text{ g/cm}^3)}{(65.37 \text{ g/mol})/(6.02 \times 10^{23} \text{ /mol})} = 1.31 \times 10^{23} \text{ cm}^{-3} = 1.31 \times 10^{29} \text{ m}^{-3} .$$

- (b) From Eq. 42-9,

$$E_F = \frac{0.121 h^2}{m_e} n^{2/3} = \frac{0.121 (6.63 \times 10^{-34} \text{ J}\cdot\text{s})^2 (1.31 \times 10^{29} \text{ m}^{-3})^{2/3}}{(9.11 \times 10^{-31} \text{ kg})(1.60 \times 10^{-19} \text{ J/eV})} = 9.43 \text{ eV} .$$

- (c) Equating the Fermi energy to $\frac{1}{2} m_e v_F^2$, we find (using the $m_e c^2$ value in Table 38-3)

$$v_F = \sqrt{\frac{2E_F c^2}{m_e c^2}} = \sqrt{\frac{2(9.43 \text{ eV})(2.998 \times 10^8 \text{ m/s})^2}{511 \times 10^3 \text{ eV}}} = 1.82 \times 10^6 \text{ m/s} .$$

- (d) The de Broglie wavelength is

$$\lambda = \frac{h}{m_e v_F} = \frac{6.63 \times 10^{-34} \text{ J}\cdot\text{s}}{(9.11 \times 10^{-31} \text{ kg})(1.82 \times 10^6 \text{ m/s})} = 0.40 \text{ nm} .$$