3.16 Figure P3.16 shows the parabolic E versus k relationship in the conduction band for an electron in two particular semiconductor materials. Determine the effective mass (in units of the free electron mass) of the two electrons.

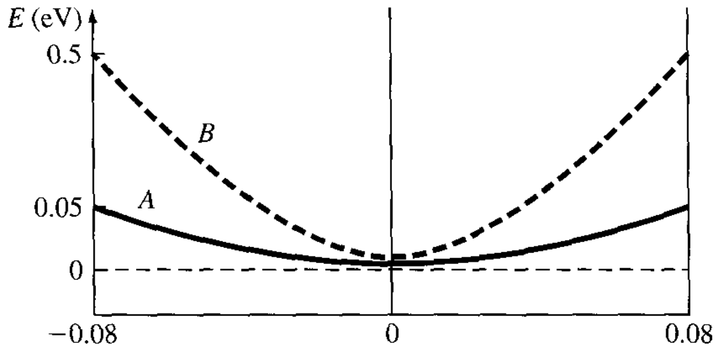

Figure P3.16

Parabola A: $E - E_c \simeq C_A K^2$ per (3.44)

@ $K = 0.08\ \text{Å}^{-1} = 0.08 \times 10^{10}\ m^{-1}$, $E = 0.05\ eV = 8.010883 \times 10^{-21}\ J$

$\hookrightarrow C_A = \dfrac{8.010883 \times 10^{-21}}{(0.08 \times 10^{10})^2} = 1.2517 \times 10^{-38}\ J \cdot m^2$

Per (3.47), $\dfrac{1}{m^*} = \dfrac{2C_1}{\hbar^2} \Rightarrow m_A^* = \dfrac{\hbar^2}{2C_A}$

$$m_A^* = \frac{(1.054571817 \times 10^{-34})^2}{2(1.2517 \times 10^{-38})} = 4.44244 \times 10^{-31}\ kg$$

$$\underline{\underline{m_A^* = 0.4877\ m_o}}$$

Parabola B: $E - E_c \simeq C_B K^2$ per (3.44)

@ $K = 0.08\ \text{Å}^{-1} = 0.08 \times 10^{10}\ m^{-1}$, $E = 0.5\ eV = 8.010883 \times 10^{-20}\ J$

$\hookrightarrow C_B = \dfrac{8.010883 \times 10^{-20}}{(0.08 \times 10^{10})^2} = 1.2517 \times 10^{-37}\ J \cdot m^2$

$$m_B^* = \frac{(1.054571817 \times 10^{-34})^2}{2(1.2517 \times 10^{-37})} = 4.44244 \times 10^{-32}\ kg$$

$$\underline{\underline{m_B^* = 0.04877\ m_o}}$$