Chapter 10

Figure 2.5

At the top of the $n=2$ band, each cell contains a whole wavelength. Thus, $n=\lambda$.
At the top of the $n=1$ band, each cell contains the half wavelength, so $n=\frac{\lambda}{2}$.

The energy is $E = \frac{\hbar^2 k^2}{2m}$

The energy at the top of the $n=2$ band is $E_{top} = \frac{\hbar^2 (2\pi/a)^2}{2m}$

$E_{top} = \frac{\hbar^2 \left(\frac{3\pi}{2a}\right)}{2m}$

$\Delta E = E_{top} - E_{top} = \frac{\hbar^2 (2\pi/a)}{2m} - \frac{\hbar^2 (2\pi/2a)}{2m}$

$\Delta E = \frac{3\hbar^2 \pi^2}{2ma^2}$

$\Delta E \approx 5001$
Semi conductor

Gap 1 eV

DT = 4K

Show that \( T \) by 30%.

Conductivity is dominated by a factor \( e^{-E_{gap}/2k_bT} \)

\[
\frac{T_f}{T_i} = \exp \left[ \frac{-E_{gap}}{2k_b} \left( \frac{1}{T_f} - \frac{1}{T_i} \right) \right] = \exp \left[ \frac{E_{gap}}{2k_b T_f T_i} \right]
\]

\[= \exp \left[ \frac{(1.6 \times 10^{-19} J)(4 K)}{2(1.38 \times 10^{-23} J/K)(295)(299)} \right] \]

\[= 1.3 \approx 30\% \text{ rise} \]
\[ E = \frac{hc}{\lambda} = \frac{1240 \text{ eV nm}}{700 \text{ nm}} = 1.77 \text{ eV} \]

\[ \lambda = \frac{hc}{E} = \frac{1240 \text{ eV nm}}{2.25 \text{ eV}} = 551 \text{ nm} \]