

Exact calculation of 1D DOS

The dispersion relation for photons is $\omega(k) = c|k|$, while for phonons it is $\omega(k) = \omega_m |\sin(ka/2)|$, and for electrons it is $E(k) = \hbar^2 k^2 / 2m$. Use the identity

$$D(\omega) = \frac{L}{2\pi} \int_{-\infty}^{\infty} dk \delta(\omega - \omega(k))$$

to calculate the exact 1D densities of states for photons, phonons and electrons. Sketch and label these functions on one set of axes.