What does the dispersion look like?

In Fig. 3-5, we plot the dispersion curve given by Eq. (3-9). $\left(\omega = \omega_m \left|\sin\left(\frac{ka}{2}\right)\right|\right)$ Negative values of k describe waves moving in the $-x$ direction.

In general,

$$\omega = vk, \tag{3-11}$$

where v is the velocity of the wave. In Fig. 3-5, this would be a straight line with slope v through the origin. The fact that the dispersion in Fig. 3-5 is *not* a straight line means that the velocity of a lattice wave depends on wavelength. The waves we are most familiar with (such as sound and light) have a velocity largely *independent* of wavelength. Waves in a lattice behave very differently. Also, we see that there exists a maximum frequency ω_m. There is a limit to the frequency at which the atoms can oscillate. *No* waves with a frequency greater than ω_m can exist in this lattice.

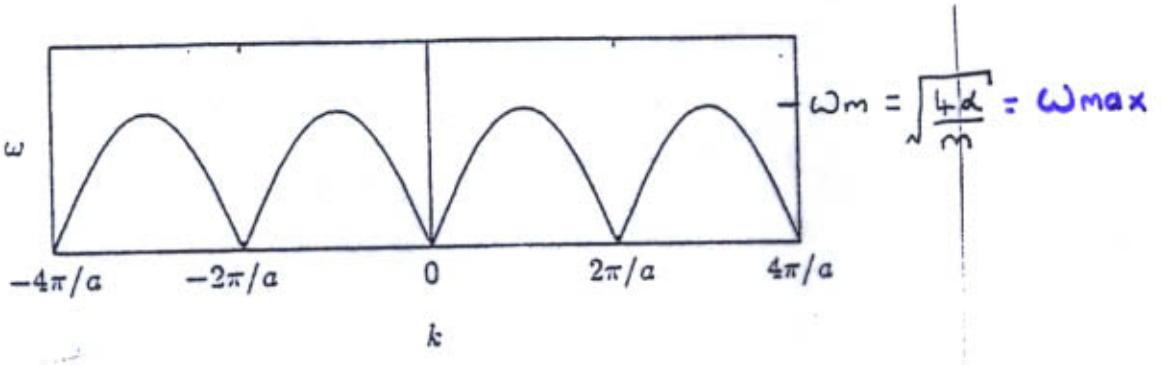

Fig. 3-5. The dispersion curve [Eq. (3-9)] for waves in a one-dimensional monatomic lattice.