From *Semiconductor Physics and Devices: Basic Principles* (4th Edition), Donald A. Neamen, McGraw Hill, 2012, ISBN 978-0-07-352958-5.
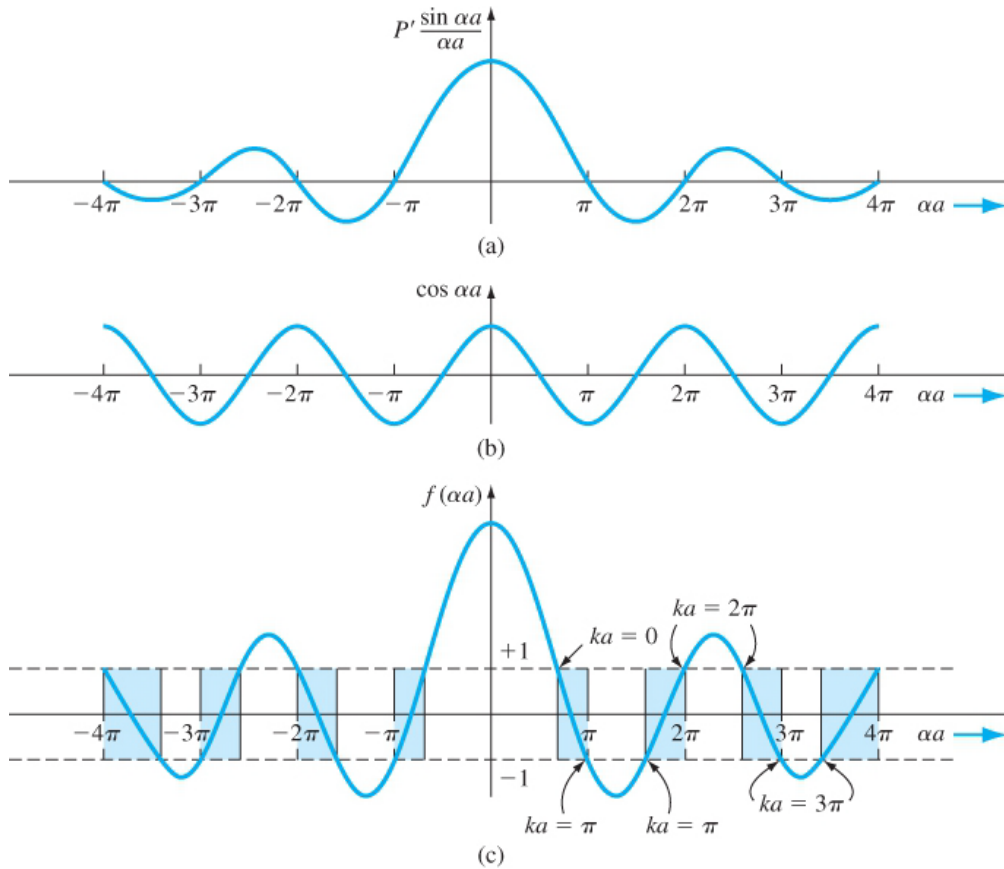

Figure 3.8 | A plot of (a) the first term in Equation (3.29), (b) the second term in Equation (3.29), and (c) the entire $f(\alpha a)$ function. The shaded areas show the allowed values of (αa) corresponding to real values of k.
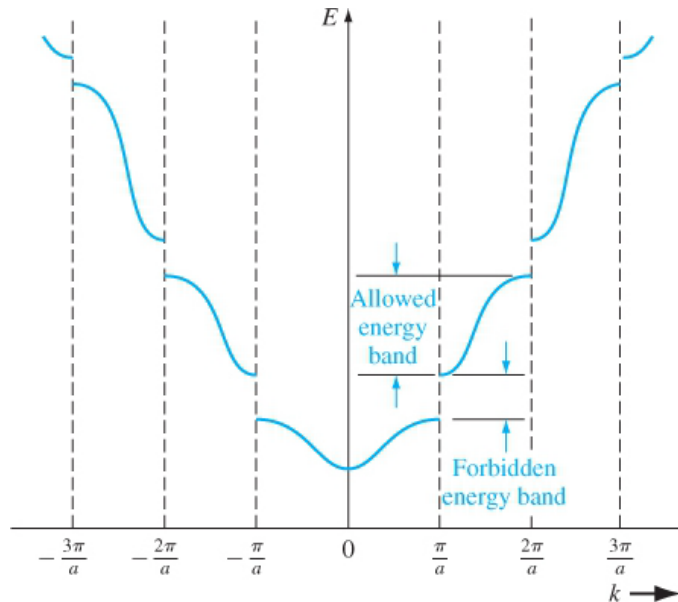

Figure 3.9 | The E versus k diagram generated from Figure 3.8. The allowed energy bands and forbidden energy bandgaps are indicated.

➤ Taking advantage of the fact that the cosine function is periodic, i.e.,

$$\cos(ka) = \cos(ka + 2n\pi) = \cos(ka - 2n\pi),$$

we can shift parts of the plot in Figure 3.9 to create a plot of E versus k in a reduced k-space. This is shown in Figures 3.10 and 3.11 and serves to clearly show the **allowed** and <u>forbidden</u> energy bands.
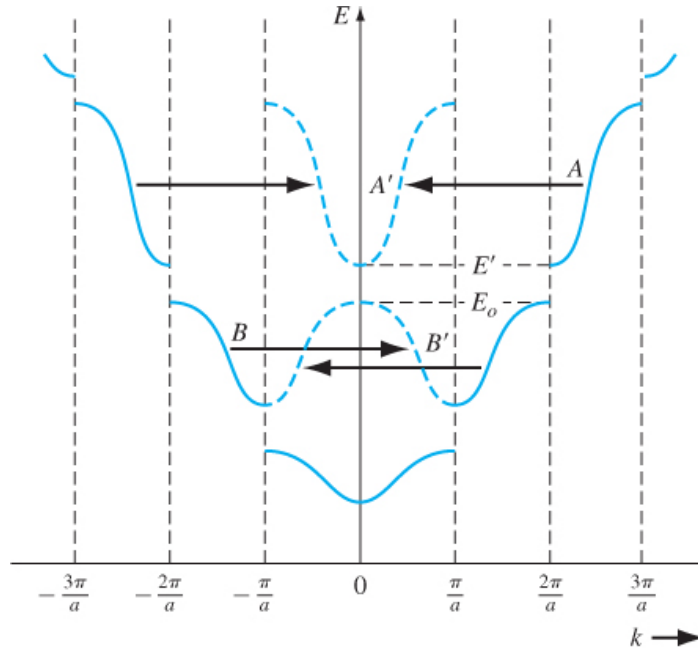

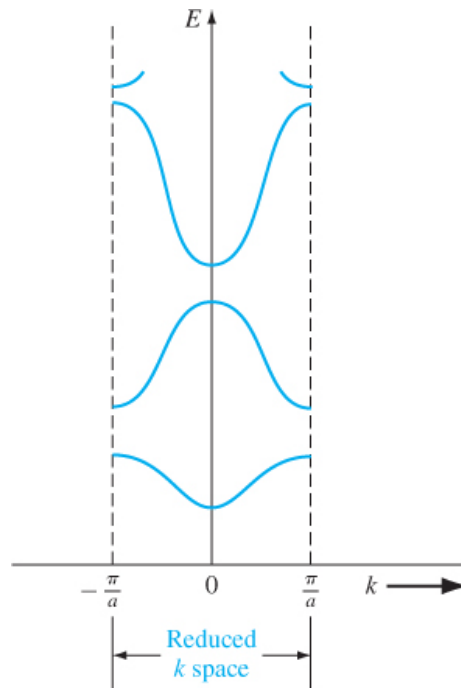**Figure 3.10** | The E versus k diagram showing 2π displacements of several sections of allowed energy bands.

Figure 3.11 | The E versus k diagram in the reduced-zone representation.