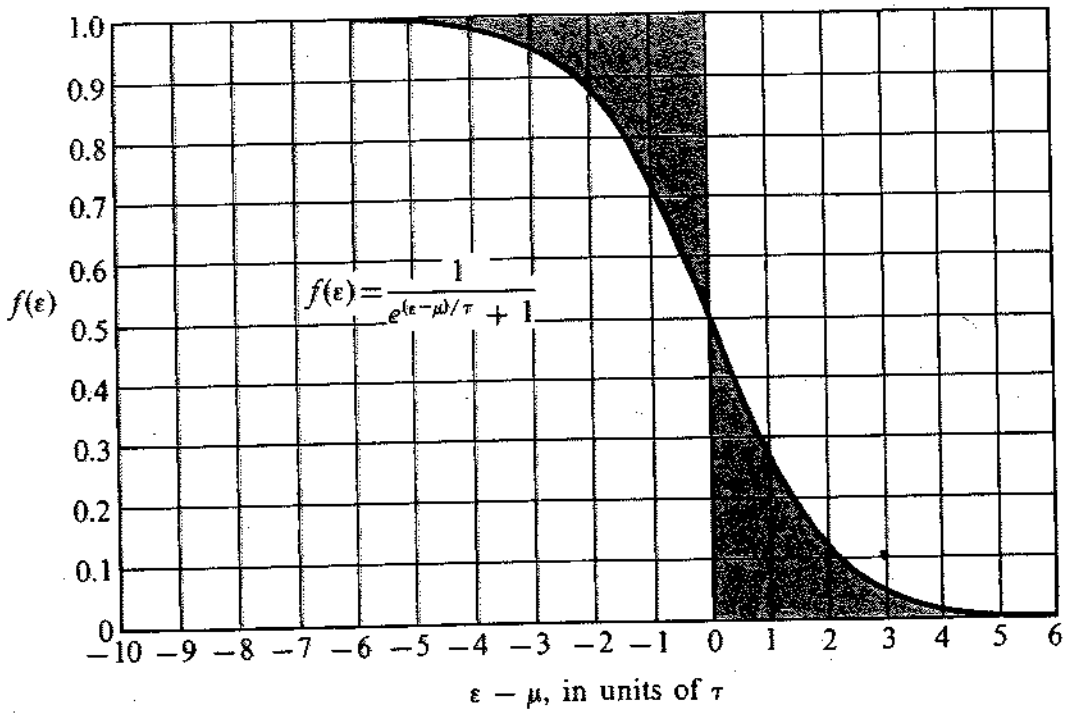

Figure 6.3 Plot of the Fermi-Dirac distribution function $f(\varepsilon)$ versus $\varepsilon - \mu$ in units of the temperature τ. The value of $f(\varepsilon)$ gives the fraction of orbitals at a given energy which are occupied when the system is in thermal equilibrium. When the system is heated from absolute zero, fermions are transferred from the shaded region at $\varepsilon/\mu < 1$ to the shaded region at $\varepsilon/\mu > 1$. For conduction electrons in a metal, μ might correspond to 50 000 K.

is the temperature dependent $\mu(\tau)$. Consider a system of many independent orbitals, as in Figure 6.4. At the temperature $\tau = 0$, all orbitals of energy below the Fermi energy are occupied by exactly one fermion each, and all orbitals of higher energy are unoccupied. At nonzero temperatures the value of the chemical potential μ departs from the Fermi energy, as we will see in Chapter 7.

If there is an orbital of energy equal to the chemical potential ($\varepsilon = \mu$), the orbital is exactly half-filled, in the sense of a thermal average:

$$f(\varepsilon = \mu) = \frac{1}{1 + 1}. \tag{6}$$

Orbitals of lower energy are more than half-filled, and orbitals of higher energy are less than half-filled.

We shall discuss the physical consequences of the Fermi-Dirac distribution in Chapter 7. Right now we go on to discuss the distribution function of non-