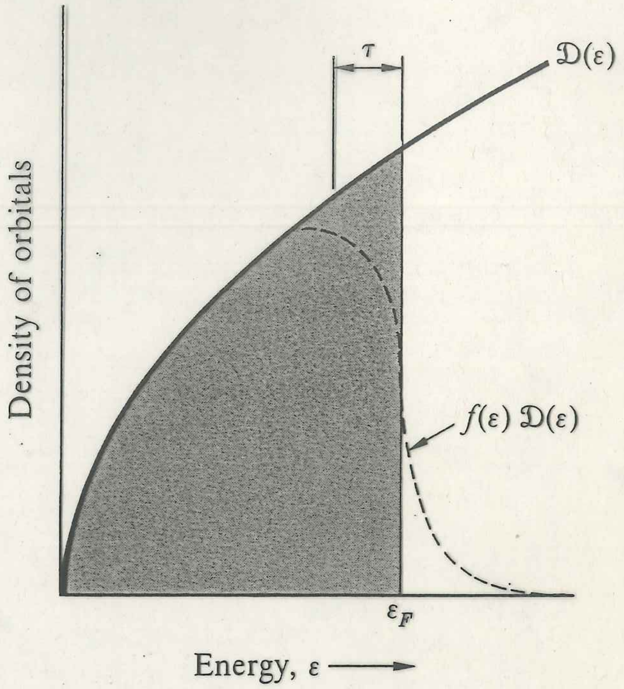

igure 7.3 Density of orbitals as a function f energy, for a free electron gas in three imensions. The dashed curve represents the ensity $f(\varepsilon)\mathfrak{D}(\varepsilon)$ of occupied orbitals at a finite emperature, but such that τ is small in omparison with ε_F. The shaded area represents he occupied orbitals at absolute zero.

When multiplied by the distribution function (Figure 6.3), the density of orbitals $\mathfrak{D}(\varepsilon)$ becomes $\mathfrak{D}(\varepsilon)f(\varepsilon)$, the density of occupied orbitals (Figure 7.3). The total number of electrons in a system may now be written as

$$\boxed{N = \int_0^\infty d\varepsilon\, \mathfrak{D}(\varepsilon) f(\varepsilon,\tau,\mu)\ ,} \tag{20}$$

where $f(\varepsilon)$ is the Fermi-Dirac distribution function described in Chapter 6. In problems where we know the total number of particles, we determine μ by requiring that the total number of particles calculated from (20) be equal to the correct value. The total kinetic energy of the electrons is

$$\boxed{U = \int_0^\infty d\varepsilon\, \varepsilon \mathfrak{D}(\varepsilon) f(\varepsilon,\tau,\mu).} \tag{21}$$

If the system is in the ground state, all orbitals are filled up to the energy ε_F, above which they are vacant. The number of electrons is equal to

$$\boxed{N = \int_0^{\varepsilon_F} d\varepsilon\, \mathfrak{D}(\varepsilon)\ ,} \tag{22}$$

and the energy is

$$\boxed{U_0 = \int_0^{\varepsilon_F} d\varepsilon\, \varepsilon \mathfrak{D}(\varepsilon).} \tag{23}$$