In this chapter we develop the principles that permit us to calculate the values of the physical properties of a system as a function of the temperature. We assume that the system $\mathcal{S}$ of interest to us is in thermal equilibrium with a very large system $\mathcal{R}$, called the **reservoir**. The system and the reservoir will have a common temperature τ because they are in thermal contact.

The total system $\mathcal{R} + \mathcal{S}$ is a closed system, insulated from all external influences, as in Figure 3.1. The total energy $U_0 = U_{\mathcal{R}} + U_{\mathcal{S}}$ is constant. In particular, if the system is in a state of energy ε_s, then $U_0 - \varepsilon_s$ is the energy of the reservoir.

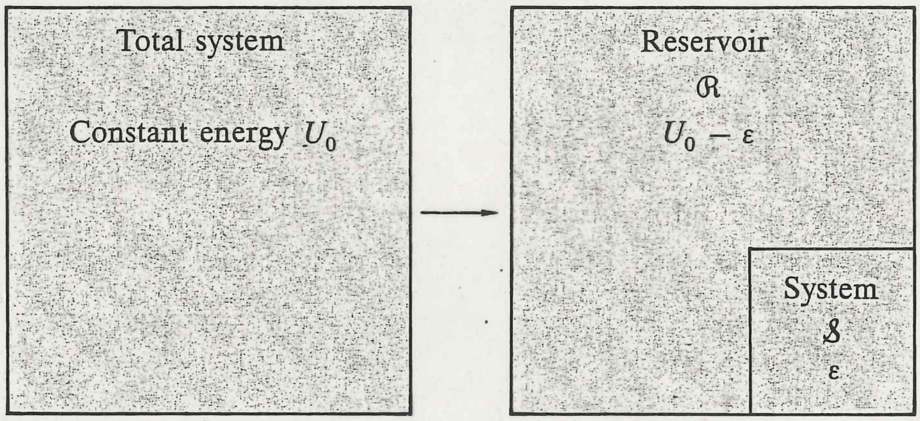

Figure 3.1 Representation of a closed total system decomposed into a reservoir $\mathcal{R}$ in thermal contact with a system $\mathcal{S}$.

BOLTZMANN FACTOR

A central problem of thermal physics is to find the probability that the system $\mathcal{S}$ will be in a specific quantum state s of energy ε_s. This probability is proportional to the Boltzmann factor.

When we specify that $\mathcal{S}$ should be in the state s, the number of accessible states of the total system is reduced to the number of accessible states of the reservoir $\mathcal{R}$, at the appropriate energy. That is, the number $g_{\mathcal{R}+\mathcal{S}}$ of states