5.4 The micro-canonical, canonical, and the grand-canonical ensemble

The macro state has to be considered by its restrictions.

micro restrictions	**macro restrictions**
Each system of the ensemble, even each micro state fulfills the restriction	Only on average the ensemble fulfills the restriction
e.g. $U_i = U$	e.g. $\sum_i p_i U_i = U$

For large systems ($N \gg 1$) micro- and macro restrictions do not differ in their physical properties.

Kind of ensemble	micro restriction Average only of systems with identical values of:	macro restrictions variable values for averaging	macro restrictions averages
micro canonical ensemble	V, N, U	$---$	$---$
canonical ensemble	V, N	U_i	$U = \sum_i p_i U_i$
grand canonical ensemble	V	U_i N_i	$U = \sum_i p_i U_i$ $N = \sum_i p_i N_i$

These ensembles correspond to different thermodynamic contacts.
Which ensemble we use for the calculation is just a question of convenience.