

1 Energy fluctuations

Consider a system of fixed volume in thermal contact with a reservoir. Show that the mean square fluctuations in the energy of the system is

$$\langle (\varepsilon - \langle \varepsilon \rangle)^2 \rangle = k_B T^2 \left(\frac{\partial U}{\partial T} \right)_V \quad (1)$$

Here U is the conventional symbol for $\langle \varepsilon \rangle$. *Hint:* Use the partition function Z to relate $(\frac{\partial U}{\partial T})_V$ to the mean square fluctuation. Also, multiply out the term $(\dots)^2$.