

# 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  $\left(\frac{\partial U}{\partial T}\right)_V$  to the mean square fluctuation. Also, multiply out the term  $(\dots)^2$ .