[tex64] **Toward thermal equilibrium via particle transfer**

A vessel with insulating walls is divided into two compartments by an internal wall that is also insulating but has a small hole of area A. The two compartments contain dilute gases of slightly different densities, $n_\pm = n \pm \frac{1}{2}dn$, at slightly different temperatures, $T_\pm = T \pm \frac{1}{2}dT$.

(a) Show that the rates at which particles and energy are transferred through the hole are (in leading orders of dn and dT):

$$\frac{dN}{dt} = \frac{A}{\sqrt{2\pi m}}\left[\sqrt{k_BT}dn + \frac{1}{2}\frac{n}{\sqrt{k_BT}}d(k_BT)\right],$$

$$\frac{dE}{dt} = \frac{A\sqrt{2}}{\sqrt{\pi m}}\left[(k_BT)^{3/2}dn + \frac{3}{2}n\sqrt{k_BT}d(k_BT)\right].$$

(b) Find the particular ratios dn/dT of density and temperature deviations for which either the particle flow or the energy flow is zero.