How do you interact?

Consider a container like that shown below, with \( n_i \) moles of a monatomic gas on one side and \( n_2 \) moles of a diatomic gas on the other. The monatomic gas has initial temperature \( T_{1i} \). The diatomic gas has initial temperature \( T_{2i} \).

a. Show that the equilibrium thermal energies are

\[
E_{1f} = \frac{3n_1}{3n_1 + 5n_2} (E_{1i} + E_{2i})
\]

\[
E_{2f} = \frac{5n_2}{3n_1 + 5n_2} (E_{1i} + E_{2i})
\]

b. Show that the equilibrium temperature is

\[
T_f = \frac{3n_1 T_{1i} + 5n_2 T_{2i}}{3n_1 + 5n_2}
\]

c. 2.0 g of helium at an initial temperature of 300 K interacts thermally with 8.0 g of oxygen at an initial temperature of 600 K. What is the final temperature? How much heat energy is transferred, and in which direction?