Answer on Question #47261, Physics, Other

Consider two containers that have volumes V1 and V2. Both volumes contain the same number of molecules of the same ideal gas. The containers initially have temperatures T1 and T2. Now the containers are joined, allowing the gases to mix. Assume that the gas has constant heat capacities:

cv =(∂u/∂T) at const V and c =(∂h/∂T) at const P =c +k_B

Find the final temperature in the container Tf.

Solution:

We write the equation of heat balance (in the final state gas work does not perform):

$$c_1 m(T - T_1) + c_2 m(T - T_2) = 0$$

$$c_1 = c_2$$

Thus,

$$T - T_1 + T - T_2 = 0$$

$$T = \frac{T_1 + T_2}{2}$$

Other solution

Using the definition of the internal energy of the gas and the law of conservation of energy, we obtain

$$U_1 + U_2 = U$$

With N atoms in the monoatomic gas, its total internal energy U is given as:

$$U = \frac{3}{2} N k_B T,$$

where N is the number of atoms in the gas.

Thus,

$$\frac{3}{2} 2N k_B T = \frac{3}{2} N k_B T + c_V N T_2$$

$$T = \frac{T_1 + T_2}{2}$$

Answer:

$$T = \frac{T_1 + T_2}{2}$$