

Answer on Question #42746, Physics, Molecular Physics | Thermodynamics

Three perfect gases at absolute temperatures T_1, T_2 and T_3 are mixed. If numbers of molecules of the gases are n_1, n_2 and n_3 respectively then temperature of mixture will be (assume no loss of energy)?

Solution:

An ideal gas can be characterized by three state variables: absolute pressure (P), volume (V), and absolute temperature (T). The relationship between them may be deduced from kinetic theory and is called the *ideal gas law*:

$$PV = nkT$$

where

n = number of molecules

k = Boltzmann constant = 1.38066×10^{-23} J/K = 8.617385×10^{-5} eV/K

From data we have

$$n_1 + n_2 + n_3 = n$$

By energy conservation

$$P_1V_1 + P_2V_2 + P_3V_3 = PV$$

Thus,

$$n_1kT_1 + n_2kT_2 + n_3kT_3 = nkT$$

So, the final temperature is

$$T = \frac{n_1T_1 + n_2T_2 + n_3T_3}{n_1 + n_2 + n_3}$$

Answer. $T = \frac{n_1T_1 + n_2T_2 + n_3T_3}{n_1 + n_2 + n_3}$