Answer on Question #48417, Physics, Molecular Physics | Thermodynamics

A closed cylinder vessel contains N moles of an ideal diatomic gas at constant temperature T. On supplying heat, temperature remains same but 'n' moles get dissociated into atoms. The heat supplied is....

Solution:

Since the gas is enclosed in a vessel, therefore, during heating process, volume of the gas remains constant. Thus, no work is done by the gas. It means heat supplied to the gas is used to increase its internal energy only.

Initial internal energy of the N moles of diatomic gas is

$$U_1 = N\frac{5}{2}RT$$

Since n moles get dissociated into atoms, therefore, after heating, vessel contains (N − n) moles of diatomic gas and 2n moles of a mono-atomic gas. Hence the internal energy for the gas, after heating, will be equal to

$$U_2 = (N-n)\frac{5}{2}RT + 2n\frac{3}{2}RT = \frac{5}{2}NRT + \frac{1}{2}nRT$$

Thus, the heat supplied is equal to the increase in internal energy

$$Q = U_2 - U_1 = \frac{5}{2}NRT + \frac{1}{2}nRT - \frac{5}{2}NRT = \frac{1}{2}nRT$$

Answer: $Q = \frac{1}{2}nRT$