Answer on Question #48362-Physics-Molecular Physics-Thermodynamics

A container filled with $v_1 = 20\ moles$ of ideal diatomic gas at absolute temperature T. when heat is supplied to gas temperature remains constant but $v_2 = 8\ moles$ dissociated into atoms. Heat energy given to gas is

Solution

Since the gas is enclosed in a vessel, therefore, during heating process, volume of the gas remains constant.

Hence, 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 gas is

$$U_1 = v_1\left(\frac{5}{2}RT\right).$$

Since n moles get dissociated into atoms, therefore, after heating, vessel contains $(v_1 - v_2)$ moles of diatomic gas and $2v_2$ moles of a mono-atomic gas. Hence the internal energy for the gas, after heating, will be equal to

$$U_2 = (v_1 - v_2)\left(\frac{5}{2}RT\right) + 2v_2\left(\frac{3}{2}RT\right) = \frac{5}{2}v_1(RT) + \frac{1}{2}v_2(RT).$$

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

$$U_2 - U_1 = \frac{1}{2}v_2(RT) = \frac{1}{2}\cdot 8(RT) = 4RT.$$

Answer: $4RT$.