Answer on Question #43118-Physics-Molecular Physics-Thermodynamics

A quantity of 5 moles of an ideal gas at temperature 200c and suffers an increase of pressure from 2atm to 6atm without change of temperature find

1-initial and final volume.

Solution

For an ideal gas the state equation is

$$pV = nRT.$$

Initial volume of an ideal gas is

$$V_i = \frac{nRT}{p_i} = \frac{5 \text{ mole} \cdot 8.31 \frac{J}{mol\ K} \cdot 473K}{202650\ Pa} = 0.097\ m^3.$$

The temperature doesn't change, that's why $pV = const$ and $p_i V_i = p_f V_f$.

Final volume of an ideal gas is

$$V_f = \frac{p_i V_i}{p_f} = \frac{V_i}{3} = \frac{0.097}{3} m^3 = 0.032\ m^3.$$

2-work done during this process and which do the work.

Solution

In isothermal process gas expands to the new volume and work is done on the gas is

$$W = -\int_{V_1}^{V_2} PdV,$$

where $P = nRT \cdot \frac{1}{V}$.

$$W = -\int_{V_1}^{V_2} nRT \cdot \frac{1}{V} dV = -nRT \ln\frac{V_2}{V_1} = -P_1 V_1 \ln\frac{V_2}{V_1} = -202650 \cdot 0.097 \ln\frac{1}{3} = 21.6 \cdot 10^3\ J = 21.6\ kJ.$$

W have sign "+", so the work is done on the gas.