Question #73626, Chemistry / Physical Chemistry / Completed

State various types of work. Calculate the work done when 1.00 mol of an ideal gas expands isothermally and reversibly at 300 x 10^2 K from 2.00 x 10^6 Pa to 2.00 x 105 Pa

Solution

Isothermal expansion:

$W = nRT \log P_2 / P_1 = 1.00 \text{ mol} \times 8.314 \text{ J/mol·K} \times 300 \times 10^2 \log 2.00 \times 10^5 / 2.00 \times 10^6 = -249420 \text{ J}$

Answer: - 249420 J.

Types of work:

In thermodynamics, the reversible work involved when a gas changes from state *A* to state *B* is[6]

$$W_{A\to B} = -\int_{V_A}^{V_B} p\,dV$$

The definition of an adiabatic process is that heat transfer to the system is zero, $\delta Q = 0$. Then, according to the first law of thermodynamics,

$$(1) \qquad dU + \delta W = \delta Q = 0,$$

An *isobaric process* is a thermodynamic process in which the pressure stays constant: $\Delta P = 0$. The heat transferred to the system does work, but also changes the internal energy of the system. This article uses the chemistry sign convention for work, where positive work is work done *on* the system. Using this convention, by the first law of thermodynamics,

$$Q = \Delta U - W$$

where *W* is work, *U* is internal energy, and *Q* is heat.[1] Pressure-volume work by the closed system is defined as:

$$W = -\int p\,dV$$