Answer on Question #41059, Physics, Molecular Physics | Thermodynamics

Calculate the work done against external atmospheric pressure when 1 g of water changes to 1672cm3 of steam. Take the atmospheric pressure as 1:013×105Nm−2

Solution

Given:

$P = 1.013 \cdot 10^5 \frac{\mathrm{N}}{\mathrm{m}^2}$.

$m = 1g = 10^{-3}kg$.

$V_2 = 1672\ \mathrm{cm}^3 = 1.672 \cdot 10^{-2}m^3$.

1 g of water is evaporated under atmospheric pressure and temperature of 100 C. The density of steam at pressure $P = 1.013 \cdot 10^5 \frac{\mathrm{N}}{\mathrm{m}^2}$ and temperature of 100 C is $\rho_{steam} = 0.59 \frac{kg}{m^3}$. It takes volume

$$V_1 = \frac{m}{\rho_{steam}} = \frac{10^{-3}kg}{0.59\frac{kg}{m^3}} = 1.69 \cdot 10^{-3}m^3.$$

The work done against external atmospheric pressure is

$$W = P\Delta V = P(V_2 - V_1) = 1.013 \cdot 10^5(1.672 \cdot 10^{-2} - 1.69 \cdot 10^{-3}) = 1.522\ kJ.$$

Answer: $\mathbf{1.522\ kJ}$.