Answer on Question #48261-Physics-Molecular Physics-Thermodynamics

The heat absorbed by a mole of an ideal gas in a quasistatic process in which temperature changes by dT and volume V changes by dV is given by

$$\delta Q = CdT + \bar{P}dV,$$

where C is its constant molar heat capacity at constant volume, and $\bar{P} = \frac{RT}{V}$ is the mean pressure.

Find the change in entropy of this gas in a quasistatic process which takes it from initial values of temperature T_i and volume V_i to the final values of temperature T_f and volume V_f. Does your answer depend upon the process involved in going from initial to final state?

Solution

$$dS = \frac{\delta Q}{T} = \frac{CdT + \bar{P}dV}{T} = \frac{CdT}{T} + \frac{\bar{P}}{T}dV.$$

But

$$\frac{\bar{P}}{T} = \frac{\frac{RT}{V}}{T} = \frac{R}{V}.$$

The change in entropy of this gas in a quasistatic process is

$$\Delta S = \int_{T_i}^{T_f} \frac{CdT}{T} + \int_{V_i}^{V_f} \frac{RdV}{V} = C\ln\frac{T_f}{T_i} + R\ln\frac{V_f}{V_i}.$$

As we can see it doesn't depend upon the process involved in going from initial to final state.