

[tex59] Ideal–gas entropy and Boltzmann’s H–function

Consider N particles of a classical monatomic ideal gas confined to a box of volume V at temperature T . Show that the entropy $S(T, V, N) = S_0 + nR \ln[(T/T_0)^{3/2}(V/V_0)]$ previously inferred from the empirical relations $pV = nRT$, $C_V = \frac{3}{2}nR$ can be derived via $S = -Nk_B H(\infty)$ from the stationary value of Boltzmann’s H-function,

$$H(t) = \int d^3r \int d^3v f(\mathbf{r}, \mathbf{v}, t) \ln f(\mathbf{r}, \mathbf{v}, t).$$

Solution: