

Are the Boltzmann and Thermodynamic Entropies Always the Same?

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Abstract. Previous work by the author [David Sands 2008 Eur. J. Phys. 29 129 doi:10.1088/0143-0807/29/1/013] has compared the Boltzmann entropy, $k \ln W$, with the thermodynamic entropy, $C \ln T$, in the case of a temperature-independent heat capacity, C . The simple form of both entropy expressions allows for a simple expression for W and a physical interpretation on the accessible states behind this expression was presented. For the case when C varies with temperature, as in a solid below the Debye temperature, it is not so obvious that this interpretation applies. If there is no simple interpretation of the accessible states it is by no means clear that the Boltzmann entropy is the same as the thermodynamic entropy. In this paper the accessible states of more complex systems is examined. It is shown that the same idea of the accessible states can be applied, but that a real difference between the Boltzmann and thermodynamic entropies is implied by this interpretation.