An Energy-Based Unit for the Thermodynamic Temperature

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Steps have been taken to define basic units in terms of fundamental constants, e.g. the kilogram is now to be based on an exact value of the Planck constant. In a similar way, it is possible to define an energy-based unit for the thermodynamic temperature by including known constants in the temperature itself:

$T' = ½\ k_b\ N_A\ T = ½\ R_{un}\ T$

T'= consolidated thermodynamic temperature (J mol^{-1})

T = conventional thermodynamic temperature (K)

k_b = Boltzmann constant (1,380 650 5 *10^{-23} J K^{-1})

N_A = Avogadro's number (6,022 141 5 *10^{23} mol^{-1})

R_{un} = universal gas constant (8,314 472 7 J K^{-1} mol^{-1})

It is suggested that the unit J mol^{-1} should be given the name boltzmann, short form: Bo, because the Boltzmann constant will abrogated if the proposal is implemented. The introduction of the concept will have no impact on thermodynamic theory and present the same problems to thermometry as fixing the value of the Boltzmann constant has. The concept may be introduced without referring to either Boltzmann constant or kelvin:

"At the present state of thermometry, the thermodynamic temperature of the triple point of water, T'_{TPW}, is 1 135, 590 XX J mol^{-1}". (T_{TPW} = 273,16 K) The thermodynamic temperature of a substance is the mean kinetic energy of particles per degree of freedom.

By introducing the Avogadro number into the definition, the numerical value is raised to everyday-life magnitude. The definition takes care of the temperature as integrating factor and as an intensive property of state. The molar entropy will be a pure number. In the Boltzmann equation that relates entropy to the probability of a state, the Boltzmann constant is replaced by $2/N_A$. The equation then contains pure numbers only, in line with Shannon's information theory. Learning, teaching and applying thermodynamics will benefit from the lack of conversion factors (k_b and R_{un}). The proposal is intended to replace kelvin in thermodynamics, not Celsius or Fahrenheit in everyday life.