The Ideal and Real Gas Heat Capacity of Cesium Atoms at High Temperatures

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The ideal gas heat capacity of cesium atoms is calculated to high temperatures using statistical mechanics. Since there are a large number of energy levels in the sum over states that contribute at high temperatures, the partition function and heat capacity become very large as the temperature increases unless the number of contributing energy levels is constrained. Two methods, the Bethe method and the ionization potential lowering method, are used to do this. In addition, some energy states within a degenerate energy level may not have experimentally determined energies. A "fill" procedure for approximating the energies of the unknown states is used. Also, if cesium atoms are considered to be a real gas that obeys the virial equation of state, the first non-ideal term in the power series expansion of the heat capacity in terms of virial coefficients depends on the second temperature derivative of the second virial coefficient which depends on the interaction potential between two cesium atoms. Two interacting ground state cesium atoms can follow either of two potential energy curves. When a ground state atom interacts with an atom in the first excited state, they can follow any of eight potential energy curves. The values of the second derivative of the second virial coefficient for the ten interactions are determined and used to calculate the non-ideal contribution to the heat capacity.