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Excluded-volume effects of molecular vibrations in a one-dimensional gas JAMES H. TAYLOR, Univ. of Central Missouri — Some common thermodynamic properties are found for N rod-like, vibrating molecules in 1D, where the length of each molecule oscillates with an amplitude determined by the molecule's internal vibrational energy. Properties are found via exact evaluation of the partition function, Z; to account for the different possible lengths of individual molecules, calculation of Z includes integration over the internal phases describing the oscillations. For N greater than 1 and large system length L, there is an increase in the average energy of the system at a given temperature—compared to that for molecules with fixed lengths—as well as in the entropy and isothermal compressibility; the pressure decreases, though, and there is a variable effect on the heat capacity. These alterations can be traced directly to an effective increase in the 1D volume available to the molecules, the changes being larger for higher energy states than for lower ones. The oscillations have minimal influence when L is large compared to the combined length of all molecules, but dominate the behavior when the two lengths become comparable.

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