

# Critical Properties of Isobaric Processes of Lennard-Jones Gases

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The thermodynamic quantities of Lennard-Jones gases, evaluated till the fourth virial coefficient, are investigated for an isobaric process. A partition function in the  $T$ - $P$  grand canonical ensemble  $Y(T, P, N)$  may be defined by the Laplace transform of the partition function  $Z(T, V, N)$  in the canonical ensemble. The Gibbs free energy is related with  $Y(T, P, N)$  by the Legendre transformation  $G(T, P, N) = -kT \log Y(T, P, N)$ . The volume, enthalpy, entropy, and heat capacity are analytically expressed as functions of the intensive variables temperature and pressure. Some critical thermodynamic quantities for Xe are calculated and drawn. At the critical point the heat capacity diverges to infinity, while the Gibbs free energy, volume, enthalpy, and entropy are continuous. This suggests that a second-order phase transition may occur at the critical point.

*Key words:* Lennard-Jones Gases; Isobaric Process; Critical Constants;  
Second-order Phase Transition.