# Physics 214A
# Problem Set 7
# Fall 1997

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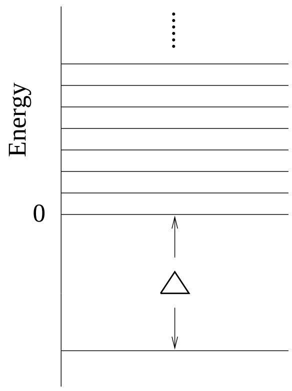
**Problem 20** (20 points).

The spectrum of a particle obeying Bose-Einstein statistics consists of a discrete state with energy $E = -\Delta$ and then the usual continuum $E = p^2/2m$.




**a)** What are the expressions for the pressure, particle number and energy as a function of V, T and $z$? ($z$ is the fugacity.)

**b)** What is the allowed range of $z$?

**c)** For fixed T, what is the minimum value of the density for which the discrete level contains, in the $V \to \infty$ limit, a finite fraction of the particles? [You may leave your answer as an integral.]

**Problem 21** (20 points).

**a)** Find the density of states $D(\epsilon)$ of a system with an energy spectrum given by

$$\epsilon_{lmn} = \gamma \left( \frac{\lambda_1 l}{L_1} + \frac{\lambda_2 m}{L_2} + \frac{\lambda_3 n}{L_3} \right)$$

where $l, m$, and $n$ are non-negative integers, the $L$'s are the dimensions of the container, $\gamma$ and the $\lambda$'s are constants, not necessarily integers. [Hint: evaluate $\int dl\, dm\, dn\, \delta(\epsilon - \epsilon_{lmn})$]

**b)** Given a Bose-Einstein gas of $N$ particles having the energy spectrum of part a., find the transition temperature $T$.

**c)** Calculate the heat capacity for $T < T_c$, and $T > T_c$.

**d)** Calculate the discontinuity in $C_v$ at $T = T_c$.