

$$S_1 = \sum_{n_x=1}^{\infty} e^{-\frac{n^2}{8mkT a^2} n_x^2}$$

$$= \sum_{n_x=1}^{\infty} e^{-d n_x^2} \quad \text{where } d = \frac{h^2}{8mkT a^2}$$

This summation can be replaced by integration
condition applied :-

spacing between two successive energy level
will be $\ll kT$

Integration Interparticle separation \gg thermal de Broglie wavelength.

$$d \gg \lambda_d$$

$$d \approx \left(\frac{V}{N} \right)^{1/3}$$

de Broglie wavelength :-

$$\lambda = \frac{h}{p}$$

Average thermal energy :-

$$\langle KE \rangle = \frac{p^2}{2m} = \frac{1}{2} kT$$

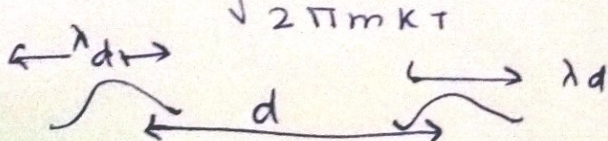
$$\Rightarrow p = \sqrt{mkT}$$

then

$$\lambda_d \approx \frac{h}{\sqrt{mkT}}$$

\Rightarrow thermal de Broglie wavelength

actual expansion of

$$\lambda_d = \frac{h}{\sqrt{2\pi mkT}}$$


The diagram shows a horizontal line of length d . On either side of this line, there are two wavy lines representing de Broglie wavelengths, each labeled λ_d . The total length of the wavy lines is $2\lambda_d$.