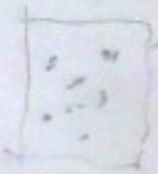
Chapter 6 : Ideal gases



V, N when is our gas classical

when part. are competing for same quantum state

examine this.

Introduce part. Number density

$n = \frac{N}{V}$ V units L^3

average spacing of part a_0

$a_0 \sim \frac{1}{n^{1/3}} \sim n^{-1/3}$

assume interparticle force has a length r_0

our gas is ideal if $a_0 >> r_0$

fixes criterion for ideal gas behavior

When quantum effects important

$\bar{n}_k$ occupation of given state

for classical behavior

$\bar{n}_k << 1$

in quasi class limit

#states $\frac{\Delta q \Delta p}{2\pi\hbar}$ = dimensionless

$\bar{n} \sim \frac{2\pi\hbar}{\Delta p \Delta q}$

what is Δp what is Δ

$\Delta p \sim \bar{p}$; $\Delta q = a_0$

$\bar{n}_k \sim \frac{\bar{p}\, a_0}{2\pi\hbar}$ $\Rightarrow$ $\boxed{a_0 >> \frac{h}{\bar{p}}}$

h

deBroglie wavelength

λ_{dB}

$a_0 >> \lambda_{dB} \rightarrow$ classical behavior

$$\boxed{k_B T >> \frac{\hbar^2}{2 m a_0^2}}$$

$$\sum_k \bar{n}_k = N$$