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Course 565 / 665 Lecturer prof. Cavagnero

Day 4.2.04 Date 9:55 am

Notes Taken By J. Hong Total Number of Pages

predict $\mu_A$ - $\mu_B$ from microscopic model.

for Ideal Gas. $q' = \sum_{j=0} e^{-\beta E_j} = e^{-\varepsilon_0/kT} + e^{-\varepsilon_1/kT} + \cdots$

define $q = q' \cdot e^{\varepsilon_0/kT} = 1 + e^{-(\varepsilon_1-\varepsilon_0)/kT} + e^{-(\varepsilon_2-\varepsilon_0)/kT} + \cdots$

for IG. can show: $\mu = -kT \ln\left(\frac{q}{N}\right)$

$$\begin{cases} \mu_A = -kT \ln \frac{q_A'}{N_A} \\ \mu_B = -kT \ln q_B'/N_B \end{cases} \xrightarrow{\text{at eq.}} \frac{q_B'}{N_B} = \frac{q_A'}{N_A}$$

$$K_{AB} = \frac{N_B}{N_A} = \frac{q_B'}{q_A'} = \frac{q_B}{q_A} \cdot e^{-(\varepsilon_{0B} - \varepsilon_{0A})/kT}$$

In general: $aA + bB \rightleftharpoons cC$

same approach leads to: $K = \frac{q_C^c}{q_A^a q_B^b} e^{-(c\varepsilon_{0C} - a\varepsilon_{0A} - b\varepsilon_{0B})/kT}$

show $\mu_A = -kT \ln \frac{q}{N}$ for IG.

$Q = \frac{q^N}{N!}$ (independent, indistinguishable)

$G = -kT \ln Q = -kT \ln \frac{q^N}{N!} = -kT \left[ \ln q^N - \ln\left(\frac{N}{e}\right)^N \right]$

(F?)

$= -kT \ln \left(\frac{qe}{N}\right)^N$

1 of 1

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$$\mu = \frac{\partial}{\partial N}\left[ kTN \ln\left(\frac{N}{qe}\right)\right] = kT\ln\left(\frac{N}{qe}\right) + kTN\frac{qe}{N}\cdot\frac{1}{qe}$$

$$= -kT\ln\frac{q}{N}$$

see. $K_{AB} = \frac{q_B}{q_A}\cdot e^{-(\varepsilon_{0B}-\varepsilon_{0A})/kT}$

if $q_A \sim q_B$, if $\varepsilon_{0A} < \varepsilon_{0B}$ $\Rightarrow$ $K_{AB}$ is small.

if $\varepsilon_{0A} < \varepsilon_{0B}$, but $q_A < q_B$, could have $K_{AB} > 1$

$K_{AB}$: the balance between ratio of partition fn. and difference of ground state energy.

1 of 2