Lecture 26 review:

1. E(T) for particles in a box: L

Combine $E_j = E_{n_x,n_y,n_z} = \frac{h^2}{8mL^2}(n_x^2+n_y^2+n_z^2)$

$E = \frac{-1}{Z}\frac{\partial Z}{\partial \beta} \rightarrow Z = \left(\frac{2\pi m k_B T}{h^2}\right)^{\frac{3}{2}} V$

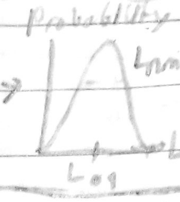
$E = \frac{3}{2}Nk_BT = \frac{3}{2}nRT$ for N particles

T ∝ energy per degree of freedom

($\frac{1}{2}k_BT$ energy per degree of freedom)

2. In notes.

$F = -kx$ } molecule vibrates at T →



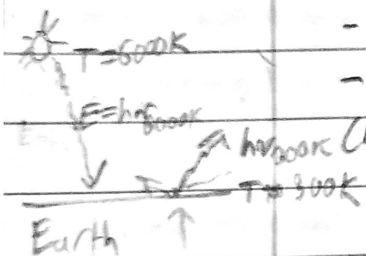
$L_{rms} = \sqrt{\frac{k_BT}{k}}$

Lecture 27: What is ΔG?:

- isolated system: $S_{tot}(t>0) > S_{tot}(t=0)$

"tot" = total or $dS_{tot} > 0$

- This is valid at constant E & V since S is a function of E, V. S(E, V...)
- Can we come up with a similar formula for constant T & P (more practical)
- ex. for $dS > 0$



- passes through O_2,
- gets absorbed by CO_2 and can return.

$N = 20$ (if $N_{sun} = 1$)

$\approx \frac{1}{2}$ radiated back into space

- How much does S (or W) change.

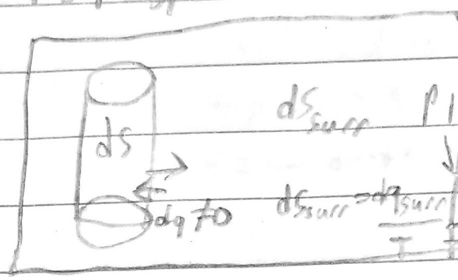
Z?

- S5.2 (exact $Z = 8\pi\left(\frac{k_BT}{ck}\right)^3$ per unit volume)
- $Z_{20} = \frac{Z_1 \cdot Z_2 \cdots Z_{20}}{20!} = \frac{Z^{20}}{20!}$

$Z_{1p\ \text{hoton},\ 6000K} = 1.8\times10^{18}\ (m^{-3})$ } $N=1$ →

$Z_{20\ \text{photons},\ 300K} = 10^{288}\ (m^{-3})$ } $N=20$ } highly spontaneous

- When is a rxn. in a sys. at constant T & P spontaneous?



"env" = environment

"tot" = total

- From postulate 1: $dS_{tot} = dS + dS_{surr} > 0$

$= dS + \frac{dH_{surr}}{T} > 0$

$dS_{tot} = dS - \frac{dH}{T} > 0$

- multiply by T on both sides

$dH - TdS < 0$

$G = H - TS$

↓

$dG = dH - TdS$ at constant T

$dG < 0 \Leftarrow dS_{tot} > 0$ if T is constant

$\frac{dG(x)}{dx}\left(\frac{1}{mol}\right) = \Delta G$

$\frac{3}{2}H_2 + \frac{1}{2}N_2 \rightarrow NH_3$