gas ideal klasikoaren propietate termodinamikoak 1_17_018_00

partikulak :
- monoatomikoak
- berdin-berdinak
- askeak (elkarrekintzarik gabeko)
- ez-erlatibistak
- bereizgarri

$\Omega(N,V,E)$ zenbakia kalkulatu, limite asintotikoan

1. $$\sum_{r=1}^{3N} \epsilon_r = E$$ ϵ_r N partikulaz osatutako sistemaren bakoitzeko askatasun-gradua

2. $V = L^3$ partikula bakarra

$$E(n_x,n_y,n_z) = \frac{h^2}{8mL^2}\left(n_x^2+n_y^2+n_z^2\right) \quad n_x,n_y,n_z = 1,2,\ldots$$

$$\longleftrightarrow$$

$$n_x^2+n_y^2+n_z^2 = \frac{8mV^{2/3}}{h^2}\cdot E$$

$$\frac{8mV^{2/3}}{h^2}\cdot E \equiv E^*$$

$$n_x^2+n_y^2+n_z^2 = E^*$$

zenbat modutan lor daiteke hori?

$$\Omega(1,V,E)$$

3. N partikula

$$\Omega(N,V,E)$$

$$\sum_{r=1}^{N}\left(n_x^2+n_y^2+n_z^2\right)_r = \sum_{r=1}^{3N} n_r^2$$

$$\frac{8mV^{2/3}}{h^2}\cdot E \equiv E^*$$

$$\sum_{r=1}^{3N} n_r^2 = E^*$$

4. bereizgarriak direnez, guztira kopurua da horrelako hau : $\sqrt{E^*}$ erradioko 3N dimentsioko esferaren gainazalean dagoen sare-puntuen kopurua

- kopuru hau E^*-ren funtzio oso irregularra $\Omega(E^*)$ ← adibidea 1_21_021, 1_22_022, 1_25_025, 1_23_023

- irregularitate hau gutxitu daiteke batuz! $\Sigma(E^*)$
hurbilketa :

$$\Sigma(N,V,E') \equiv \sum_{E\le E'} \Omega(N,V,E')$$

$$\Sigma_N(E^*) = \sum_{E' \le E^*} \Omega_N(E^*)$$

← 1_19_019
1_20_020

5. $\Sigma_N(E^*)$ kalkulierbar machen

$$\Sigma_N(E^*) \approx \left(\frac{1}{2}\right)^{3N} \left\{ \frac{\pi^{\frac{3N}{2}}}{\left(\frac{3N}{2}\right)!} \cdot (E^*)^{\frac{3N}{2}} \right\}$$

← 1_28_028

$E^* =$

$$\Sigma(N,V,E) \approx \left(\frac{V}{h^3}\right)^N \frac{(2\pi m E)^{\frac{3N}{2}}}{\left(\frac{3N}{2}\right)!}$$

Stirling: $\ln n! = n \ln n - n$ $\left(\lim_{n\to\infty} \frac{n!}{\sqrt{2\pi n}\left(\frac{n}{e}\right)^n} = 1 \right)$ ← wiki

ln

$$\ln \Sigma(N,V,E) \approx N \ln\left\{ \frac{V}{h^3} \left(\frac{4\pi m E}{3N} \right)^{3/2} \right\} + \frac{3}{2}N$$

← 1_29_029

6. $\Gamma(N,V,E;\Delta) \approx \frac{\partial}{\partial E}\left(\Sigma(N,V,E)\right) \cdot \Delta \approx \frac{3N}{2} \frac{\Delta}{E} \Sigma(N,V,E)$

← 1_24_024
1_26_026
1_27_027
1_30_030
1_31_031
1_32_032
1_33_033