

1 Adibidea:

Osziladore harmonikoz osatutako sistema: azterketa klasikoa

(i) partizio-funtzioa

SISTEMA

N

osziladore harmoniko dimentsiobakar

“aske” (ia-ia independente)

bereiztezin

$$H(q_i, p_i) = \frac{1}{2}m\omega^2 q_i^2 + \frac{1}{2m}p_i^2 \quad (i = 1, \dots, N)$$

$$\begin{aligned} Q_1(\beta) &= \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} \exp \left\{ -\beta \left(\frac{1}{2}m\omega^2 q_i^2 + \frac{1}{2m}p_i^2 \right) \right\} \frac{dq dp}{h} \\ &= \frac{1}{h} \left(\frac{2\pi}{\beta m \omega^2} \right)^{1/2} \left(\frac{2\pi m}{\beta} \right)^{1/2} = \frac{1}{\beta \hbar \omega} \end{aligned}$$

$$Q_N(\beta) = [Q_1(\beta)]^N = (\beta \hbar \omega)^{-N}$$

bereiztezin

$$Q_N(V, T) = \frac{1}{N!} \left[\frac{1}{\beta \hbar \omega} \right]^N$$

fotoiak

bereizgarri

$$Q_N(V, T) = \left[\frac{1}{\beta \hbar \omega} \right]^N$$

fonoiak (energia-mailak)