

# Física Estadística I

## Tarea 02: Mecánica Estadística Clásica

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14 Febrero 2020

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### **Problema 1** *N three-dimensional harmonic oscillators*

For a collection of  $N$  three-dimensional quantum harmonic oscillators of frequency  $\omega$  and total energy  $E$ , find that the number of microstates  $\Omega$ , entropy  $S$ , and the temperature  $T$  are given by:

$$\Omega(E, N) = \frac{(E/\hbar\omega + 3N/2 - 1)!}{(3N - 1)! (E/\hbar\omega - 3N/2)!},$$
$$S(E, N) = Nk_B \left[ \left( \frac{E}{N\hbar\omega} + \frac{3}{2} \right) \ln \left( \frac{E}{N\hbar\omega} + \frac{3}{2} \right) - \left( \frac{E}{N\hbar\omega} - \frac{3}{2} \right) \ln \left( \frac{E}{N\hbar\omega} - \frac{3}{2} \right) \right],$$
$$T = \frac{\hbar\omega}{k_B} \left[ \ln \frac{(E/N\hbar\omega + 3/2)}{(E/N\hbar\omega - 3/2)} \right]^{-1}.$$

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### **Problema 2** *Classical spin system*

We have a system of three classical non-interacting spins that can be aligned up  $\uparrow$ , or down  $\downarrow$ . The spins are under the influence of an applied magnetic field towards the down direction. Such field gives an  $\epsilon$  energy for the  $\uparrow$  configuration, and an  $-\epsilon$  energy for the  $\downarrow$  configuration. Using the microcanonical ensemble, obtain the probability of the following configurations,

1.  $(\downarrow\uparrow\uparrow)$ , if the total energy is  $\epsilon$ .
2.  $(\downarrow\downarrow\downarrow)$ , if the total energy is  $\epsilon$ .
3.  $(\downarrow\downarrow\downarrow)$ , if the total energy is  $-3\epsilon$ .

Where the probability is defined as:

$$P = \frac{\text{possible cases}}{\text{total cases}}.$$

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