Lista de exercícios 4:

Problemas 1-4: Questões 1, 2, 3 e 4 do Cap. IV do Cohen-Tannoudji.

Problemas 5-7: Questões 1, 2, e 3 do Cap. V do Cohen-Tannoudji.

Problemas 8-10: Questões 1, 2, e 3 do Cap. VI do Cohen-Tannoudji.

Problema 11:

(a) Calculate the expectation value of the operator $\hat{X}^4$ in the N-representation with respect to the state $|\, n\rangle$ (i.e., $\langle n \mid \hat{X}^4 \mid n\rangle$).

(b) Use the result of (a) to calculate the energy E_n for a particle whose Hamiltonian is $\hat{H} = \hat{P}^2/(2m) + \frac{1}{2}m\omega^2\hat{X}^2 - \lambda\hat{X}^4$.

Problema 12:

(a) Show that $\Delta J_x \, \Delta J_y = \hbar^2[j\,(j+1) - m^2]/2$, where $\Delta J_x = \sqrt{\langle \hat{J}_x^2 \rangle - \langle \hat{J}_x \rangle^2}$ and the same for ΔJ_y.

(b) Show that this relation is consistent with $\Delta J_x \, \Delta J_y \;\geq\; (\hbar/2)\,|\langle \hat{J}_z \rangle| = \hbar^2 m/2$.

Problema 13:

Consider a particle of total angular momentum $j = 1$. Find the matrix for the component of $\vec{J}$ along a unit vector with arbitrary direction $\vec{n}$. Find its eigenvalues and eigenvectors.