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Quiz 27

$$\mathbf{T}^{(1)}_{\pm 1} = \mp 2^{-1/2}\left(\mathbf{x} \pm i\mathbf{y}\right), \quad \mathbf{T}^{(1)}_{0} = \mathbf{z}$$

$$\left[\mathbf{J}_i, \mathbf{q}_j\right] = i\hbar \sum_k \varepsilon_{ijk} \mathbf{q}_k$$

A. Show that $\left[\mathbf{J}_z, \mathbf{T}^{(1)}_{-1}\right] = \hbar \mathbf{T}^{(1)}_{-1}$

B. Show that $\left[\mathbf{J}_-, \mathbf{T}^{(1)}_{-1}\right] = 0$

C. If $\mathbf{T}^{(\omega)}_{\mu}$ satisifes the $\left[\mathbf{J}_\pm, \mathbf{T}^{(\omega)}_{\mu}\right] = \hbar\left[\omega(\omega+1) - \mu(\mu \pm 1)\right]^{1/2} \mathbf{T}^{(\omega)}_{\mu\pm 1}$ and $\left[\mathbf{J}_z, \mathbf{T}^{(\omega)}_{\mu}\right] = \hbar\mu \mathbf{T}^{(\omega)}_{\mu}$ definitions, then we are supposed to know all selection rules for matrix elements of $\mathbf{T}^{(\omega)}_{\mu}$ in the $|JM_J\rangle$ basis set. What are the ΔJ and ΔM_J selection rules for $\mathbf{T}^{(3)}_{+2}$?

$\Delta J =$ $\qquad\qquad$ $\Delta M_J =$

(over)

D. Show that the operator $(\mathbf{L}_{+})^2$ satisfies at least one part of the commutation rule definition for $\mathbf{T}_{+2}^{(2)}$: $\left[\mathbf{J}_z, \mathbf{T}_2^{(2)}\right] = \hbar 2\mathbf{T}_2^{(2)}$.

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5.73 Quantum Mechanics I
Fall 2018

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