Question

$$S_x = \frac{\hbar}{\sqrt{2}} \begin{pmatrix} 0 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{pmatrix}; \quad S_y = \frac{\hbar}{\sqrt{2}} \begin{pmatrix} 0 & -i & 0 \\ i & 0 & -i \\ 0 & i & 0 \end{pmatrix}; \quad S_z = \hbar \begin{pmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & -1 \end{pmatrix}.$$

[1] What are the spin wave functions for the states in which S_x will have values

(i) $\hbar$ (ii) 0 (iii) -$\hbar$?

[2] If the spin wave function is given by

$$\chi = N \begin{pmatrix} 12 \\ 3i \\ 4 \end{pmatrix}$$

where N is normalization constant. Find the probabilities that the x component of spin will have values (i) $\hbar$; (ii) 0; (iii) $-\hbar$. Verify that all three probabilities add to one. [6]

Category A: Marks 10/12

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  Adjoint not taken correctly.

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