Eigen functions

$S_z \doteq \eta_+^{\wedge} \eta_-^{\wedge}$ [these are the eigen states where it derives the orientation of spin values]

$\hbar/2$ from 3 & 2 L derivation

① $\lambda_1 = \frac{\hbar}{2}$ $S_z \eta_+^{\wedge} = \hbar/2 (\eta_+^{\wedge})$

② $S_n \begin{pmatrix} \alpha \\ \beta \end{pmatrix} = \hbar/2 \begin{pmatrix} \alpha \\ \beta \end{pmatrix}$

③ $\hbar/2 \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} \alpha \\ \beta \end{pmatrix} = \hbar/2 \begin{pmatrix} \alpha \\ \beta \end{pmatrix}$

$\begin{pmatrix} 0 & \hbar/2 \\ \hbar/2 & 0 \end{pmatrix} \begin{pmatrix} \alpha \\ \beta \end{pmatrix} = \begin{pmatrix} \hbar/2\,\alpha \\ \hbar/2\,\beta \end{pmatrix}$

④ $\begin{pmatrix} 0 & \beta \\ \alpha & 0 \end{pmatrix} = \hbar/2 \begin{pmatrix} \alpha \\ \beta \end{pmatrix}$

⑤ $\begin{pmatrix} \beta \\ \alpha \end{pmatrix} = \hbar/2 \begin{pmatrix} \alpha \\ \beta \end{pmatrix}$

⑥ $\begin{pmatrix} \beta \\ \alpha \end{pmatrix} = \begin{pmatrix} \alpha \\ \beta \end{pmatrix}$

⑦ derives α and β are equal

⑧ $\begin{pmatrix}\alpha\\ \beta\end{pmatrix} \Rightarrow \begin{pmatrix}\alpha\\ \alpha\end{pmatrix}$

Normalise matrix [MUST for eigen function]

$$\int \psi^* \psi \, dx = 1$$ [wave function normalization

⑨ $\begin{pmatrix}\alpha\\ \alpha\end{pmatrix}^* \begin{pmatrix}\alpha\\ \alpha\end{pmatrix} = 1$

[1) $\begin{pmatrix}\alpha\\ \beta\end{pmatrix} = \begin{pmatrix}\alpha\\ \alpha\end{pmatrix}$ from the derivation of matrix
2) $\begin{pmatrix}\alpha\\ \beta\end{pmatrix}$ derived as $\mathcal{H}$ eigen function]

10) $\begin{pmatrix}\alpha\\ \alpha\end{pmatrix}^*$! - take the transposed matrix

1) column to row
2) change - from [i] to [-i] wherever [i] is present

11) (α, α) [i not present so focus on part I]

12) $(\alpha, \alpha)\begin{pmatrix}\alpha\\ \alpha\end{pmatrix} = 1$

$\alpha^2 + \alpha^2 = 1$

$2\alpha^2 = 1$

$\alpha^2 = \frac{1}{2}$

$\alpha = \sqrt{\frac{1}{2}}$

$\alpha = \frac{1}{\sqrt{2}}$