A particle in an infinite square well has an initial state vector

$$|\Psi(t=0)\rangle = A(|\varphi_1\rangle - |\varphi_2\rangle + \iota|\varphi_3\rangle).$$

where $|\varphi_n\rangle$ are the energy eigenstates. This also means

$$\langle\Psi(t=0)| = \bar{A}(\langle\varphi_1| - \langle\varphi_2| + \iota\langle\varphi_3|)$$

$$|\Psi(t=0)\rangle = \frac{A}{\alpha\beta\gamma}\ (\alpha\beta|\varphi_1\rangle - \beta\gamma|\varphi_2\rangle + \alpha\gamma\iota|\varphi_3\rangle)$$

In the energy basis,

$$|\varphi_1\rangle \doteq \begin{pmatrix}1\\0\\0\end{pmatrix},\quad |\varphi_2\rangle \doteq \begin{pmatrix}0\\1\\0\end{pmatrix},\quad \text{and } |\varphi_3\rangle \doteq \begin{pmatrix}0\\0\\1\end{pmatrix}.$$

So,

$$|\Psi(t=0)\rangle \doteq \begin{pmatrix}A\\-A\\\iota A\end{pmatrix}.$$

(**a**) Multiplying the state vector by its magnitude normalizes it.

$$|\Psi'(t=0)\rangle \doteq \frac{A}{\sqrt{(3A^2)}}\begin{pmatrix}1\\-1\\\iota\end{pmatrix} = \frac{1}{\sqrt{3}}\begin{pmatrix}1\\-1\\\iota\end{pmatrix}.$$