Tensor Product of Pauli Y and X Gates

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The Pauli Y Gate:

$Y \equiv \sigma_y \equiv \begin{bmatrix} 0 & -i \\ i & 0 \end{bmatrix}$ where ba

The Pauli X Gate:

$X \equiv \sigma_x \equiv \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$ where basis' ar

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The Tensor Product of the P

We can see that $Y \otimes V =$

sis' are $|0\rangle = i\begin{bmatrix}0\\1\end{bmatrix}$ & $|1\rangle = -i\begin{bmatrix}1\\0\end{bmatrix}$

e $|0\rangle = \begin{bmatrix}0\\1\end{bmatrix}$ & $|1\rangle = \begin{bmatrix}1\\0\end{bmatrix}$

Pauli Y and X matrix is denoted

$) \cdot X \quad (-i) \cdot X$

$\cdot X \quad 0 \cdot X$ with for vector to f by $Y \otimes X$.

find as a result of this tensor product, also

Work:

Step 1: "Find $|v_1\rangle$"

$$|v_1\rangle = \begin{bmatrix} 0 \\ i \end{bmatrix} \otimes \begin{bmatrix} 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ i \\ i \end{bmatrix}$$

Using the tensored resul

we see that $Y \otimes X =$

$\cdot x \qquad 0 \cdot x \Big]$ with four vectors to

$$\begin{bmatrix} 0 \cdot 0 \\ 0 \cdot 1 \\ \cdot 0 \\ \cdot 1 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ i \end{bmatrix}$$

<u>Step 2</u>: "Find $|v_2\rangle$"

$$|v_2\rangle = \begin{bmatrix} 0 \\ i \end{bmatrix} \otimes$$

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ts above,

$$\begin{bmatrix} 0 & 0 & 0 & -i \\ 0 & 0 & -i & 0 \\ 0 & i & 0 & 0 \\ i & 0 & 0 & 0 \end{bmatrix}$$

which surprisin

... of this tensor product obs...

$$\begin{bmatrix}1\\0\end{bmatrix} = \begin{bmatrix}0\cdot 1\\0\cdot 0\\i\cdot 1\\i\cdot 0\end{bmatrix} = \begin{bmatrix}0\\0\\i\\0\end{bmatrix}$$

<u>Step 3:</u> "Find ...

$|v_3\rangle = [\ldots$

...ngly differs from the tensor Produc...