4.5 2

$$|\uparrow\rangle = \begin{bmatrix} 1 \\ 0 \end{bmatrix} \qquad |\psi_1\rangle = C_{10}\,|\uparrow\rangle + C_{11}\,|\downarrow\rangle = \begin{bmatrix} C_{10} \\ C_{11} \end{bmatrix} \in \mathbb{C}^2$$

$$|\downarrow\rangle = \begin{bmatrix} 0 \\ 1 \end{bmatrix} \qquad |\psi_2\rangle = C_{20}\,|\uparrow\rangle + C_{21}\,|\downarrow\rangle = \begin{bmatrix} C_{20} \\ 221 \end{bmatrix} \in \mathbb{C}^2$$

$$|\psi_1\rangle \otimes |\psi_2\rangle = \begin{bmatrix} C_{10} & C_{20} \\ C_{10} & C_{21} \\ C_{11} & C_{20} \\ C_{11} & C_{21} \end{bmatrix} \in \mathbb{C}^4$$

$$= C_{10}C_{20}|\uparrow\rangle \otimes |\uparrow\rangle + C_{10}C_{21}|\uparrow\rangle \otimes |\downarrow\rangle + C_{11}C_{20}|\downarrow\rangle \otimes |\uparrow\rangle + C_{11}C_{21}|\downarrow\rangle \otimes |\downarrow\rangle$$

En general un vector con n particulas generico permanecera a $\mathbb{C}^{2n}$

4. 5.3

$$|\phi\rangle = |x_0\rangle \otimes |y_1\rangle + |x_1\rangle \otimes |y_1\rangle$$

$$|\psi_1\rangle = C_0\,|x_0\rangle + C_1\,|x_1\rangle = \begin{bmatrix} C_0 \\ C_1 \end{bmatrix}$$

$$|\psi_2\rangle = C_0'\,|y_0\rangle + C_1'\,|y_1\rangle = \begin{bmatrix} C_0' \\ C_1' \end{bmatrix}$$

$$|\phi\rangle = |\psi_1\rangle \otimes |\psi_2\rangle = \begin{bmatrix} C_0 & C_0' \\ C_0 & C_1' \\ C_1 & C_0' \\ C_1 & C_1' \end{bmatrix}$$

$$|\phi\rangle = C_0C_0'\,|x_0\rangle \otimes |y_0\rangle + C_0C_1'\,|x_0\rangle \times |y_1\rangle + C_1C_0'\,|x_1\rangle \otimes |y_0\rangle + C_1C_1'\,|x_1\rangle \otimes |y_0\rangle$$

Para que se cumpla $|\phi\rangle$ inicial

$$C_0 C_0' = 0 \qquad\qquad C_0' = 0$$
$$C_0 C_1' = 1 \quad \text{por lo que} \quad C_0 = 1$$
$$C_1 C_0' = 0 \qquad\qquad C_1 = 1$$
$$C_1 C_1 = 1 \qquad\qquad C_1' = 1$$

Por lo tanto son separables de esta Forma y una solucion seria :

$$|\psi_1\rangle = |x_0\rangle + |x_1\rangle = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

$$|\psi_2\rangle = |y_1\rangle = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$