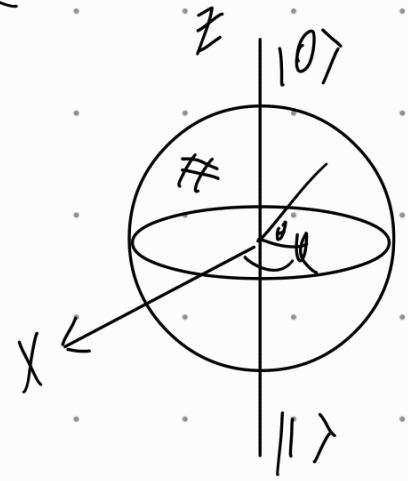
#1

$$\begin{bmatrix} 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} 0 & 0 \\ 0 & 1 \\ 1 & 0 \\ 1 & 1 \end{bmatrix} \rightarrow \begin{bmatrix} 0 & 1 \\ 0 & 0 \\ 1 & 1 \\ 1 & 0 \end{bmatrix}$$

#2



$$|\psi_z\rangle = \cos\left(\frac{\theta}{2}\right)|0\rangle + \sin\left(\frac{\theta}{2}\right)e^{i\phi}|1\rangle$$

$\theta = \pi$

$\phi = \frac{\pi}{2}$

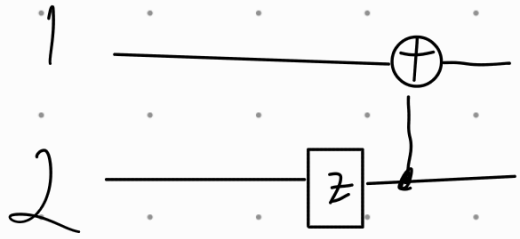
a. $|\psi_z\rangle = 0|0\rangle + i|1\rangle$

$$\frac{1}{i+0}\left(0|0\rangle + i|1\rangle\right)$$

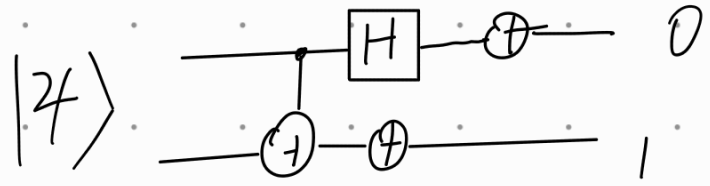
$$|\psi_z\rangle = 0|0\rangle + 1|1\rangle$$

$$|\psi_x\rangle = \frac{1}{\sqrt{2}}|0\rangle + \frac{1}{2}|1\rangle$$

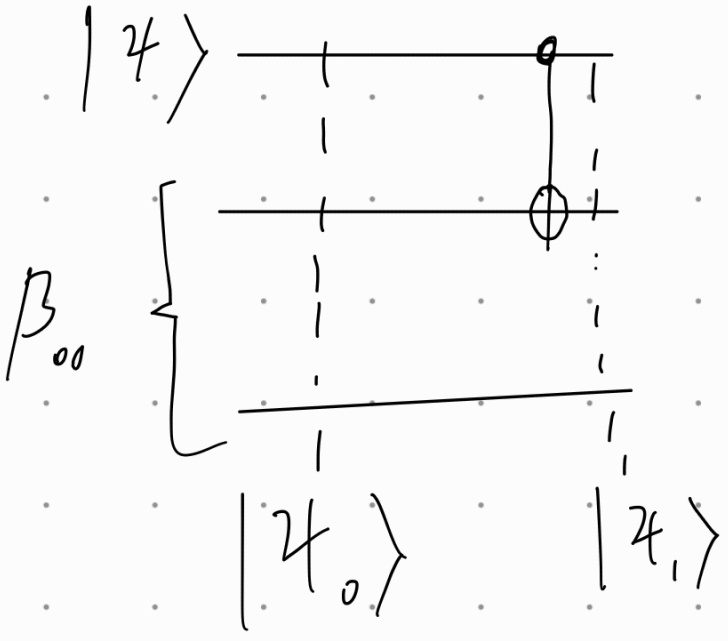
#3



#4



#5.



$$|4\rangle = \alpha|0\rangle + \beta|1\rangle$$

$$|4_1\rangle = \alpha|000\rangle|011\rangle + \beta|110\rangle|101\rangle$$