

Quiz 2

Name: _____ Date: _____ I participated today: _____

1. Which of the following are possible single-qubit gates? Circle all that apply. (Hint: Consider how each matrix would transform the state vectors $\begin{bmatrix} 1 \\ 0 \end{bmatrix}$ and $\begin{bmatrix} 0 \\ 1 \end{bmatrix}$. Is the result a valid single-qubit state?)

a. $\begin{bmatrix} 1 \\ 0 \end{bmatrix}$

c. $\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$

e. $\frac{1}{\sqrt{2}} \begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$

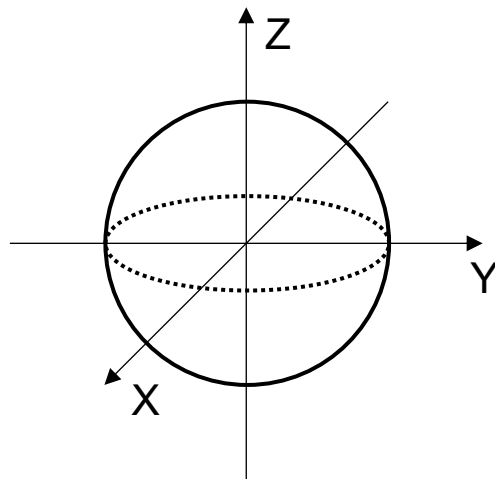
b. $\begin{bmatrix} 0 & 1 \end{bmatrix}$

d. $\begin{bmatrix} 0 & 2 \\ 2 & 0 \end{bmatrix}$

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

2. What is the difference between relative and global phase?
3. True or False: Two qubits could have different relative phases but the same measurement probabilities.

4. Label the vectors $|0\rangle = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$, $|1\rangle = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$, $|+\rangle = \frac{1}{\sqrt{2}} \begin{bmatrix} 1 \\ 1 \end{bmatrix}$, $|-\rangle = \frac{1}{\sqrt{2}} \begin{bmatrix} 1 \\ -1 \end{bmatrix}$, $|i\rangle = \frac{1}{\sqrt{2}} \begin{bmatrix} 1 \\ i \end{bmatrix}$, and $|-i\rangle = \frac{1}{\sqrt{2}} \begin{bmatrix} 1 \\ -i \end{bmatrix}$ on the Bloch sphere shown below. (Recall that the spherical coordinates (θ, φ) on the Bloch sphere map to the state vector $|\psi\rangle = \begin{bmatrix} \cos\left(\frac{\theta}{2}\right) \\ e^{i\varphi} \sin\left(\frac{\theta}{2}\right) \end{bmatrix}$.)



5. How might you prepare the state $\frac{\sqrt{3}}{2}|0\rangle + \frac{1}{2}|1\rangle$?