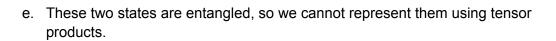
- a.  $|+\rangle$
- b.  $|-\rangle$
- c.  $|-+\rangle$
- d.  $\begin{bmatrix} \\ + \end{bmatrix}$
- $\begin{bmatrix} 0 \\ 0 \end{bmatrix}$

2. Is the tensor product of  $\begin{bmatrix} 0\\1 \end{bmatrix}$  and  $\begin{bmatrix} 0\\1 \end{bmatrix}$  the same as the tensor product of  $\begin{bmatrix} 0\\1 \end{bmatrix}$  and  $\begin{bmatrix} 1\\0 \end{bmatrix}$ ?

- a. Yes, because the qubits are the same.
- b. No, because the gubits are different.
- c. No, because the qubits are in a different state.
- d. Yes, because even though the qubits are different, they will give the same result.
- e. No, because this is an entangled state and the tensor product cannot be used here.

3. What is the tensor product of these two qubit states  $\begin{bmatrix} \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} \end{bmatrix}$  and  $\begin{bmatrix} \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} \end{bmatrix}$ ?

- $rac{1}{\sqrt{2}}egin{bmatrix}1\\1\\1\\1\end{bmatrix}$
- b.  $\begin{bmatrix} 1\\1\\1\\1\\1\end{bmatrix}$
- $\frac{1}{4} \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$
- $\begin{bmatrix} 1 \\ 0 \\ 1 \\ 0 \end{bmatrix}$



$$\begin{bmatrix} \frac{\sqrt{3}}{2} \\ 0 \\ \frac{1}{2} \\ 0 \end{bmatrix}_{\mathbf{c}}$$

4. What is the probability of measuring  $|01\rangle$  in this quantum system:  $\begin{bmatrix} \frac{\sqrt{3}}{2} \\ 0 \\ \frac{1}{2} \\ 0 \end{bmatrix}$ ?

a. 
$$\dfrac{\sqrt{3}}{2}$$

d. 
$$\frac{1}{2}$$

e. 
$$\overline{4}$$

5. What is the probability of measuring  $|00\rangle$  in this quantum system:

$$\sqrt{rac{1}{3}}|00
angle+\sqrt{rac{1}{6}}|01
angle+\sqrt{rac{1}{3}}|10
angle+\sqrt{rac{1}{6}}|11
angle
angle_{oldsymbol{?}}$$

a. 
$$\sqrt{\frac{1}{3}}$$

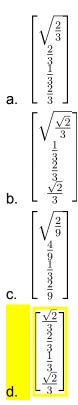
b. 
$$\frac{1}{3}$$

c. 
$$\sqrt{\frac{1}{6}}$$

d. 
$$\frac{1}{6}$$

$$\frac{2}{2}$$

6. What is the tensor product of these two qubit states: 
$$\begin{bmatrix} \sqrt{\frac{3}{3}} \\ \sqrt{\frac{1}{3}} \end{bmatrix}$$
 and  $\begin{bmatrix} \sqrt{\frac{3}{3}} \\ \sqrt{\frac{2}{3}} \end{bmatrix}$ ?



- e. These two states are entangled, so we cannot represent them using tensor products.
- 7. Given the quantum state  $\begin{bmatrix} 0\\ \frac{1}{\sqrt{2}}\\ 0\\ -\frac{1}{\sqrt{2}} \end{bmatrix}$ , if we apply the X gate to the second qubit, what is the new state?



- $\begin{bmatrix} \frac{1}{\sqrt{2}} \\ 0 \\ 0 \\ \frac{-1}{2} \end{bmatrix}$
- b.  $\begin{bmatrix} 0 \\ \frac{-1}{\sqrt{2}} \end{bmatrix}$
- $\begin{bmatrix} \frac{1}{\sqrt{2}} \\ 0 \\ 0 \\ \frac{1}{\sqrt{2}} \end{bmatrix}$
- $\begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$
- $\mathbf{d}. \quad \begin{bmatrix} 0 \\ -1 \\ 0 \end{bmatrix}$ 
  - $\begin{bmatrix} 0 \\ 0 \\ 1 \\ 0 \end{bmatrix}$
- **e**. [0
- 8. Consider the quantum state  $|101\rangle$ . If we apply the CNOT gate to the first (leftmost) qubit (control) and the second (middle) qubit (target), what is the resulting state?
  - a.  $|101\rangle$
  - b.  $|111\rangle$
  - c.  $|100\rangle$
  - d.  $|001\rangle$
  - e.  $|110\rangle$

9. If a collection	n of qubits are in the sta	ate below, how many	qubits are there?	

```
0 ]
     0
   0\\ \frac{1}{\sqrt{3}}\\ 0
   \begin{array}{c} 0 \\ \frac{1}{\sqrt{3}} \\ 0 \end{array}
     0
     0
     0
     0
     0
     0
     0
     0
     0
     0
     0
     0
     0
     0
     0
     0
     0
     0
     0
     0
     0
\begin{bmatrix} 0 \\ \frac{1}{\sqrt{3}} \end{bmatrix}
```

- a. 3
- b. 4
- c. 5d. 6
- e. Impossible to tell