Quiz 1

Name: _____ Date: _____ I participated today: _____

1. What is the difference between classical and quantum computation?

2. When are assignments due in a typical week? Are late assignments accepted?

3. Let $A = \begin{bmatrix} \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} & -\frac{1}{\sqrt{2}} \end{bmatrix}$, $|x\rangle = \begin{bmatrix} \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} \end{bmatrix}$. $A|x\rangle = ?$

4. Let $|x\rangle = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$, $|y\rangle = \begin{bmatrix} y_1 \\ y_2 \end{bmatrix}$. Which of the following expressions denote the tensor product of $|x\rangle$ and $|y\rangle$? (Circle all that apply.)

   a. $|x\rangle \otimes |y\rangle$

   b. $|x\rangle|y\rangle$

   c. $|x, y\rangle$

   d. $|xy\rangle$

   e. $\langle x|y\rangle$

   f. $\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \otimes \begin{bmatrix} y_1 \\ y_2 \end{bmatrix}$

   g. $\begin{bmatrix} x_1 y_1 \\ x_1 y_2 \\ x_2 y_1 \\ x_2 y_2 \end{bmatrix}$

   h. $x_1 y_1 + x_2 y_2$

5. What does it mean for a qubit to be “in superposition”?

6. True or False: Measuring a qubit in superposition necessarily changes its state.

7. What is the probability of observing a $|1\rangle$ when measuring a qubit with the state $\frac{3}{5}|0\rangle + \frac{4}{5}|1\rangle$?

8. Which of the following could represent the state of a single qubit? (Circle all that apply.)

   a. $|0\rangle$

   b. $|0\rangle + |1\rangle$

   c. $\frac{1}{\sqrt{2}}(|0\rangle + i|1\rangle)$

   d. $\frac{1}{2}|0\rangle - \frac{\sqrt{3}}{2}|1\rangle$

   e. $2|0\rangle - \sqrt{3}\,|1\rangle$

   f. $\cos\left(\frac{\pi}{12}\right) \cdot |0\rangle + \sin\left(\frac{\pi}{12}\right) \cdot |1\rangle$

9. What is the difference between a digital logic gate and a quantum logic gate?

10. What is the result of applying an X gate to a qubit with the state $\frac{1}{\sqrt{2}}(|0\rangle + |1\rangle)$? (Recall the X gate is defined as the matrix $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$.)