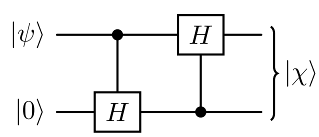
Quiz - 3

Instructions

- The following questions **may have more than one correct answers**.
- There is no negative marking for wrong answers.
- Correct answers are worth one point. Partially correct answers are worth half a point.
- Refer to the slides from the previous weeks for the definitions of gates.

Questions

1. Consider the following quantum circuit:



If $|\psi\rangle = |+\rangle$, the output state $|\chi\rangle$ is given by:

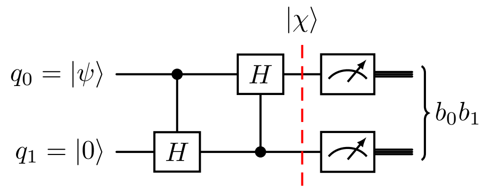
a. $\frac{1}{2\sqrt{2}}\big(2\,|00\rangle + |01\rangle + \sqrt{2}\,|10\rangle + |11\rangle\big)$

b. $\frac{1}{2\sqrt{2}}\big(2\,|00\rangle - |01\rangle - \sqrt{2}\,|10\rangle - |11\rangle\big)$

c. $\frac{1}{2\sqrt{2}}\big(2\,|00\rangle + |01\rangle - \sqrt{2}\,|10\rangle - |11\rangle\big)$

d. $\frac{1}{2\sqrt{2}}\big(-2\,|00\rangle - |01\rangle - \sqrt{2}\,|10\rangle + |11\rangle\big)$

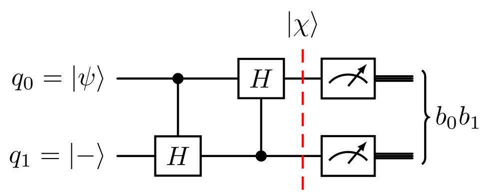
2. Consider the following quantum circuit:



If $|\psi\rangle = |1\rangle$, then output state $|\chi\rangle$ is __________ and the probability of measuring the output $b_0b_1 = 00$ is __________.

a. 'not entangled' and $\frac{1}{4}$.
b. 'not entangled' and 0.
c. 'entangled' and 0.
d. 'entangled' and $\frac{1}{4}$.

3. Consider the following quantum circuit:



If $|\psi\rangle = |1\rangle$, then output state $|\chi\rangle$ is __________ and the probability of measuring the output $b_0b_1 = 11$ is __________.

a. 'not entangled' and $\frac{1}{2}$.
b. 'not entangled' and 0.
c. 'entangled' and 0.
d. 'entangled' and $\frac{1}{2}$.

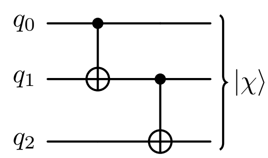
4. If a quantum state is denoted by a point (θ, ϕ), on the Bloch sphere. Then the state orthonormal to this state has which of the following coordinates?

a. $(\theta, \pi - \phi)$
b. $(\pi - \theta, \pi - \phi)$
c. $(\theta, \pi - \phi)$
d. $\left(\frac{\pi}{2} - \theta, \pi - \phi\right)$

5. If the $|+\rangle$ is rotated by 45° about the z-axis. The new coordinates of the state on the Bloch sphere is:

   a. $\left(\frac{\pi}{2}, \frac{\pi}{2}\right)$
   b. $\left(\frac{\pi}{4}, \frac{\pi}{4}\right)$
   c. $\left(\frac{\pi}{2}, \frac{\pi}{4}\right)$
   d. $\left(\frac{\pi}{4}, \frac{\pi}{2}\right)$

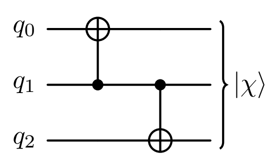
6. Consider the circuit given below:



   If $|\chi\rangle$ is known to be $\frac{|000\rangle+|111\rangle}{\sqrt{2}}$, then the initial states of the qubits q_0,q_1 and q_2, respectively are?

   a. $q_0 = |+\rangle$, $q_1 = |0\rangle$ and $q_2 = |0\rangle$
   b. $q_0 = |0\rangle$, $q_1 = |+\rangle$ and $q_2 = |0\rangle$
   c. $q_0 = |+\rangle$, $q_1 = |+\rangle$ and $q_2 = |0\rangle$
   d. $q_0 = |0\rangle$, $q_1 = |0\rangle$ and $q_2 = |+\rangle$

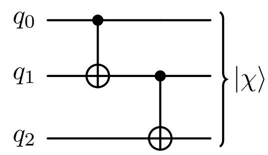
7. Consider the circuit given below:



   If $|\chi\rangle$ is known to be $\frac{|010\rangle+|101\rangle}{\sqrt{2}}$, then the initial states of the qubits q_0,q_1 and q_2, respectively are?

   a. $q_0 = |+\rangle$, $q_1 = |1\rangle$ and $q_2 = |1\rangle$
   b. $q_0 = |0\rangle$, $q_1 = |+\rangle$ and $q_2 = |0\rangle$
   c. $q_0 = |+\rangle$, $q_1 = |1\rangle$ and $q_2 = |1\rangle$
   d. $q_0 = |1\rangle$, $q_1 = |+\rangle$ and $q_2 = |1\rangle$

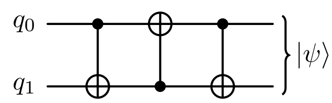
8. Consider the circuit given below:



If $|\chi\rangle$ is known to be $\frac{|011\rangle+|111\rangle}{\sqrt{2}}$, then the initial states of the qubits q_0,q_1 and q_2, respectively are?

a. $q_0 = |+\rangle$, $q_1 = |1\rangle$ and $q_2 = |1\rangle$
b. $q_0 = |0\rangle$, $q_1 = |+\rangle$ and $q_2 = |+\rangle$
c. $q_0 = |+\rangle$, $q_1 = |+\rangle$ and $q_2 = |+\rangle$
d. none of the above.

9. Consider the following quantum circuit:



The choice(s) of the initial state which remain unchanged as result of this circuit are:

a. $\frac{1}{2}(|00\rangle + |01\rangle + |10\rangle + |11\rangle)$
b. $\frac{1}{\sqrt{2}}(|00\rangle + |10\rangle)$
c. $\frac{1}{2}(|00\rangle + |01\rangle + |10\rangle - |11\rangle)$
d. $\frac{1}{\sqrt{2}}(|00\rangle + |11\rangle)$

10. Given a single qubit state of the form, $|\psi\rangle = a\,|0\rangle + b\,|1\rangle \;:\; a, b \in \mathbb{R}$ and $|a|^2 + |b|^2 = 1$. Which of the following transformations will convert $|\psi\rangle$ to $|\phi\rangle$ such that, $\langle\psi|\phi\rangle = 0$?

a. $ZHZH$
b. Z
c. $HXHX$
d. HYH