QUANTUM STATES FOR TWO QUBIT SYSTEMS

Question 1

We define a state $|\psi>=\alpha|00>+\beta|01>+\gamma|10>+\delta|11>$ to be a valid quantum state if $|\alpha|^2+|\beta|^2+|\gamma|^2+|\delta|^2=1$. Which of the following equations describe a valid quantum state?

(a) Example: $\frac{1}{2}|00>+\frac{1}{2}|01>+\frac{1}{2}|10>+\frac{1}{2}|11>$

$$\alpha = \frac{1}{2}, \beta = \frac{1}{2}, \gamma = \frac{1}{2}, \delta = \frac{1}{2}$$
$$\alpha^2 + \beta^2 + \gamma^2 + \delta^2 = (\frac{1}{2})^2 + (\frac{1}{2})^2 + (\frac{1}{2})^2 + (\frac{1}{2})^2 = 1$$

Since $\alpha^2+\beta^2+\gamma^2+\delta^2=1$, $|\psi>$ is a valid quantum state.

(b) $|\psi> = \frac{\sqrt{7}}{5}|00> + \frac{\sqrt{7}}{\sqrt{5}}|01> + \frac{3}{5}|10> + \frac{\sqrt{2}}{5}|11>$

(c) $|\psi>=|00>$

(d) $|\psi\rangle = |00\rangle + |01\rangle + |10\rangle + |11\rangle$

(e) $ \psi>=$	$\frac{3}{5} 00>+\frac{4}{5} 01>$
	MEASUREMENT

Question 2

For the following, quantum states, what would the qubits most likely collapse to?

(a) Example: $\frac{1}{2}|00>+\frac{1}{2}|01>+\frac{1}{2}|10>+\frac{1}{2}|11>$

This state is in an equal superposition of the four states $|00\rangle$, $|01\rangle$, $|10\rangle$, $|11\rangle$. Therefore, we can equally expect the states to be:

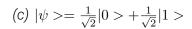
First Qubit: 0, Second Qubit: 0

First Qubit: 0, Second Qubit: 1

First Qubit: 1, Second Qubit: 0

First Qubit: 1, Second Qubit: 1

(b)
$$|\psi>=|00>$$



(d) $|\psi> = \frac{1}{\sqrt{2}}|00> + \frac{1}{\sqrt{2}}|11>$

(e) For $|\psi>=\frac{1}{\sqrt{2}}|00>+\frac{1}{\sqrt{2}}|11>$, if we measure the first qubit to result in 0, what can we say about the second qubit?

(f) For $|\psi>=\frac{1}{\sqrt{2}}|01>+\frac{1}{\sqrt{2}}|10>$, if we measure the first qubit to result in 0, what can we say about the second qubit?

(g) For $|\psi>=\frac{1}{\sqrt{2}}|00>+\frac{1}{\sqrt{2}}|11>$, if we measure the first qubit to result in 1, what can we say about the second qubit?

(h) For $|\psi>=\frac{1}{\sqrt{2}}|00>+\frac{1}{\sqrt{2}}|01>$, if we measure the first qubit to result in 0, what can we say about the second qubit?

ENTANGLEMENT: BELL STATES

Question 3

Prepare bell states starting with the states |00>, |01>, |10>, |11>. What is the resulting state?

