Introduction to Quantum Computing Assignment 1 July 12, 2017

Please show **all** your work! Answers without supporting work will not be given credit. Write answers in spaces provided. Any wrong answer will be judged harshly by your peers and mocked by your professor. Failure to complete the assignment will result in immediate termination from the course.

Name:_____

1. Draw the Bloch Sphere and label the axis. Indicate on the Bloch Sphere the points that represent the qubit when it is $|0\rangle$ and $|1\rangle$, and when the qubit is in a state of superposition.

2. Define Superposition and Entanglement.

3. For each item, decompose into single column vectors in Dirac notation, then solve the complete column vector.

   Example: $|00\rangle$

$$|00\rangle = |0\rangle \otimes |0\rangle = \begin{bmatrix} 1 \\ 0 \end{bmatrix} \otimes \begin{bmatrix} 1 \\ 0 \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \end{bmatrix} \tag{1}$$

   (a) $|10\rangle$

   (b) $|101\rangle$

   (c) $|111\rangle$

   (d) $|1010\rangle$

Cont.

4. Give the complete matrix or row/column vector for the following given

$$|\alpha\rangle = \begin{bmatrix} a_1 \\ a_2 \end{bmatrix} \; |\beta\rangle = \begin{bmatrix} b_1 \\ b_2 \end{bmatrix}$$

(a) $\langle\alpha|$

(b) $\langle\alpha|\beta\rangle$

(c) $|\beta\rangle \langle\alpha|$

The End.