

# Sample of the 1st short IQC test

(This is just a trial test. )

1. Show that  $XYX = -Y$ .
2. What quantum state will be at the output of the following quantum circuit?

$$|0\rangle \xrightarrow{Z} \xrightarrow{H} \xrightarrow{X} \xrightarrow{H} \quad ?$$

3. How many  $T^\dagger$  gates are needed to change the 1-qubit state  $|+\rangle$  into the state  $|i_-\rangle$ ?
4. Create a matrix representation of a projector created from state  $|+\rangle$ . Then apply such a projector on a general one-qubit state  $\alpha|0\rangle + \beta|1\rangle$
5. Draw a Bloch sphere and the resulting states of two following quantum circuits with the angles specified. Don't forget to describe the axis.

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$$|0\rangle \text{ --- } \boxed{R_z(\pi)} \text{ --- } \boxed{R_x(-\pi/2)} \text{ --- }$$

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$$|0\rangle \text{ --- } \boxed{H} \text{ --- } \boxed{R_y(\pi/4)} \text{ --- }$$

6. Starting from the 1-qubit state  $|0\rangle$ , can you create the following state using the gate set  $\{H, Z, S, T\}$ ? If yes, show how. If no, explain why.

$$|\psi\rangle = \frac{1}{\sqrt{2}}(|0\rangle + e^{i\frac{\pi}{2}}|1\rangle)$$

7. In the case of a measurement of the following quantum state, with what probability will state  $|1\rangle$  be detected?

$$|\psi\rangle = \frac{1}{\sqrt{2}}(|0\rangle + e^{-i\frac{\pi}{4}}|1\rangle)$$