

QUIZ 6

Suppose we have two single-qubit quantum registers A and B . Alice has register A and Bob has register B . Suppose initially the two registers are in the state

$$|\text{EPR}\rangle_{AB} = \frac{1}{\sqrt{2}}(|00\rangle_{AB} + |11\rangle_{AB}).$$

Alice has the following single-qubit gates in her lab.

$$\begin{aligned} \text{NOT} = X &= \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} & Y &= \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix} \\ Z &= \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix} & H &= \begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix} \end{aligned}$$

Question 1: What gate should Alice apply to her register A so that the joint state of A and B goes from $|\text{EPR}\rangle$ to

$$|\psi_1\rangle = \frac{1}{\sqrt{2}}(|01\rangle_{AB} + |10\rangle_{AB})$$

Question 2: What gate should Alice apply to her register A so that the state of A and B goes from $|\text{EPR}\rangle$ to

$$|\psi_2\rangle = \frac{1}{\sqrt{2}}(|01\rangle_{AB} - |10\rangle_{AB})$$

Question 3: Suppose the initial state of the registers is $|\text{EPR}\rangle$. What would the state become if Alice applies H to her register A and Bob applies H to her register B ?