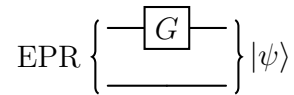


## Quiz 9

Let  $G = \begin{bmatrix} \alpha & \beta \\ \gamma & \delta \end{bmatrix}$ . Consider the following circuit



Let  $|\psi\rangle$  be the output state of the circuit expressed as  $\frac{1}{\sqrt{2}}|0\rangle|\psi_0\rangle + \frac{1}{\sqrt{2}}|1\rangle|\psi_1\rangle$ .

**Question 1** Let  $G'$  be an operator such that

$$\begin{aligned} G'|0\rangle &\rightarrow |\psi_0\rangle \\ G'|1\rangle &\rightarrow |\psi_1\rangle \end{aligned}$$

Write down a matrix corresponding to the operator  $G'$ .

**Question 2** For an angle  $\theta \in [-\pi, \pi]$ , let  $|u\rangle = \cos\theta|0\rangle + \sin\theta|1\rangle$  and  $|u^\perp\rangle = -\sin\theta|0\rangle + \cos\theta|1\rangle$ .

Consider the state  $(\frac{1}{\sqrt{2}}|u\rangle|u\rangle + \frac{1}{\sqrt{2}}|u^\perp\rangle|u^\perp\rangle)$ . Express this state in the form  $a|00\rangle + b|01\rangle + c|10\rangle + d|11\rangle$  and write down the values of  $a, b, c$  and  $d$ .