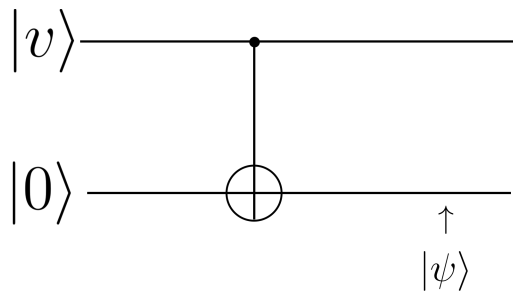


## 2.3 Multi-Qubit Gates: CNOT, Toffoli, Controlled Gates

1. Consider the circuit below,



What is  $|\psi\rangle$  if

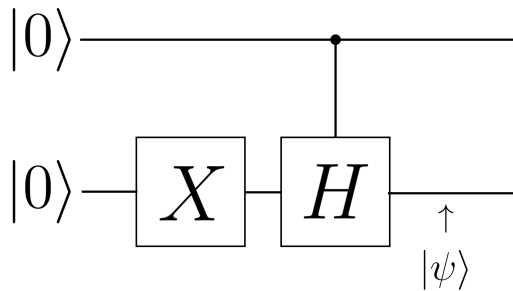
(a)  $|v\rangle = |0\rangle$

(b)  $|v\rangle = |1\rangle$

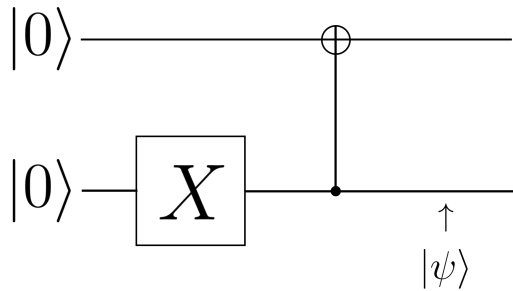
(c)  $|v\rangle = |+\rangle$

2. In the quantum circuits below, find the state  $|\psi\rangle$

(a)



(b)



**Answers**

1.

(a)  $|\psi\rangle = |00\rangle$

(b)  $|\psi\rangle = |11\rangle$

$$\begin{aligned} \text{(c) } |\psi\rangle &= CNOT \frac{1}{\sqrt{2}} \left( |00\rangle + |10\rangle \right) \\ &= \frac{1}{\sqrt{2}} \left( CNOT|00\rangle + CNOT|10\rangle \right) \\ &= \frac{1}{\sqrt{2}} \left( |00\rangle + |11\rangle \right) \end{aligned}$$

2.

(a)  $|\psi\rangle = |01\rangle$

(b)  $|\psi\rangle = |11\rangle$