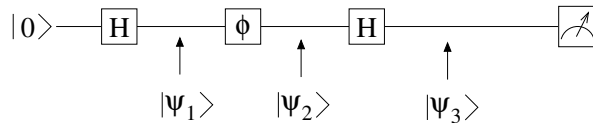


Nanophysics — Fall 2016

Exercise 2

(1) **Interferometers**

The circuit below shows a single qubit model of an interferometer.

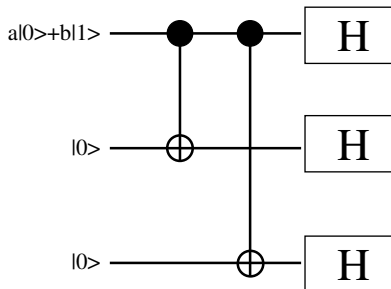


Let the gate ϕ map $|0\rangle \rightarrow |0\rangle$ and $|1\rangle \rightarrow e^{i\phi}|1\rangle$

- (a) What are the states $|\psi_1\rangle$, $|\psi_2\rangle$ and $|\psi_3\rangle$?
- (b) What is the probability of measuring the final qubit to be one ?

(2) **Bit flip error correction code**

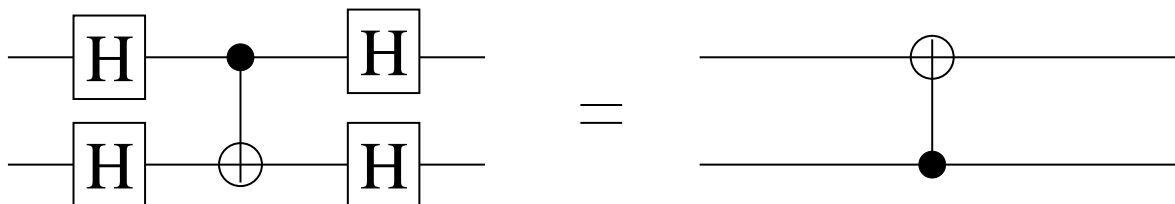
Consider the circuit shown below.



- (a) What is the final three qubit state ?
- (b) Express the state obtained in (a) in $|+\rangle$ and $|-\rangle$ basis.

(3) **Quantum circuits**

Show that:



(4) **Controlled operations**

Consider a controlled operation with a NOT gate being performed on the second qubit, conditional on the first qubit being set to zero. This is shown below, by the circuit on the left hand side. Show that

