Homework 2
CMSC 691R Quantum Computation

1 Problem 1.

Given that

1. Alice and Bob are separated by a great distance
2. Alice holds at her location a qubit labeled by A
3. Bob holds at his location a qubit labeled by B
4. Unknown to Alice and Bob, the state of the quantum system $\mathcal{Q}_{AB}$ consisting of qubits A and B is really given by the ket
$$|\psi_{AB}\rangle = \frac{4\,|0_A 1_B\rangle - 3\,|1_A 0_B\rangle}{5}$$
5. Alice holds at her location a third a third qubit labeled by C with a state (known by neither Alice nor Bob) given by the ket
$$|\psi_C\rangle = \frac{3\,|0_C\rangle + 2\sqrt{2}\,(1+i)\,|1_C\rangle}{5}$$
6. Alice and Bob erroneously assume that the state of $\mathcal{Q}_{AB}$ is the maximally entangled EPR state given by the ket
$$\frac{|0_A 1_B\rangle - |1_A 0_B\rangle}{\sqrt{2}}$$
7. Alice applies the standard[1] quantum teleportation protocol using $\mathcal{Q}_{AB}$ to teleport the state of qubit C to Bob.

After completion of the quantum teleportation protocol, exactly what is the qubit state received by Bob? How close is it to the original state of Qubit C? Please show your work, and explain in full.

References

[1] Gruska, Jozef, "**Quantum Computing**," McGraw-Hill (1999).

[2] Jozsa, Richard, **Quantum information and its properties**, in "**Introduction to Quantum Computation**," (edited by Lo, Hoi-Kwong, Sandu Popescu, and Tim Spiller), World Scientific (1998), pp 49 - 75.

[1] For a definition of "standard quantum teleportation protocol," please refer to [1, pages 251-256] and [2, pages 56-60].