Applied Mathematics 3B

Assignment #8 **7:30, 11 October 2011**

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1. Calculate

$$\sigma_x\sigma_y, \quad \sigma_y\sigma_x, \qquad \sigma_x\sigma_z, \quad \sigma_z\sigma_x, \qquad \sigma_y\sigma_z, \quad \sigma_z\sigma_y$$

in terms of σ_x, σ_y and σ_z where

$$\sigma_x := |0\rangle\langle 1| + |1\rangle\langle 0|, \qquad \sigma_y := -i|0\rangle\langle 1| + i|1\rangle\langle 0|, \qquad \sigma_z := |0\rangle\langle 0| - |1\rangle\langle 1|.$$

2. Consider the state

$$\frac{1}{\sqrt{2}}(|0\rangle \otimes |0\rangle + |1\rangle \otimes |1\rangle).$$

We wish to teleport the *second* qubit of this entangled pair, i.e. we prepare the state

$$\frac{1}{\sqrt{2}}(|0\rangle \otimes |0\rangle + |1\rangle \otimes |1\rangle) \otimes \frac{1}{\sqrt{2}}(|0\rangle \otimes |0\rangle + |1\rangle \otimes |1\rangle).$$

(a) Express the *second* and *third* qubits in terms of the Bell basis.

(b) Apply

$$(I_2 \otimes U_H \otimes I_2 \otimes I_2)(I_2 \otimes U_{CNOT} \otimes I_2)$$

to the state.

(c) Describe the result of measurement of the *second* and *third* qubits in the computational basis $\{\, |0\rangle, |1\rangle \,\}$.

(d) Describe the correction according to teleportation according to the results of the measurement above.

Thus we apply the teleportation protocol on the right hand three qubits.
Are the first and teleported qubits still entangled?