HW 4

1-8) T. 3, 1, 4, 8, 14, 17, 18, 19 (use Mathematica). Note that both $S$ and $J$ are being used for angular momentum operators. They are two different names for the same operators. Later, we will use $L$, $N$, and $T$ as names for angular momenta in different contexts. The math is the same, but the physical meaning will vary from problem to problem.

9) Show that if the transformation between two bases $a$ and $b$ is represented by the unitary matrix $U$, i.e. $\psi_a = U(ab) \psi_b$, the matrix representations of an operator $\hat{O}$ are related by $O(a) = U(ba) \dagger O(b) U(ba)$.

10) Besides the angular momentum operators, another set of operators of interest for spin-1 particles are $Q_{ij} = J_i J_j + J_j J_i$, where $i$ and $j = x, y, z$. Construct the operators $Q_{xz}$ and $Q_{yz}$ and calculate their commutator. Finish the uncertainty relation $\Delta Q_{xz} \Delta Q_{yz} \geq \frac{1}{2} \langle ? \rangle$. 