StudentID: _____

PHYS 451 Quantum Mechanics I (Spring 2018)
Quiz #4

Consider a particle with a definite value of the orbital angular momentum, $l = 1$.

1. How many independent states are there that correspond to this value of the angular momentum?

2. Find the matrices representing operators $\hat{L}_x$ and $\hat{L}_y$ in the basis of eigenstates of $\hat{L}_z$ for this specific case of $l = 1$.

3. If we knew how to measure the quantity $L_x^4 + L_y^4$, what whould be the possible outcomes of such a measurement?

4. What would be the average value of the above measurements provided they are performed on a large ensemble of particles prepared in the state with the maximum value of the z-projection of the angular momentum.

Useful info: Ladder operators for the z-projection of the orbital angular momentum

Definition: $\hat{L}_\pm = \hat{L}_x \pm i\hat{L}_y$
Action on eigenstates of $\hat{\mathbf{L}}^2$ and $\hat{L}_z$: $\hat{L}_\pm |l, m\rangle = \hbar\sqrt{l(l+1) - m(m \pm 1)}\, |l, m \pm 1\rangle$