(a) matrices representing the operator: J^2, J_X, J_y and J_z in the $|3/2, m\rangle$ basis.

$$J^2 = \begin{pmatrix} \frac{15}{4} & 0 & 0 & 0 \\ 0 & \frac{15}{4} & 0 & 0 \\ 0 & 0 & \frac{15}{4} & 0 \\ 0 & 0 & 0 & \frac{15}{4} \end{pmatrix} \tag{1}$$

$$J_x = \begin{pmatrix} 0 & \frac{\sqrt{3}}{2} & 0 & 0 \\ \frac{\sqrt{3}}{2} & 0 & 1 & 0 \\ 0 & 1 & 0 & \frac{\sqrt{3}}{2} \\ 0 & 0 & \frac{\sqrt{3}}{2} & 0 \end{pmatrix} \tag{2}$$

$$J_y = \begin{pmatrix} 0 & -\frac{\sqrt{3}}{2}i & 0 & 0 \\ \frac{\sqrt{3}}{2}i & 0 & -i & 0 \\ 0 & i & 0 & -\frac{\sqrt{3}}{2}i \\ 0 & 0 & \frac{\sqrt{3}}{2}i & 0 \end{pmatrix} \tag{3}$$

$$J_z = \begin{pmatrix} \frac{3}{2} & 0 & 0 & 0 \\ 0 & \frac{1}{2} & 0 & 0 \\ 0 & 0 & -\frac{1}{2} & 0 \\ 0 & 0 & 0 & -\frac{3}{2} \end{pmatrix} \tag{4}$$

(b) RHS result of the commutator: $[J_x, J_y] = i * J_z$

$$[J_x, J_y] = \begin{pmatrix} \frac{3}{2}i & 0 & 0 & 0 \\ 0 & \frac{1}{2}i & 0 & 0 \\ 0 & 0 & -\frac{1}{2}i & 0 \\ 0 & 0 & 0 & -\frac{3}{2}i \end{pmatrix} \tag{5}$$

(c) $< J_x >$ and $< (J_x)^2 >$ with respect to the state $|\psi\rangle = (0, 0, 1, 0)$:

$$< J_x >= 0 \tag{6}$$

$$< J_x^2 >= \frac{7}{4} \tag{7}$$

(d) δJ_x and δJ_y with respect to the state $|\psi\rangle = (0, 0, 1, 0)$:

$$\delta J_x = \frac{\sqrt{7}}{2} \tag{8}$$

$$\delta J_y = \frac{\sqrt{7}}{2} \tag{9}$$