1. Show $\hat{J}_z \hat{J}_x |+x\rangle \neq \hat{J}_x \hat{J}_z |+x\rangle$ for a $j = 1/2$ particle

2. Townsend says that the eigenstates of some observable, lets call them $|\lambda\rangle$, satisfy $\langle\lambda|\lambda\rangle = 1$. Why?

3. Find the representation of $\hat{J}_+$ for a $j = 1/2$ particle in the z representation. Check that it has the right effect on the $|+z\rangle = \begin{pmatrix} 1 \\ 0 \end{pmatrix}$ and $|-z\rangle = \begin{pmatrix} 0 \\ 1 \end{pmatrix}$ states

4. Use your result from 1 along with $\hat{J}_y = \frac{\hbar}{2}\begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix}$ to verify $[\hat{J}_z, \hat{J}_x] = i\hbar \hat{J}_y$