33 continued

so $\hat{L}^2 |\psi\rangle = \hat{A}_+ \, l(l+1)\hbar^2 |l, l\rangle + 2\hbar^2 \hat{A}_+ \, l \, |l, l\rangle + 2\hbar^2 A_+ |l, l\rangle$

$= \hbar^2 [l(l+1) + 2l + 2] |\psi\rangle = \hbar^2 (l+1)(l+2) |\psi\rangle$

so $|\psi\rangle$ is an eigenstate of $\hat{L}^2$ and $\hat{L}_3$

with eigenvalues $\hbar^2 (l+1)(l+2)$ and $\hbar(l+1)$

respectively i.e. is like $|l+1, l+1\rangle$

$\therefore \quad |\psi\rangle = A_+ |l, l\rangle = \lambda \, |l+1, l+1\rangle$