PHYS 357 Pset 4. Due 11:59 PM Thursday Oct. 3

1. Townsend 3.1

2. Townsend 3.2. If you choose, you may just verify that the states shown are eigenvectors rather than solve the full eigenvector problem by hand.

3. Townsend 3.7

4. For a 3-state spin-1 system, we know the raising/lowering operators need to look like

$$J_+ \propto \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix}$$

   and J_- is the conjugate-transpose. We know that for J_z, $J_\pm = J_x \pm iJ_y$. Use these forms to solve for J_x and J_y in terms of J_+ and J_-. For a spin-1 system, the eigenvalues of $J_{x,y,z}$ must be $\hbar(1, 0, -1)$. Use this fact to find the coefficient of proportionality for J_x, J_y and write the properly weighted forms of J_x and J_y. If all has gone well, they should agree with Equation 3.28 in Townsend.

5. Show that the commutation relations we expect for angular momentum hold for the spin-1 basis you've just worked out. You may do this on a computer if you choose.

6. What are the eigenstates of J_x and J_y in the J_z basis? What are the raising and lowering operators? Show that the raising and lowering operators for J_x behave as expected on the eigenstates of J_x. Do the same for J_y. Once again, you may do this on a computer.