

## Homework #10 for Physics 371

Due 4pm Friday, April 8

- 1) Using the 3x3 matrix representations of  $L_x$  and  $L_y$  for  $\ell = 1$ , show that the eigenvalues of  $L_x$  and  $L_y$  are  $-\hbar$ ,  $0$ ,  $\hbar$ .
- 2) Using the matrix from problem 1, find the eigenvectors of  $L_x$  corresponding to  $L_x = 0$  and  $L_x = \hbar$ . Calculate  $\langle L_z \rangle$  and  $\langle L_z^2 \rangle$  using these two  $L_x$ -eigenvectors.
- 3) Write down the 4x4 matrix representations of  $S_x$ ,  $S_y$ , and  $S_z$  for  $S = 3/2$ . Using matrix algebra, verify that these matrices satisfy  $\vec{S}^2 = S_x^2 + S_y^2 + S_z^2$ .
- 4) Consider a particle of mass  $m$  in the ground state of a box in the form of a cube of volume  $V = L^3$ .
  - a) Determine the *pressure* the particle exerts on the walls of the box

$$P = -\frac{\partial E_0}{\partial V}.$$

- b) Compare the ratio  $PV/E$  found in part (a) to that of an ideal gas.
- 5–7) Griffiths 4.25, 4.27, and 4.30.