Homework 4

5. (60 points) Using the *expressions* :

$$[L_i, L_j] = i \sum_k \epsilon_{ijk} L_k$$

$$[L_i, A_j] = i \sum_k \epsilon_{ijk} A_k$$

$$[A_i, A_j] = -2\, i m \hbar^2 H \sum_k \epsilon_{ijk} L_k$$

and

$$[H, A_i] = 0$$

Calculate

$[L^2, A_i]$, $[L^2, A^2] = 0$,

$[H, A^2]$,

$[A^2 A_i]$

6. (70 points) Using above relations as well as the *relation* :

$$\hat{A}^2 = 2 m \hbar^2 \hat{H} \left(L^2 + 1\right) + m^2 Z^2 e^4$$

calculate the energy spectrum of Hydrogenlike atoms.

7. (20 points) Calculate the Rydberg Constant.