

QUANTUM MECHANICS H.W №5

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PROBLEM (1)

- Calculate $\langle \vec{L} \cdot \vec{S} \rangle$ for $\ell = 2$ and $s = \frac{1}{2}$ for the maximal value for j
- draw the splitting due to spin-orbit interaction in the energy level above (let $n = 3$ for example)

PROBLEM (2)

- List all the eigenstates for $\ell = 1$ for an electron in an atom.(include spin). Express the list in terms of the uncoupled and coupled basis representations.
- Calculate the Clebsh-Gordon coefficients for the state $|j = \frac{1}{2}, m_j = \frac{-1}{2}\rangle$

PROBLEM (3)

Derive Rydberg formula for the hydrogen atom.

PROBLEM (4)

Find the ground state first order correction to the simple harmonic oscillator with an extra term of the potential:

$$H^{(1)} = \frac{1}{2}bx^2$$