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1. Suppose you could find a solution $\psi(r_1, r_2, \cdots, r_Z)$ to the Schroedinger equation $\hat{H}\psi = E\psi$ for the Hamiltonian of a neutral atom of atomic number Z. Describe how you would construct from it a completely symmetric function, and a completely antisymmetric function, which also satisfy the Schroedinger equation, with the same energy. What happens to the completely antisymmetric function if $\psi(r_1, r_2, \cdots, r_Z)$ is symmetric in (say) its first two arguments ($r_1 \leftrightarrow r_2$)?
2. [EXTRA CREDIT] The ground state energy of a system is estimated both by the Rayleigh-Ritz variational method and by a second order perturbation theory calculation. The Rayleigh-Ritz result is found to be -27.1eV and the perturbation theory result -26.0eV. Which lies closer to the true ground state energy? Suppose the numbers had been reversed. Would it still be possible to decide which estimate is better? Explain your reasoning.