2. A system of two indistinguishable spin-1/2 particles is governed by the Hamiltonian

$$H = \frac{|\vec{p}_1|^2}{2m} + \frac{|\vec{p}_2|^2}{2m} + \lambda \frac{\vec{\sigma}_1 \cdot \vec{\sigma}_2}{|\vec{x}_1 - \vec{x}_2|} \ ,$$

where $\vec{\sigma}_k$ ($k = 1, 2$) are the Pauli spin operators of the two particles, and $\vec{p}_k$, $\vec{x}_k$ are their (3-dimensional) momenta and positions, respectively. Find the ground state energies for the two cases:

(a) $\lambda > 0$.

(b) $\lambda < 0$.

(c) For each sign of λ specify also the degeneracy of the ground state, in the center of mass frame.