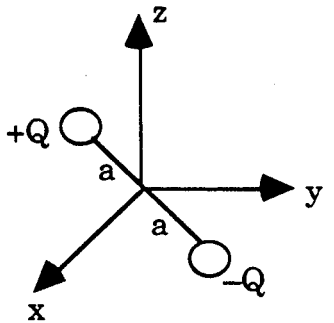
QM7a1196B

Consider two point particles of opposite charge (± Q) and equal mass m attached by a rigid massless rod of length 2a. Let the rod pivot freely in three dimensions about its center. The Hamiltonian of the system is $H_0 = L^2/2I$, where L is its angular momentum, and $I = 2ma^2$.



(a) What are the quantum numbers that describe the system? Write down the eigenenergies and indicate their degeneracies (no derivation required).

(b) An electric field, **E**, is now applied along the z-axis. What interaction term, V, must be added to the Hamiltonian H_0 to include the effect of the field? Consider the eigenvalues of the three operators L^2, L_z, and $H = H_0 + V$; which can be used to label the quantum numbers of the stationary states?

(c) Will the interaction produce a linear Stark effect in the ground state energy (i.e., a term in the energy which is linear in the field)? Explain your reasoning.

(d) Determine the second order correction in **E** to the ground state energy.