

4. Two identical *non-interacting* spin-1/2 particles occupy the same one-dimensional simple harmonic oscillator potential. The single-particle wave functions for the ground state and the first excited state are $\psi_g(x)$ and $\psi_e(x)$, respectively, where x is measured along the one dimension. Give expressions for the full wave functions (including the spin part) of the ground and all possible first excited states of the two-particle system. What are the associated total (spin) angular momenta?

[6]

5. Without detailed calculations draw the wave function $\Psi_{\text{inf}}(x)$ for the third lowest energy eigenstate of an infinite square well along the x axis.

[3]

A particle is confined in the 1D potential $V(x)$ shown below. Without detailed calculations, sketch the wave function $\Psi(x)$ of the third lowest energy eigenstate (with energy E_3 indicated by the dashed line). Mark the positions A, B, C on your sketch. Explain the qualitative features of the wave function in the various regions. You may find it useful to take Ψ_{inf} as a starting point of your considerations.

[5]

