

Homework VII - PHYS652

1. shankar: 17.2.1
2. shankar: 17.2.2
3. Two identical (spinless) bosons in an infinite square well are interacting weakly via $V(x_1, x_2) = -aV_0\delta(x_1 - x_2)$. a is the width of the well, and V_0 positive.
 - a) Determine the ground state and the first excited state and their energies, if ignoring the weak interaction.
 - b) Determine first order corrections to these energies in the presence of weak interaction.
4. Given a 3-dim infinite cubical well with $V(x) = 0$, for $0 < x < a, 0 < y < a, 0 < z < a$, and $V(x) = \infty$ otherwise. A perturbation of the form $H' = a^3V_0\delta(x - a/4)\delta(y - a/2)\delta(z - 3a/4)$ is applied. Calculate the energies to first order for the first excited (unperturbed) energy level.
5. Evaluate or prove following commutators:
 $[\vec{L} \circ \vec{S}, \vec{L}] = i\hbar\vec{L} \times \vec{S}$; $[\vec{L} \circ \vec{S}, \vec{S}]$; $[\vec{L} \circ \vec{S}, \vec{J}]$; $[\vec{L} \circ \vec{S}, L^2]$; $[\vec{L} \circ \vec{S}, S^2]$; $[\vec{L} \circ \vec{S}, J^2]$
Discuss their relevance for the spin-orbit coupling correction terms
6. shankar: 17.2.7
7. shankar: 18.2.2. Qualitatively discuss how the transition probability depends on τ .