

PHY 342 HW Ch.6a

Do problem 6.2, 6.3, and 6.6* [bonus] plus the following.

q6.1

Consider the Dirac δ atom, i.e., the bound state to the potential $-\alpha\delta(x)$. Suppose a perturbation is introduced in the form of a square well, $H' = -V_0$ for $|x| \leq \frac{a}{2}$ and zero elsewhere.

(a) Calculate the first-order energy correction E^1 to the bound state. (b) Let $V_0 = V_c$ be the condition when E^1 is equal to the unperturbed energy. If $V_0 \geq V_c$, the perturbation is said to be strong; if $V_0 \ll V_c$, it is said to be weak, and this is the regime first-order perturbation is considered valid. Find V_c , and comment on the result.

q6.2

Let the perturbation on an SHO be $H' = -\alpha\delta(x)$.

Calculate the first-order energy correction to (a) the ground state and (b) the first excited state. Explain the latter result.

q6.3

Suppose the nuclear charge of a hydrogen-like atom is changed from Z to $Z + \delta$. Calculate the first-order energy correction of the ground state.

If you do it the eeezy way, no computation of integrals should be necessary.