Please answer the following questions

Q1. The unperturbed wavefunction for the infinite square well are

$$\psi_n^0 = \sqrt{\frac{2}{a}} \sin\left(\frac{n\pi}{a} x\right)$$

Suppose we perturbe the system by simply raising the floor of the well a constantamount of $V_{0.}$ **Find the** first order correction to the energies

Q2. Suppose we put a delta function bump in the center of the infinit square well

$H' = \alpha\delta(x - \alpha/2)$ where α is a constant .

1. Find the first order correction to the allowed energies .explain why the the energies are not perturbed for even n
2. Find the second order correction to the energies E^2 .

Q3. For the harmonic oscillator [$V(x) = (1/2)\, kX^2$] the allowed energies are $E_n = (n+1)\hbar w$,

where n= 0,1,2,3,…. And $w = (k/m)^{1/2}$ is the classical frequency . Suppose that the spring constant increase slightly $k \rightarrow (1+\varepsilon)k$.

1. Find the exact new energyies .
2. Find the first order correction to the allowed energies .explain why the the energies are not perturbed for even n
3. Find the second order correction to the energies E^2 .

Q4) Levine q 8.30 When the variation function ϕ = *c*1 *f*1 + *c*2 *f*2 is applied to a certain quantum-mechanical problem, one finds < *f*1 /*H*/ *f*1> = 4*a*, < *f*1 *H*/ *f*2> = *a*, < *f*/ *H*/ *f*2> = 6*a*, < *f*1 / *f*1> = 2*b*, < *f*2 / *f*2> = 3*b*, < *f*1 / *f*2> = *b*, where *a* and *b* are known positive constants. Use this ϕ to find (in terms of *a* and *b*) upper bounds to the lowest two energies, and for each *W*, find *c*1 and *c*2 for the normalized f.

Q5) Levine 8.31 Solve the second-order secular equation for the special case where *H*11 = *H*22 and *S*11 = *S*22. (*Reminder:* *f*1 and *f*2 are real functions.) Then solve for *c*1>*c*2 for each of the two roots *W*1 and *W*2.