Chem. 540
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Perturbation Theory – Problem 2

Consider a quadratic perturbation,

$$V(\hat{x}) = \frac{1}{2}b\hat{x}^2 ,$$

on a harmonic oscillator

$$\hat{H}_0 = \frac{\hat{p}^2}{2m} + \frac{1}{2}m\omega^2\hat{x}^2 .$$

Calculate the corrections to the energy eigenvalues through second order in the perturbation. Show that your results are consistent with the expansion of the exact eigenvalues through second order in the perturbation parameter b.