Physics 4410
Quantum Mechanics 2

Lecture 26

Time-independent perturbation theory: non-degenerate, second order

October 28, 2020

1. Review first order perturbation theory.

2. Write down an equation for second order corrections.

3. Find $E_n^{(2)}$.

Activity 1: Consider the following Hamiltonian:

$$H = \begin{pmatrix} a & \epsilon & 0 \\ \epsilon & 0 & \epsilon \\ 0 & \epsilon & b \end{pmatrix}.$$

(a) Calculate the eigenvalues of H to first order in ϵ.

Consider the following Hamiltonian:

$$H = \begin{pmatrix} a & \epsilon & 0 \\ \epsilon & 0 & \epsilon \\ 0 & \epsilon & b \end{pmatrix}.$$

(b) Calculate the eigenvalues of H to second order in ϵ.

Consider the following Hamiltonian:

$$H = \begin{pmatrix} a & \epsilon & 0 \\ \epsilon & 0 & \epsilon \\ 0 & \epsilon & b \end{pmatrix}.$$

(c) Do you think your answer breaks down if $a = b$? What if $a = 0$?

Activity 2: Show that second order perturbation theory always decreases the energy of the ground state.