

Physics 115C Hw 2

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Problem 1

(a)

We have that the first order corrections to the energy is given by

$$E_n^1 = \langle \psi_n | H' | \psi_n \rangle$$

Therefore in our case we have that

$$E_n^1 = \alpha \langle \psi_n | \delta(x - \frac{L}{2}) | \psi_n \rangle$$

Therefore we get that

$$\begin{aligned} E_n^1 &= \alpha \int \psi_n^*(x) \delta(x - \frac{L}{2}) \psi_n(x) dx \\ &= \alpha |\psi(\frac{L}{2})|^2 \\ &= \alpha \frac{2}{L} \sin^2\left(\frac{n\pi}{2}\right) \\ &= \begin{cases} \alpha \frac{2}{L} & \text{if } n \text{ is odd} \\ 0 & \text{if } n \text{ is even} \end{cases} \end{aligned}$$