《量子信息基础》2022.3.24随堂作业：

1. (Text book\* Problem 7.8)

Let the two “good” unperturbed states be

where and are determined (up to normalization) by Equation 7.27 (or

Equation 7.29). Show explicitly that

1. are orthogonal ();
2. ;
3. , where given by Equation 7.33.

(a)

由7.27可得

由于

代入可得

推导正确给15分

(b)

推导正确给15分

(c)

推导正确给15分

1. (Text book\* Problem 7.1)

Suppose we put a delta-function bump in the center of the infinite square well:

where *α* is a constant.

(a) Find the first-order correction to the allowed energies. Explain why the energies are not perturbed for even *n*.

(b) Find the first three nonzero terms in the expansion (Equation 7.13) of the correction to the ground state, .

(a)

For even *n*

推导正确给15分

(b)

The first three non-zero terms are m = 3, 5, 7.

推导正确给15分

1. Considering we have free electron gas in a rectangular area in two dimension, derive the Fermi energy and the density of energy states in two dimension. *Note: the Fermi-energy formula written on the text book was derived in three dimension. You need follow the same procedure but the result will be slightly different comparing to the three dimension case.*

The wavefunction should have the form of

where

Considering the following boundary conditions held

The solutions for wavefunctions are

The area in the k-space every state would occupy

For

So

推导正确和给出正确答案给25分

\* David J. Griffiths, and Darrell F. Schroeter, Introduction to Quantum Mechanics (3rd Edition), Cambridge University Press (2018).