《量子信息基础》第二章第二部分：

1. (1) Construct the full analytic equations for the normalized wave function and of harmonic oscillators. ( and are done in example 2.4 in the text book\*)

(2) Prove the orthonormality of the stationary states of the harmonic oscillators (textbook\* page 64).

1. <即教材\*问题2.12 和Example 2.5>

Starting from equation 2.69, find , , , , and for the *n*-th stationary state of the harmonic oscillator. Check the uncertainty principle between and is satisfied.

1. (1) Prove that in the infinite square well, the wave function satisfy the orthogonal condition

and write down the expansion formula for an arbitrary function *f*(*x*) (text book\* Page 51).

(2) <text book\* Problem 2.37>

A particle in the infinite square well has the initial wave function

Determine *A*, find , and calculate , as a function of time. *Hint:* and can be reduced, by repeated application of the trigonometric sum formulas, to linear combinations of and , with

1. Prove that for wave functions , and operator *A*, the following two conditions hold.
2. (Ref to text book\* Problem 3.39)

Find the matrix elements and in the orthonormal basis of stationary states for the harmonic oscillator . Construct the corresponding matrix and , and construct the corresponding matrix from the matrix and .

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