《量子信息基础》2022.3.8随堂作业：

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\*)

在推导过程中给出, (或者)的正确形式给10分

写出的推导和正确结果给10分，只给出推导或结果给5分



写出的推导和正确结果给10分，只给出推导或结果给5分

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

Unless , must be zero. Due to normalization condition

写出推导和分析给10分

(3) Use the Matlab code eigenfunction.m to compare the analytic and numerical results for wavefunctions , , and and plot out the results. *Note: since the Matlab function eig() does an automatic normalization in the obtained wave function phi(:, n), you need to compare phi(:, 1)/del\_x^0.5, phi(:, 2)/del\_x^0.5, phi(:, 3)\*del\_x/0.5, phi(:, 4)/del\_x^0.5 to , , and respectively. And there will be a phase difference in the result*.

给出结果的比较并符合(仅有相位差距)的给20分。强度有差距曲线形状一致的扣5分，每一个形状不符合的曲线扣5分。

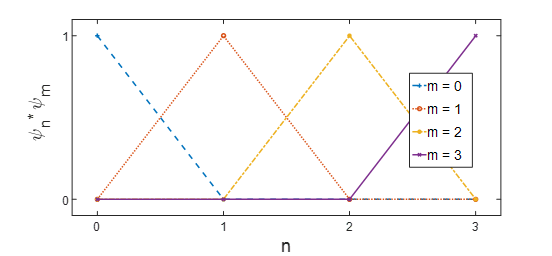
(4) Use the Matlab code eigenfunction.m to test the orthonormality condition between , , and and plot out results.











给出比较结果的给10分

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.

同时给出推导和答案给5分，只给出其中一个给3分

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