**武汉大学物理科学与技术学院2016－2017(一)**

**《量子力学》课程期末考试试题A卷**

**学号： 姓名： 专业： 得分：**

1. A particle of mass m in the half harmonic oscillator potential:

,

Please find the allowed energies(10 points)

1. Show that projection operator are idempotent: , and then find the eigenvalues and eigenvectors(10points).
2. Find the matrix representing Sx for a particle spin 3/2 by using the basis of eigenstates of Sz(6 points), and solve the characteristic equation to determine the eigenvalues of Sx.(6 points)
3. Write down the Hamiltonian for two noninteracting identical particles in one-dimensional infinite square well, find the energies and wave functions of fermion ground state and next two excited states.(14 points)
4. Consider a three-dimensional vector space spanned by an orthonormal basis |1>, |2>, |3>. Kets |α> and |β> are given by



(1). Construct bra <α| and <β|, (5 points)

(2). Find <α|β> and <β|α>, (5 points)

(3). Find matrix elements of the operator . (5 points)

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



(1). Find the first-order correction to the allowed energies. (7 points)

(2). Find the first three nonzero terms in the expansion of the correction to the

ground state (8 points)

7. The electron in a hydrogen atom occupies the combined spin and position state



(1). If you measured the orbital angular momentum squared , what values

might you get, and what is the probability each? (4 points)

(2). Same for the z component of orbital angular momentum  (4 points)

(3). Same for spin angular momentum  (4 points)

(4). Same for z component of spin angular momentum  (4 points)

(5). If you measured the total angular momentum squared , what values

might you get, and what is the probability each? (4 points)

(6). Same for (4 points)