**武汉大学物理科学与技术学院2017－2018(一)**

**《量子力学》课程期末考试试题A卷**

**学号： 姓名： 专业： 得分：**

1. (15 points)A particle of mass *m* in the infinite square well has the initial wave function:

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determine A(3 points), find (8 poingts),and calculate the expectation value of the energy(4 points).

1. (16 points)Construct the angular momentum matrices () and  for a system of angular quantum number .
2. (15 points)Find the allowed three lowest energies of two-noninteracting particles in the half harmonic oscillator

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(a). distinguishable particles(5 points);

(b). identical bosons(5 points);

(c). identical fermions(5 points).

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1. (20 points)The Hamiltonian for a certain three-level system is prepresented by the matrix

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two other observes; A and B, are represented by the matrix

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where ω,λ and μ are positive real numbers

(a). Find the eigenvalues and normoalized eigenvectors of H, A and B(4 points);

(b). Suppose the system starts out in the generic state

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Find the expectation values of H, A and B (4 points);

(c). find the (4 points);

(d). if you measured the energy of state at time t, what values might you get, and what is the probability of each (4 points)?

(e). answer the same question (d) for A and B (4 points).

1. (12 points)Two identical fermions are placed in an infinite square well

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they interact weakly with one another, via the potential:

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(a). ignoring the interaction between the particles, find the ground state and the first excited state, wave functions and energies(6points);

(b). use first-order perturbation theory to estimate the effect of of the particle-particle interaction on the energies of the ground and the first excited state (6 points).

1. (12 points) Suppose you are given a quantum system whose Hamiltonian H0 admits just two eigenstates, ψa with energy Ea, and ψb with energy Eb, They are orthogonal, normalized and nondegenerate, now we turn on a perturbation , with the following matrix elements:

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(a). estimate the energies of the perturbed system using second-order perturbation theory(6 points);

(b). estimate the ground state energy of the perturbed system using the variational principle, with a trial function of the form  (6 points).

1. (10 points) A particle of mass m is initially in the ground state of the one-dimensional infinite square well. At time t=0 a “brick” is drop into the well, so that the potential becomes

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where V0<<E1, and E1 is the energy of ground state. After a time T, the brick is removed, and the energy of the particle is measured. Find the probability in first-order perturbation that the result is now E2.