國立中央大學九十一學年度碩士班研究生入學試題卷

所別: 電機工程學系 乙組 科目: 近代物理 共 1 頁 第 1 頁

1. The wave function for the n = 2 state of a simple harmonic oscillator is $A(1-2\alpha x^2)\exp(-\alpha x^2/2)$.
   (a)What is its energy level? (10 points)
   (b) Find $\langle x \rangle$ and $\langle x^2 \rangle$. (10 points)

2. Consider a particle of mass m trapped in a one-dimensional box of width l.
   (a)Write down the normalized wave functions for the first three energy levels assuming the probabilities of being in ground, first excited and second excited state are 60%, 30%, and 10%, respectively. (15 points)
   (b) Indicate the most probable location of the particle for each state.. (6 points)

3. Explain
   (a)Heisenberg uncertainty principle. (5 points)
   (b) Wave-particle duality (4 points)

4. Discuss the basic assumptions of Maxwell-Boltzmann, Fermi-Dirac, and Bose-Einstein statistics. How do they differ, and what are their similarities? (20 points)

5. Discuss the mechanisms responsible for the different types of bonds that can occur to form stable moleculars.(20 points)

6. Show that the minimum potential energy of an ion pair in an ionic solid is $U_0 = -\alpha k \frac{e^2}{r_0}\left(1-\frac{1}{m}\right)$ where r_0 is the equilibrium separation between ions, α is the Madelung constant, and the repulsive potential energy between ions is B/r^m. $|U_0|$ is called the ionic cohesive energy and is the energy required to separate infinity an ion pair originally at a separation of r_0 in the crystal. (10 points)