國立中央大學八十五學年度碩士班研究生入學試題卷

所別: 物理研究所　不分組　科目: 近代物理學　共 1 頁 第 1 頁

1. With a light of wavelength at 300 nm incident on potassium(K), the electrons are emitted with a maximum kinetic energy 2 eV .
   (a) What is the work function(in eV) and the threshold wavelength(in nm) for the photoelectric effect with potassium?(5%)
   (b) How do you experimentally observed photoelectric effect of potassium? and the determination of the work function? Draw a complete experimental design, show all necessary apparatus and circuits.(請畫出所有的須用儀器及線路) (10%)

2.(a) Using uncertainty principle to show that the minimum energy of a harmonic oscillator is E= hν/2 (10%).
   (b) Write the Schroedinger equation for a two dimensional simple harmonic oscillator. (5%)) What is the general form of the energy of the system in quantum mechanics? (5%)

3.(a) What are the possible spin and total angular momenta of the excited states of sodium (Na) with the following electron configurations:
   $(1s)^2(2s)^2(2p)^6(3p)$ and $(1s)^2(2s)^2(2p)^6(3d)$?(5%)

   (b) Spin-orbit interaction can be written as $V= \alpha(\ell \cdot s)$. The fine structure level splitting of 3P state of Na is 0.02 eV. Calculate the coupling constant α for both cases in (a).(10%)

   (c) Make a sketch to illustrate the LS coupling splitting of the energy levels of an atom with (3d)(4p) configuration .(5%)

4.(a) Describe the Stern-Gerlach experiment. Show all apparatus needed (8%)
   (b) Explain the observation of the electron spin by using the Stern- Gerlach experiment (7%)

5. .(a) Calculate the wavelength of a free electron with total energy E. (5%)
   (b) N free electrons contained in a cubic box of volume v. Calculate the Fermi energy of this system. (10%)

6. A particle of total energy 0.5 V_0 is incident from the -x axis on a step potential V(x) given by

$$V(x) = \begin{cases} V_0 , & x > 0 \\ 0 , & x < 0 \end{cases}$$

   (a) Find the probability that the incident particle reflected from the step potential. (5%)
   (b) Calculate the penetration distance when the particle penetrated through the step potential. (5%)
   (c) Calculate the energy uncertainty of the particle in the region of x > 0. (5%)