淡江大學 98 學年度碩士班招生考試試題

系別：物理學系　　科目：近 代 物 理

准帶項目請打「V」	
V	簡單型計算機

本試題共 1 頁，　大題

[每大題配分 20 分]

1. (a) Discuss the significance about the zero-point motion of a quantum particle in a rigid box.
   (b) Discuss the Compton effect. Do you observe a Compton effect with visible light? Why?
   (c) What is the difference between Davisson-Gemer experiment and Thomson experiment?
   (d) Describe the Stern-Gerlach experiment and its significance.

2. (a) The X-ray spectrum of a metal target consists of a broad continuous spectrum plus a number of lines. Discuss the origin of the spectra.
   (b) Describe the Wine displacement law. Sketch roughly the spectral distribution (energy density $\rho(\lambda)$ verse wave length λ) of black body radiation at several different temperatures.
   (c) In the photoelectric effect, explain why the stopping potential depends on the frequency of the light but not on the intensity?
   (d) Imagine a single free electron in the atmosphere. Does the spin angular momentum vector of the electron align with the magnetic field lines due to the Earth's magnetic field? Why?

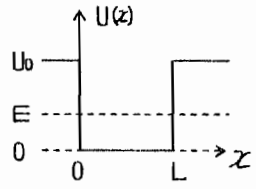
3. Consider the electron wave function:

$$\psi(x)=\begin{cases} C\cdot\sin(\frac{2\pi x}{L}), & \text{for } 0\le x \le L \\ 0 \quad , & \text{for } x<0 \text{ or } x>L \end{cases}$$

   (a) Determine in terms of L the normalization constant C.
   (b) Draw a graph of $\Psi(x)$ over the interval: $-L \leqq x \leqq 2L$.
   (c) Draw a graph of $|\Psi(x)|^2$ over the interval : $-L \leqq x \leqq 2L$.
   (d) What is the probability that an electron is in the interval: $0 \leqq x \leqq L/3$.

4. Consider a particle of mass m confined in a rigid, one-dimensional box of length L. The potential –energy function that describes the particle is: $U(x)=\begin{cases} 0, & \text{for } 0\le x \le L \\ \infty, & \text{for } x\le 0 \text{ and } x\ge L \end{cases}$
   (a) Find the solution $\Psi(x)$ for the time independent Schrödinger equation.
   (b) Find the allowed energies.
   (c) Find the normalized wave function, $\Psi_n(x)$.
   (d) Calculate the probability density at the position x inside the box.

5. A particle of mass m in a finite potential quantum well of depth U_0 and width L. with energy $E < U_0$.
   (a) Write the time independent Schrödinger equation of $\Psi(x)$ for $x \geqq L$.
   (b) If $\Psi(x=L)=\Psi_0$, find the general solution of Schrödinger equation for $x \geqq L$.
   (c) Find the penetration distance η, (the distance of location as $\Psi(x)=e^{-1}\Psi_0$).
   (d) If the wave function for a particle in a finite quantum well is shown in Fig. 5b, What is the particle's quantum number?



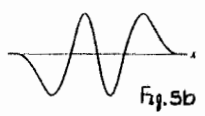


Fig.5b