國立中央大學八十七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 共 / 頁 第 / 頁

1. (a) (10%)請問康普吞 (Compton) 效應是什麼？這效應有何特別的地方？
   (b) (10%)如入射 x 光波長為 λ_0，散射到 θ 角後波長變為 λ_1，請試導出
   $\lambda_1 - \lambda_0 = \lambda_c (1-\cos\theta)$ 其中 $\lambda_c = h/m_0 C$ (m_0 為電子質量)。

2. 薛丁格(Schrodinger)方程為

$$-\frac{\hbar^2}{2m}\frac{\partial^2 \psi(x,t)}{\partial x^2} + V(x,t)\psi(x,t) = i\hbar\frac{\partial \psi(x,t)}{\partial t}$$

(a) (10%)為何在處理無窮方位井 (infinite square potential)，此方程化為

$$\frac{d^2\varphi_n(x)}{dx^2} + \frac{2m}{\hbar^2}[E_n - V(x)]\varphi_n(x) = 0$$

(b) (10%)請解出 E_n.

3. (10%)氫原子由一個質子，一個電子構成，這個系統可具有哪些量子數 (quantum number)？這些量子數之間有何關係？實驗室裡可看到氫原子光譜，它是連續還是不連續？它和哪些量子關？為何？

4. (a) (10%) The wavelength of a yellow emission line of sodium is 5890A. What is the energy of a photon having this wavelength?
   (b) (10%) What is the kinetic energy of an electron having the same de Broglie wavelength?

5. (10%) Please plot the Fermi-Dirac distribution at (a) zero temperature and (b) a finite temperature T.

6. Concerning solids with a crystalline structure, please
   (a) (10%) explain the terms "allowed energy band" and "forbidden energy band"
   (b) (10%) plot the dispersion function of a solid with such bands.