# 國立臺灣大學 105 學年度碩士班招生考試試題



1. (a) The magnetic moment of silver atom is only1 Bohr magneton although it has 47 electrons? Explain. (8%)
(b) Ignoring the nuclear effects, what is the magnetic moment of an atom in the $^3P_0$ state? (8%)
(c) In a Stern-Gerlah experiment, a collimated beam of neutral atoms is split up into 7 equally spaced lines. What is the total angular momentum of the atom? (8%)

2. Show that $[x^2, p_x] = 2i\hbar x$ (12%)

3. A particle is trapped in a one dimensional potential given by a linear simple harmonic oscillator which potential can be defined as $kx^2/2$. At a time $t = 0$ the state of the particle is described by the wave function $\Psi = C_1\Psi_1 + C2\Psi_2$, where $\Psi_1$ and $\Psi_2$ are the eigen-functions belonging to the eigen-values $E_1$ and $E_2$. What is the expected value of the energy? (20%)

4. (a) Write down three-dimensional time-independent Schrodinger equation in Cartesian coordinates. By separating the variables $\psi(x, y, z) = X(x)Y(y)Z(z)$, solve this equation for a particle of mass $m$ confined to a rectangular box of sides $a$, $b$, and $c$, with zero potential inside. (12%)
(b) Show that the particle has energy given by $E = (\hbar^2/8m)[n_x^2/a^2 + n_y^2/b^2 + n_z^2/c^2]$. (12%)

5. In the Compton scattering, the photon of energy $E_0 = h\nu_0$ and momentum $P_0 = h\nu_0/c$ is scattered from a free electron of rest mass $m$. Show that
(a) the scattered photon will have energy $E = E_0 / [1+ \alpha(1-\cos\theta)]$, where $\theta$ is the angle through which the photon is scattered and $\alpha = h\nu_0/mc^2$ (10%)
(b) the kinetic energy acquired by the electron is $T = \alpha E_0 (1-\cos\theta) / [1+ \alpha(1-\cos\theta)]$ (10%)

**試題隨卷繳回**