

臺北市立教育大學
九十五學年度研究所碩士班入學考試試題

所 別：自然科學系碩士班(自然科學組物理類)

科 目：近代物理

考試時間：90 分鐘【13:30 – 15:00】

總 分：100 分

※ 注意：不必抄題，作答時請將試題題號及答案依照順序寫在答卷上；限用毛筆、藍色或黑色筆作答，使用其他顏色或鉛筆作答者，所考科目以零分計算。(於本試題紙上作答者，不予計分。)

1. An electron is confined to a one-dimensional infinite square well between 0 and b . (a) Derive from the Schrodinger's equation to find the wave function of the quantum state $n = 3$ (6 %) (b) Calculate the expectation value of the electron's momentum $\langle p \rangle$ for the $n = 3$ state (6 %) (c) If the electron make a transition from its first excited state to its ground state, what is the wavelength of the photon emitted. (6 %)
2. (a) Calculate the Lande g factor of ^{11}Na atom at its ground state and its first excited state (5 %) (b) Draw the splitting energy levels to show the anomalous Zeeman effect for two D lines of ^{11}Na atom. (11 %)
3. Prove that $[\vec{L}, f(\vec{r})] = \frac{\hbar}{i} \vec{r} \times \nabla f$, where $f(\vec{r})$ is any function that can be expended in a power series in $\vec{r}$. (13%)

4. A particle of mass m moves in 3 dimensions in the potential $V(\vec{r}) = \frac{1}{2}kr^2$.

By considering Cartesian coordinates, determine the energy spectrum, both energies and degeneracies. (20%)

5. An electron of total energy 1 eV is incident upon a rectangular barrier of height 2 eV and thickness 0.8 nm. Calculate the probability that the electron

can penetrate the barrier. (11%)

6. Determine the field gradient of a 50cm long Stern-Gerlach magnet that would produce a 1 mm separation at the end of the magnet between the two components of a beam of silver atoms emitted with typical kinetic energy from a 960°C oven. The magnetic dipole moment of silver is due to a single $l = 0$ electron. (11%)
7. (a) What is the total energy E of a 2.50 MeV electron? (b) What is the magnitude p of the electron's momentum? (11%)