國立高雄師範大學 101 學年度碩士班招生考試試題

系所別：物理學系

科　目：近代物理（全一頁）

1. Derive the Doppler effect for light.（10％）

2. A wave of wavelength λ passes through a slit and arrives a screen that is at a distance L away from the slit. Find the width of the slit such that we can get the narrowest image on the screen.（20％）

3. A mass m is bound by a potential well $V(x) = -\gamma\delta(x)$. Find the energy.（10％）

4. A hydrogen atom is at the ground state. Solve the Schrödinger equation and find the bound energy of the electron.（20％）

5. （1）Use $p = \gamma m_0 v$ and $E = \gamma m_0 c^2$ to prove that $E^2 = p^2 c^2 + m_0^2 c^4$

   where $\gamma = (1 - v^2/c^2)^{-1/2}$.（10％）

   （2）A particle of rest mass m_0 moves at speed u along the $+x$ axis in frame S. the linear

   momentum of the particle is $p_x = \gamma(u)m_0 u$ and its energy is $E = \gamma(u)m_0 c^2$

   where $\gamma(u) = (1 - u^2/c^2)^{-1/2}$. Frame S' moves at velocity v along the $+x$ axis of frame S.

   Show that the linear momentum and energy in frame S' are related to the values in S

   according to $E' = \gamma(E - vp_x);\quad p_x' = \gamma(p_x - vE/c^2)$ where $\gamma = (1 - v^2/c^2)^{-1/2}$. [*Hint*:

   The speed of the particle in frame S' is $u' = (u - v)/(1 - uv/c^2)$.]（20％）

6. Write down Schrodinger's wave equation for wave function $\Psi(\vec{x}, t)$ and explain the meaning of it.（10％）