國立彰化師範大學 101 學年度碩士班招生考試試題

系所：　光電科技研究所　　　　　　　　　　　　　科目：　近代物理


- ✓ Some constants : e = 1.602 x 10^{-19} C , m_e=9.11 x 10^{-31} kg, Planck's constant = 6.626×10^{-34} J-s.
- ✓ 該標示單位的答案，一定要寫上「單位」。

1. (a) Please explain "Photoelectric effect". (5%)
   (b) The threshold wavelength for photoelectric emission in tungsten is 230nm. What wavelength of light must be used for ejected electrons with maximum energy of 1.5eV? (10%)

2. (a) Please explain "Doppler effect". (5%)
   (b) A spectral line whose wavelength in a laboratory is 400nm is found to be shifted to 600nm in the spectrum of a distant galaxy. What is its recession speed? (10%)

3. (a) Please explain "Compton effect". (5%)
   (b) What is the frequency of an x-ray photon whose momentum is 1.1 x 10^{-23} kg·m /s ? (5%)
   (c) A 100-KeV x-ray incidents on a target and then the energy of the x-ray becomes 90 KeV after leaving the target, please determine its scattering angle. (10%)

4. Some electrons with kinetic energy of 50 eV are incident into an unknown crystal.
   (a) Please calculate the wavelength of these electrons. (4%)
   (b) If a strong Bragg diffraction peak is obtained at an angle of 60° after electron is incident to this unknown crystal. Please calculate the distance between two adjacent diffracted atomic planes in this solid. (6%)
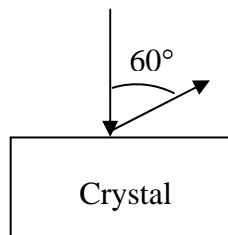
5. An electron (with mass m_e) is free to move along x-axis between x =0 to L and there is no probability to find this electron outside this region. Assume the wavefunction of this electron is ψ.
   (a) What is the possible wavefunction form for this electron? (Derive from Schrödinger's Eq.) (5%)
   (b) What are the boundary conditions for this electron? (Explanation is required) (5%)
   (c) Calculate electron energy E as a function L, m_e, and quantized level n. (10%)
   (d) Find the probability that the electron of ground state can be found between 2L/5 and 3L/5. (10%)
   (e) Assume this electron is confined in a width of 1 nm. Please calculate the ground state energy (in unit of eV)? (3%)
   (f) If this electron absorbs a photon with certain energy and is excited from the ground state to the third energy level (i.e. n=3). Please calculate this photon energy (in unit of eV). (4%)
   (g) Continue from (f), what is the wavelength of this photon (in unit of nm)? (3%)