國立彰化師範大學 99 學年度碩士班招生考試試題

系所：光電科技研究所　　選考甲　　科目：近代物理

☆☆請在答案紙上作答☆☆　　

- ✓ Planck's constant = 6.626×10^{-34} J-s. Boltzmann's constant = 1.38×10^{-23} J/K.
- ✓ 該標示單位的答案，一定要寫上「單位」

1. Please explain the following terminologies in detail. (20%)
   (1) Photoelectric effect
   (2) de Broglie wave
   (3) Compton effect
   (4) uncertainty principle

2. Find the de Broglie wavelength of an electron whose speed is $2.0\times10^{8}\,m/s$. (10%)

3. The distance between adjacent atomic planes in calcite is 0.3 nm. What is the smallest angle between these planes and an incident beam of 30-pm x-ray at which scattered x-ray can be detected? (10%)

4. An x-ray photon of initial frequency $1.5\times10^{19}\,Hz$ collides with an electron and is scattered through 90^{o}. Find its new frequency. (10%)

5. The radius of Sun is 6.96×10^{8} m and the surface temperature is 5760 K. Assume Sun is a black body with a surface emissivity of 1. Please calculate the radiation power density of Sun. (10%)

6. (1) What is Pauli exclusive principle?
   (2) How Pauli exclusive principle affect the electronic states of atoms?
   (3) Please write the electron orbitals of Si (Z=14). (10 %)

7. A particle with mass of M, moves inside a well, defined between x= －L and x= L, with an infinite barrier. Please answer the following questions: (20%)
   (1) Please find the wave function of this particle.
   (2) Please find the allowed energy values for this particle.
   (3) If this particle is an electron and the well width is 5 nm. This electron is excited from ground state (n=1) to an adjacent excited state (n=2) by absorbing energy from incident photons. Please find the wavelength of incident photons.
   (4) If the barrier height at one side is reduced from infinite value to a finite V. What will the allowed energy values change? Please discuss qualitatively.

8. (1) What is "stimulated emission"? (2) Please calculate the emission photon wavelength of GaAs (bandgap = 1.42 eV). (10%)