國立彰化師範大學 97 學年度碩士班招生考試試題

系所：電子工程學系碩士班　　組別：甲組　　科目：近代物理

☆☆請在答案紙上作答☆☆　　

Physical constants:

Planck's constant h= 6.626×10^{-34} J-s., c= 3×10^{8}m/sec, m_e=9.1×10^{-31} kg.
e = 1.602×10^{-19} C , ε_0= 8.854×10^{-12} $C^2/N\cdot m^2$,
The Boltzmann's constant k_B=1.38×10^{-23} J/K.

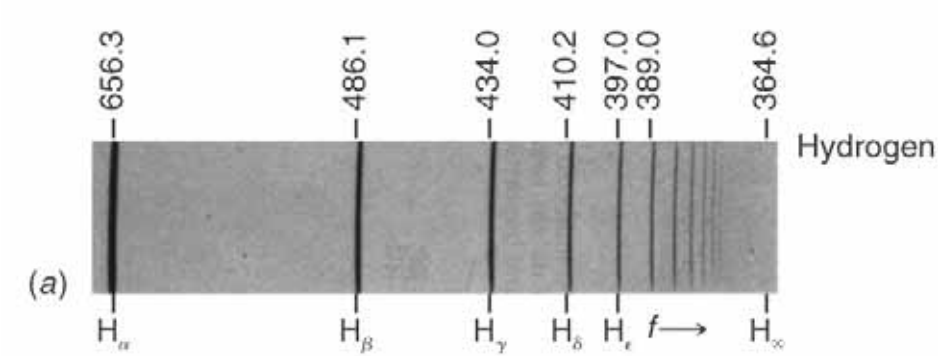

Fig.1

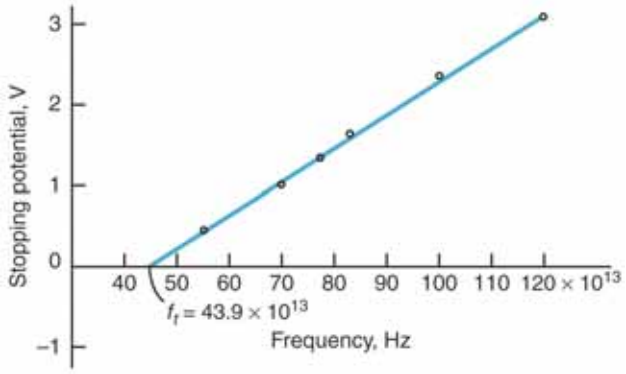

Fig.2

1. Answer the following questions: **(40%)**

   (a) For a particle within a potential energy $V(X)=\frac{1}{2}Kx^2=\frac{1}{2}mw^2x^2$, what is the lowest quantized energy level? **(5%)**

   (b) What is quantized angular momentum assumption in Bohr's H atom model? **(5%)**

   (c) The empirical fit for the H atom spectra shown in Fig.1 is $\lambda_n=364.6\frac{n^2}{n^2-4}nm$. Calculate the Rydberg constant from this data (please show your calculations). **(10%)**

   (d) If the lifetime of an excited state of an atom is 10^{-7}sec, what is the uncertainty in the energy of photons emitted by such atoms in the spontaneous decay to the ground state? **(5%)**

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(e) Explain the origin of the Bremsstrahlung spectrum in the X-ray tube spectra. **(5%)**

(f) Fig. 2 shows the experimental data of the photoelectric effect. Use the data to calculate the Planck's constant (please show your calculations). **(10%)**

2. $-\frac{\eta^2}{2m}\frac{\partial^2\Psi(x,t)}{\partial x^2}+V(x,t)\Psi(x,t)=i\eta\frac{\partial\Psi(x,t)}{\partial t}$ is the one dimensional Schrödinger equation. If the potential energy does not change with time, deduce the time-independent Schrödinger equation. **(20%)**

3. The first three wave functions for a simple harmonic oscillator are:

$$\psi_0(x)=A_0e^{-\frac{m\omega x^2}{2\eta}}$$

$$\psi_1(x)=A_1\sqrt{\frac{m\omega}{\eta}}xe^{-\frac{m\omega x^2}{2\eta}}$$

$$\psi_2(x)=A_2\left(1-\frac{2m\omega x^2}{\eta}\right)e^{-\frac{m\omega x^2}{2\eta}}$$

Prove that $\psi_1(x)$ and $\psi_2(x)$ are orthogonal. **(20%)**

4. For the potential energy shown here, calculate the coefficient of transmission T for the case when the total energy is larger than V_0. **(20%)**