國立彰化師範大學 99 學年度碩士班招生考試試題

系所：電子工程學系　　組別：甲組(選考乙)　　科目：近代物理

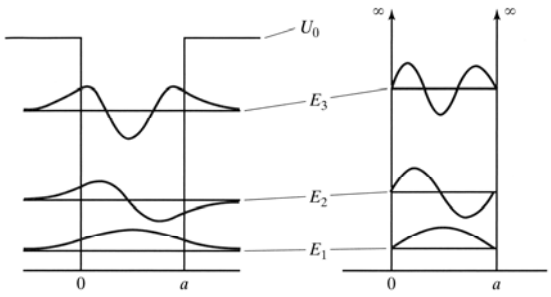
☆☆請在答案紙上作答☆☆　　

Physical constants:

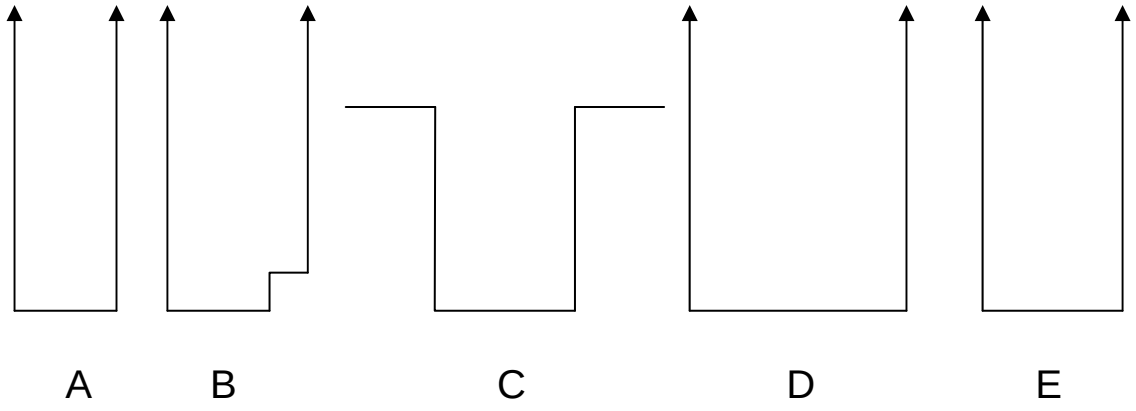
Planck's constant h = 6.626×10^{-34} J-s, c = 3×10^{8}m/sec, $\varepsilon_0 = 8.854 \times 10^{-12}$ $C^2/N \cdot m^2$,

$m_e = 9.1 \times 10^{-31}$ kg, e = 1.602×10^{-19} C. The Boltzmann's constant $k_B = 1.38 \times 10^{-23}$ J/K.

1. The potential energy of an electron is $V(x) = \frac{1}{2} m \varpi^2 x^2$.
   (a) What is the lowest quantized energy level calculated by Schrodinger equation?
   (b) What is the energy of the photon emitted when the electron transits from the third energy level down to the second energy level? (6%)
2. Describe any two phenomena observed in the Photoelectric Effect experiment that can not be explained by classical physics. (6%)
3. What is the most important concept proved by the Compton Effect experiment? (5%)
4. Please write down the postulates/assumptions in Bohr's atomic model. (15%)
5. Explain qualitatively why the E_i in the finite energy well is lower than the E_i in the infinite well? (10%)



6. The potential energies are drawn down to scale. Compare the ground state energy in each case. (Ex: A>B>C>D>E) (10%)



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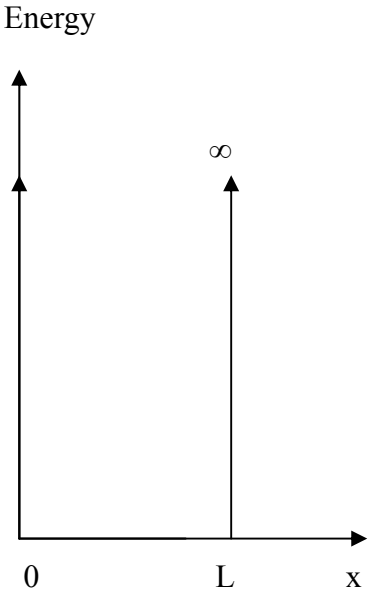
7. Mosley summarized the L-series X-ray spectrum emitted from atoms as $f = cR_{\infty}(\frac{1}{2^2} - \frac{1}{n^2})(Z - 7.4)^2$

where f is the X-ray frequency, c is the speed of light, R_{∞} is the Rydberg constant. Z is the atomic number, and n= 3,4,5…

Explain **qualitatively** the origin of 7.4 in the formula. (8%)

8. (a) Calculate the ground state wave function of a particle with mass m inside a one-dimensional infinite well. The width of the well is L as illustrated in the figure.

(b) Then calculate the expectation value for its momentum. (20%)



9. A beam of particles, each with the same total energy E and the same mass m, move from left to right. The potential energy is shown in figure. Calculate the reflection coefficient for

(a) $E > V_0$

(b) $E < V_0$ (20%)