

國 立 清 華 大 學 命 題 紙

九十三學年度 原子科學 系(所) 甲 組碩士班入學考試

科目 近代物理 科號 3501 共 1 頁第 1 頁 *請在試卷【答案卷】內作答

1. a) Please describe in detail the difference between the Mie scattering and the Rayleigh scattering. (20%)
b) Why the sky is blue, why the fog is white, and why the sun turns to red at sunset? (15%)

2. a) Please describe what is the "Stokes shift" and how does people utilize the stokes shift when constructing the fluorescence detection system? (10%)
b) In the emission spectrum and the excitation spectrum of fluorescence, in the most case, there is a mirror symmetry between them. Please explain why does the mirror symmetry occur. (10%)
(Hint: transition probability)

3. Please describe what is the difference between the "old quantum theory" (A.D. 1905-1925) and Quantum Mechanics (A.D. 1925-). (15%)

4. a) Please derive the wave function for the barrier potential. (20%)
Conditions: A particle of total energy E in the region $x < 0$, which is incident upon the barrier in the direction of increasing x .
The potential :
$$V(x) = \begin{cases} V_0 & 0 < x < a \\ 0 & x < 0 \text{ or } x > a \end{cases} \quad (E < V_0)$$

b) Use the above results to explain how the Scanning Tunneling Microscopy (STM) works.(10%)