


注意：考試開始鈴響前，不得翻閱試題，
並不得書寫、畫記、作答。

國立清華大學 108 學年度碩士班考試入學試題

系所班組別：生命科學院 丙組

考試科目(代碼)：近代物理(0602)

— 作答注意事項 —

1. 請核對答案卷(卡)上之准考證號、科目名稱是否正確。
2. 作答中如有發現試題印刷不清，得舉手請監試人員處理，但不得要求解釋題意。
3. 考生限在答案卷上標記「由此開始作答」區內作答，且不可書寫姓名、准考證號或與作答無關之其他文字或符號。
4. 答案卷用盡不得要求加頁。
5. 答案卷可用任何書寫工具作答，惟為方便閱卷辨識，請儘量使用藍色或黑色書寫；答案卡限用 2B 鉛筆畫記；如畫記不清(含未依範例畫記)致光學閱讀機無法辨識答案者，其後果一律由考生自行負責。
6. 其他應考規則、違規處理及扣分方式，請自行詳閱准考證明上「國立清華大學試場規則及違規處理辦法」，無法因本試題封面作答注意事項中未列明而稱未知悉。

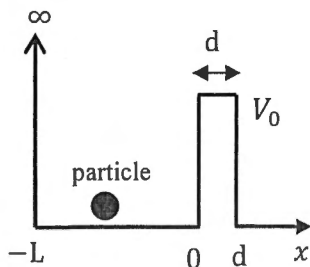
國立清華大學 108 學年度碩士班考試入學試題

系所班組別：生命科學院丙組

考試科目（代碼）：近代物理(0602)

共 2 頁，第 1 頁 *請在【答案卷】作答

1. (15%) Muons are elementary particles that are naturally produced by the collision of cosmic rays and molecules in the upper atmosphere several kilometers above the surface of the Earth. Muons are unstable and have a very short lifetime of only $2.2 \mu\text{s}$. Therefore, most of these particles could travel a distance of about 650m during their lifetime and should never reach the surface of the Earth. However, detectors on Earth can detect a large number of muons. Please explain why.
2. (15%) In the late 19th early 20th centuries, classical physics was seriously challenged by several experiments, which led to the development of modern physics. Please describe at least two of such experiments and explain why classical physics failed and modern physics succeeded in interpreting the results of these experiments.
3. (15%) Electron microscopy (EM) changes life science research by providing a resolution that is far beyond that of optical microscopy. Please briefly describe the principle of EM from the perspective of quantum physics and explain why EM can reach such a fine resolution.
4. (20%) Given the one dimensional time-independent (stationary) Schrödinger's equation of a particle, $E\Psi(x) = -\frac{\hbar^2}{2m} \frac{d^2}{dx^2} \Psi(x) + V(x)\Psi(x)$, please solve for the wave function $\Psi(x)$ between $x = 0$ and $x = d$, i.e. inside the finite wall, in a system as depicted below. The particle has a mass m and an energy $E < V_0$, and is initially trapped in the well between $x = -L$ and $x = 0$ with the boundary conditions of $\Psi(-L) = 0$ and $\Psi(0) = \Psi_0$.



國立清華大學 108 學年度碩士班考試入學試題

系所班組別：生命科學院丙組

考試科目（代碼）：近代物理(0602)

共 2 頁，第 2 頁 *請在【答案卷】作答

5. (15%) In an experiment, a student measured the amount of two radioactive nuclides A and B and found that A is twice more abundant than B. Three days later, the student found that A and B are equally abundant. If A has a half-life of 1 day, what is the half-life of B?
6. (20%) A material X is irradiated by neutrons so that radioactive atoms are produced continually. At the same time, the radioactive atoms decay based on the conventional radioactive decay law. Suppose that the radioactive atoms are produced at a constant rate R and decay at the rate of λN , where N is the amount radioactive atoms. Show that N is given by

$$N = \frac{R}{\lambda}(1 - e^{-\lambda t})$$