


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：核子工程與科學研究所 甲組
考試科目(代碼)：近代物理(3203)

—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。

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系所班組別：核子工程與科學研究所甲組(工程組)

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共 2 頁，第 1 頁 *請在【答案卷、卡】作答

Please fill in the blanks (each blank is 5 points) $h=6.63 \times 10^{-34}$ Js; the electron mass is 9.11×10^{-31} kg, $1 e = 1.602 \times 10^{-19}$ C, light speed 3×10^8 m/s

1. In the National Synchrotron Radiation Research Center, the Taiwan Photon Source is an electron synchrotron with the electron energy of 3 GeV and the circumference is 518 m. Please tell me what is the speed of electron in the storage ring? _____ and how long it takes to finish a circle inside the storage ring? _____
2. What kind of potentials that the energy levels (a) E_n proportional $-(1/n^2)$; _____ (b) E_n proportional to n^2 ; _____ (c) E_n proportional to $(n+1/2)h\omega/2\pi$ _____.
3. In the nuclear reaction $^{10}\text{B}(n,\alpha)^7\text{Li}$, a 10 keV neutron reacted with steady ^{10}B nucleus, during the compound stage, a 0.48 MeV prompt gamma ray was emitted from the compound nucleus. Please tell me what is the energy (_____ in MeV) of alpha particle, and what is the energy of ^7Li ion (_____ in MeV). The rest mass of ^{10}B is 10.013 amu; neutron is 1.0086652 amu (or 1.67495×10^{-24} g); alpha is 6.64424×10^{-27} kg; and ^7Li is 7.016003 amu.
4. For a non-relativistic free particle, what is the relation between ω (frequency) and k (momentum or wavevector), assume the mass of the particle is m . _____ . What is the wavelength of a 400 keV electron in a transmission electron microscopy? (_____ nm).
5. Please write down the full English name of ESR? _____. If I detect a significant signal of ESR from the silicon wafer, then what was happened on this silicon wafer before? _____ (Hint: a perfect silicon wafer should have no ESR signal)
6. (a) Give the spectroscopic notation of $n=4, l=3, j=7/2$. _____
(b) What are the values of l and j for the spectroscopy notation of $^2\text{P}_{3/2}$. _____
7. Please write down the one-dimensional time-dependent Schrodinger equation.

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共 2 頁，第 2 頁 *請在【答案卷、卡】作答

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8. What is the relation between μ (magnetic moment) and L (angular momentum) for an orbiting charge with charge q with mass m ? _____
If the applied magnetic field is B , what is the relation between the Larmor frequency (ω_L) and B . _____
9. Which elements (_____ and _____) in the periodical table ($Z < 82$) have highest and lowest ionization energy of the electron, respectively?
10. What are the names (_____ and _____) of fluorescence X-rays emitted due to the de-excitation of transitions from L shell to K-shell and M-shell to K-shell, respectively, after the K-shell electron is ejected by either hard X-ray or charged particle.
11. What will be happened to a neutron eventually after the neutron leaks out of a nuclear reactor. Assume the leaked neutron does not collide or interact with any matter anymore? _____
12. I have two copper conductors twisted and wired together to send the electricity power to my air conditioner. We all know that when the copper wires sit in the air, a natural copper oxide layer always forms on the surface of copper wires. Usually the copper oxide is an insulator. Please tell me why it is still conducting the electric power through. The answer is due to _____ effect.