

國立中山大學 107 學年度碩士暨碩士專班招生考試試題

科目名稱：近代物理【物理系碩士班】

題號：423001

※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）（選擇題） 共3頁第1頁

單選題 [共十一題]

*1~9 題每題 10 分，10~11 題每題 5 分，答錯不倒扣。

- [10%] Can a photon transfer all of its energy to a free electron?
 - Yes
 - No
 - It depends on the photon's energy
 - It depends on photon's polarization
- [10%] A photon of initial energy 0.1 MeV undergoes Compton scattering at an angle of 60° . What is the energy of the scattered photon? (The rest energy of electron is $m_e c^2 = 0.511$ MeV.)
 - 8.361×10^4 eV
 - 8.55×10^4 eV
 - 8.741×10^4 eV
 - 9.111×10^4 eV
- [10%] It's known that energy levels of hydrogen follows $E_n = -13.6/n^2$ eV with $n = 1, 2, 3, \dots$. Consider a process that an electron in hydrogen makes a transition from the $n = 2$ state to the $n = 1$ state without emitting a photon. Instead, the excess energy is transferred to an outer electron in the $n = 4$ state, which is ejected by the atom. What is the kinetic energy of the ejected electron?
 - 2.55 eV
 - 9.35 eV
 - 10.2 eV
 - 11.05 eV
- [10%] Estimate the order of the kinetic energy of an electron confined within a nucleus of size 1.0×10^{-14} m by using the uncertainty principle.
 - 10 eV
 - 10 keV
 - 10 MeV
 - 1 GeV
- [10%] A light source of wavelength illuminates a metal and ejects photoelectrons with a maximum kinetic energy of 1.0 eV. A second light source with half the wavelength of the first ejects photoelectrons with a maximum kinetic energy of 4.0 eV. What is the work function of the metal?
 - 0.5 eV
 - 2.0 eV
 - 3.5 eV
 - 4.0 eV

背面有題

試題隨卷繳回

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6. [10%] The radial part of a wave function for an atom is given by $\psi(r) = Ar^2 e^{-\frac{r}{2a_0}}$ where A is the normalization constant and a_0 is a positive number. Calculate the expectation value of r for this state.
- A. $2a_0$
 - B. $3a_0$
 - C. $4a_0$
 - D. $5a_0$
7. [10%] What is the ground-state energy of 5 non-interacting bosons (of mass m) in a one-dimensional box of length L ?
- A. 0
 - B. $\frac{\pi^2 \hbar^2}{2mL^2}$
 - C. $\frac{5\pi^2 \hbar^2}{2mL^2}$
 - D. $\frac{55\pi^2 \hbar^2}{2mL^2}$
8. [10%] For $l = 2$, what is the minimum value of $(L_x)^2 + (L_y)^2$, where L_x and L_y are x and y components of angular momentum?
- A. 0
 - B. \hbar^2
 - C. $2\hbar^2$
 - D. $6\hbar^2$
9. [10%] Which of the following atoms would you expect to have no ground state split by the spin-orbit interaction?
- A. Na
 - B. Al
 - C. Si
 - D. Cu

10. [5%] Which line in Figure 1 should be the Fermi distribution?

- A. A
- B. B
- C. C

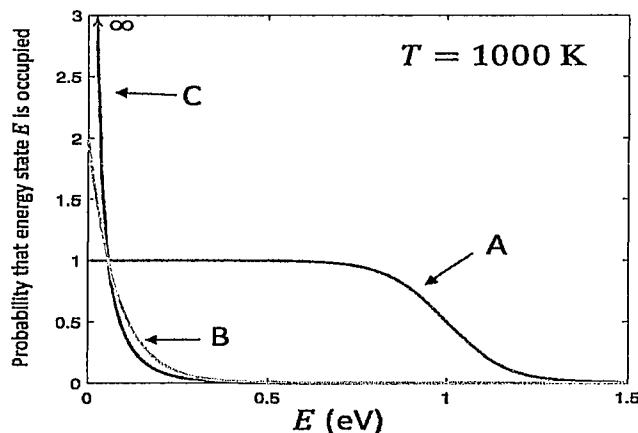


Figure 1

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11. [5%] The band structure for an imaginary semiconductor is shown in Figure 2, where E_F is the Fermi energy. What is the minimal photon energy to directly excite an electron from the valence band to the conduction band?

- A. 0.7 eV
- B. 0.8 eV
- C. 1.2 eV
- D. 1.5 eV

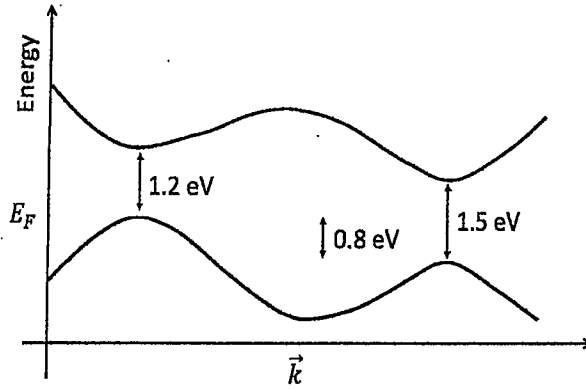


Figure 2