

华中师范大学 2014 -2015 学年第 二 学期 期末考试试卷

课程名称 Atomic Physics 课程编号 42910012 任课教师 侯德富

题型	选择	填空	简答	计算与综合		总分
分值	16	20	24	40		100
得分						

得分	评阅人

一、选择题：（4 题，共 16 分，每题 4 分）

- 1、 Using an electron with energy 12.5 eV to excite the ground state of hydrogen (H) atom , the excited Hydrogen atom will transit to lower energy levels , which transitions list below can occur? ()

A. the 3rd energy level → 1st level B. the 2nd level → the 1st level

C. the 4th level → the 1st level D. the 3rd level → the 2nd level
- 2、 In a atom with two valence electron(one p,one d), how many atom states in L-S coupling? ()

A、 7 B、 9 C、 12 D、 5
3. The minimum wavelength from an x-ray tube under a working potential $2 \times 10^6 \text{ V}$ is ()

A) 1 \AA B) 0.15 \AA C) 10^{-2} \AA D) 10^{-5} \AA
- 4 **The static energy and moving energy is E_0 , and E , the ratio between the Compton wavelength and its de Broglie wave length is () .**

A、 $\sqrt{\left(\frac{E_0}{E}\right)^2 - 1}$ B、 $\sqrt{\left(\frac{E}{E_0}\right)^2 - 1}$ C、 $\sqrt{\left(\frac{E}{E_0 + 1}\right)^2 - 1}$ D、 $\sqrt{\left(\frac{E - 1}{E_0}\right)^2 - 1}$

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二、填空题：（5 题，共 20 分，每题 4 分）

- 1 The longest wavelength photon emitted in the Balmer series ($n=2$) is _____.this wavelength fall in the visible spectrum _____
- 2 The hypothesizes in Bohr's theory are _____
- 3 An object from outer space moves past the Earth at $0.8c$. You measure the length of the object as 3.3m in the Earth's frame, its length In the object's rest frame is _____
- 4 The L absorption edge of a neodmium atom($z=60$)is 0.19nm .the work required to ionize a K electron from the neodmium atom is _____
- 5 The ground state of Al atom is ${}^2P_{\frac{1}{2}}$, its total angular momentum is _____ , its Lande g-Factor is _____ .

得分	评阅人

三、简答题：（4 题，共 24 分，每题 6 分）

- 1、What are the maximum electrons number allowed for the following quantum numbers ?

(1) n, l, m_l (2) n, l (3) n

- 2、What's the content of Pauli Exclusion Principe.

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3 The following experiments were significant in the development of atomic physics. Choose two , in each case, briefly describe the experiment and summarize what it contributed to the development of the theory.
(a) Stern-Gerlach experiment (b) Compton Scattering (c) Franck-Hertz Experiment

4 Give a brief introduction of the interactions between photons and matter.

得分	评阅人

四、计算与综合题：（共 40 分）

1 A beam of monochromatic light with a wavelength of 5.4\AA is incident upon a set of crystal planes, at an angle of 90° with respect to the incident beam, a maximum second-order diffraction is observed, what is the distance of the crystal planes (10)

2 In Compton scattering, an incident photon with wavelength λ is scattered by a static electron with mass m , if λ' , E' represent the wavelength and energy of the scattered photon with scattering angle θ .

(1) Derive the expressions for λ' and E' ;

(2) Derive the kinetic energy of the recoiling electron (15)

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3. Using L-S coupling , Pauli principle and Hund rule to decide the ground state of Carbon atom (C atom, $Z=6$) (15)

普朗克常数 $h=6.626 \times 10^{-34}$ 焦耳·秒
基本电荷 $e=1.602 \times 10^{-19}$
光速 $c=3 \times 10^8$ 米/秒
里德伯常数 $R_{\infty}=1.097 \times 10^7$ 米⁻¹

真空介电常数 $\epsilon_0 = 8.85 \times 10^{-12}$ 安·秒·伏⁻¹·米⁻¹
玻尔磁子 $\mu_B=0.927 \times 10^{-23}$ 安·米²
玻尔兹曼常数 $k=1.38 \times 10^{-23}$ 焦耳·开⁻¹
质子质量 $m_p=1.67 \times 10^{-27}$ 千克=938 兆电子伏/c²