

华中师范大学 2015 -2016 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、Multiple Choices: (Total 16, each 4 points)

- 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、Which experiments indicated the “nuclear structure” of atoms ()

A. Electron double-slit experiment B. Franck-Hertz experiment

C. Stern-Gelarch experiment D. Rutherford scattering experiment

- 3、If an atom locates at $^2D_{5/2}$ state, its Lande g factor is ()

A 1/6 B 2/3 C 6/5 D 7/6

- 4、The angular momentum quantum number of two electrons is respectively: $L_1=4, L_2=3$, thus the total orbital Angular momentum quantum numbers could be ()

A. 0, 1, 2, 3, 4 B. 0, 1, 2, 3, 4, 5, 6, 7

C. 1, 2, 3, 4, 5, 6, 7 D. 3, 4, 5, 6, 7

学号:

学生姓名:

年级:

专业:

院(系):

线
封
密

得分	评阅人

二、 Completion : (total 20, each 4 points)

- The longest wavelength photon emitted in the Balmer series ($n=2$) is _____.this wavelength fall in the visible spectrum _____
- The hypothesizes in Bohr's theory are _____
- 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 _____
- The ground state of Al atom is ${}^2P_{\frac{1}{2}}$, its total angular momentum is _____, its spin magnetic moment is _____
- The average speed of an electron in the first Bohr orbit of an atom of atomic number Z is, in units of the velocity of light _____

得分	评阅人

三、 Brief Answer Questions : (toal 24 , each 6 points)

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

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

- 2、 Try to describe how an electron's orbital magnetic moment interacts with an external magntetic field.

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) Photo-electric Effect experiment (c) Franck-Hertz Experiment

4 What are Normal and Anomalous Zeeman effects and what are their producing conditions ?

得分	评阅人

四、Calculation and comprehensive question: (共 40 分)

1 Event 1 occurs at $X_1=10$ m at $t_1=1$ s. Event 2 occurs at $X_2=600000010$ m at time $t_2=2.8$ s . Is there any reference frame where these two events can be reversed so that event 2 occurs before event 1? Prove your answer (12 points)

2.What is the Zeem splitting of the the D lines $3^2 P_{\{3/2, 1/2\}} \rightarrow 3^2 S_{\{1/2\}}$ of sodium doublet at a position where the magnetic field is 2.5T? (18)

- (1) If we look at it in the diection perpendicular to the magnetic field, how many spectra lines will be observed?
- (2) If If we look at it in the diection parallel to the magnetic field, how many spectra lines will be observed?
What are their polarizations
- (3) Does it belong to Normal Zeeman effect? Draw a diagram for the energy levels after the splitting.

3 Compute the angles between the spin angular momentum and the orbital angular momentum of the electron in L=1 State (10)

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