KINGDOOM OF SAUDI ARABIA
Al Imam Mohammad Ibn Saud Islamic University
College of Science
Physics Department

المملكة العربية السعودية
جامعة الإمام محمد بن سعود الإسلامية
كلية العلوم-قسم الفيزياء

Phy 462-191-Male-143720

Type of Exam: Midterm 2 **Academic Year:** 1436/1437 (2015/2016)
Subject: Atomic Physics (Phy 462) **Level:** 7 (Male**s Section**)
Date: Monday 25 April 2016 **Allowed Time:** One Hour
Time: 10:30 am - 11:30am

Instructions

1. Shows all work must be done in the exam booklet.
2. This is a closed book exam.
3. Calculators are allowed, but books, notes, computers and cell phones are not allowed.
4. Do all questions.
5. You have 60 **minutes** to solve the questions**.**

Student Name :الأسم	**Student ID.: Number: الرقم الجامعى**	**Department :الشعبة**

	Number of Questions	Number of Questions to be Answered	Number of Points	Obtained Points
Question 1	4	All	5	
Question 2	3	All	5	
Question 3	2	All	5	
Question 4	3	All	5	
Total			**Total: 20**	

Physical constants and conversion factors

1eV = 1.60×10^{-19}**J**
Electron mass $\mathbf{m_e} = 9.11\times10^{-31}$kg
Elementary charge e = 1.60×10^{-19}C
Planck's constant h = 6.63×10^{-34} **J.s** or **h** = 4.14×10^{-15} **eVs**
Speed of light; $\mathbf{c} = 3.0\times10^{8}\mathbf{m.s^{-1}}$
Bohr's radius $\mathbf{a_0}$= 0.0529**nm**,
$\mathbf{k} = (4\pi\varepsilon_0)^{-1} = 9.0\times10^{9}\mathbf{N.m^2C^{-2}}$, **1amu** = 1.66×10^{-27}**kg**
Rydberg constant, $\mathbf{R_H}=1.09\times10^{7}\mathbf{m^{-1}}$
Bohr magneton $\mu_B = e\hbar/2m = 9.27\times10^{-24}$ Am^2

Answer all Questions

Question 1 [5 points]:

1.1. A certain shell has principal quantum number n = 5, how many subshells does this shell contain? **(1 point)**

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1.2. Calculate the maximum shell population of electron if n = 6? **(1 point)**

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1.3. According to the Bohr postulation and quantum mechanics determine the orbital angular momentum $\vec{L}$ for an electron if n =2? **(2 points)**

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1.4. What is the largest possible magnitude of the angular momentum for n = 4? **(1 point)**

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Question 2 [5 points]:

2.1. Calculate the allowed values of j for a *d* electron? **(1 point)**

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2.2. Use the selection rules for the two electrons system; find the lines transitions $\Delta\ell$ and Δj between states from $d_{5/2}$ to $P_{3/2}$? **(2points)**

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2.3. For directional in the space, find the orbital angular momentum along $\vec{L}_Z$, if ℓ =2? **(2points)**

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Question 3 [5points]:

3.1. Calculate the possible values of $\vec{L}.\vec{S}$ for ℓ= 1 and s = ½? **(2points)**

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3.2. What is the orbital angular momentum for electrons in *2p*, *3d*, and *3f* orbitals (expressed in terms of ħ)? How many radial and angular nodes do each of these orbitals have? **(3 points)**

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Question 4 [5points]:

4.1. Use the format for the term symbols is $^{2S+1}\ell_J$, determine the electronic configuration for an atom with the term symbol $^4S_{3/2}$? (2 points)

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4.2. Use the Russel-Saunders coupling between $\vec{L}$ and $\vec{J}$, calculate the possible values of $\vec{L}.\vec{J}$ in terms of quantum numbers for ℓ = 1 and S = ½? (2 points)

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4.3. Write the orbital magnetic dipole moment of an electron depends on its orbital angular momentum? (1 point)

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Good Wishes