31/03/2016

DOON UNIVERSITY, DEHRADUN

Mid Semester Examination, Second Semester, 2015-16

School of Physical Sciences

2-Years MSc Program

Course: PHC-454: Atomic and Molecular Physics

Time Allowed: 2 Hours *Maximum Marks: 30*

Note: Attempt All Questions from Sections A,B,C.

SECTION: A *(Marks: 1 X 6 = 6)*

1. The ratio of frequencies of the first line of the Lyman series and first line of Balmer series is
   (A) 27/5 (B) 27/8 (C) 8/27 (D) 5/27
2. The Bohr formula is utilized to calculate ionization energy. *He* atom is found to yield a result higher than experimental value because of
   (A) Electron-electron interaction (B) Spin-orbit interaction
   (C) Spin-spin interaction (D) None of the above
3. The maximum number of electron in a subshell with orbital quantum number l is
   (A) $(2l+1)$ (B) $2(2l-1)$ (C) $2(2l+1)$ (D) $l(l+1)$
4. The magnetic moment associated with first orbit in hydrogen atom is given by
   (A) $\frac{h}{4\pi me}$ (B) $\frac{4\pi me}{h}$ (C) $\frac{eh}{4\pi m}$ (D) $\frac{ehm}{4\pi}$
5. For an atom in the state of $^2D_{5/2}$ the Lande g factor should be
   (A) 2 (B) 1.75 (C) 1.20 (D) 1.33
6. The spectral term of an atom having filled subshell has ground state
   (A) $^1P_1$ (B) $^2S_{1/2}$ (C) $^1S_0$ (D) $^1D_2$.

SECTION: B *(Marks: 4 X 3 = 12)*

7. What are symmetric and antisymmetric wave functions? State and prove Pauli's exclusion principle on the basis of these functions. Derive an expression for the maximum number of electrons that can go into a shell with its principal quantum number n.
8. Find the total magnetic moment, in Bohr magneton, of an atom in the $^3P_2$ state. Into how many substate will this state split in presence of weak magnetic field as well as high magnetic field.
9. Deduced terms of $3p4d$ configuration system in L-S and j-j couplings. Show them in diagram. Find out the spectral term for $4d\,^2 5s$.

SECTION: C *(Marks: 6 X 2 = 12)*

10. An atom with quartet transition, the separation between the upper state multiplet levels are found to be 12, 20, and 28 cm^{-1}, while the separation between the lower state multiplet levels are found to be 15 and 25 cm^{-1}. Obtain the term of the particular transition involved and draw the energy level diagram also.
11. Illustrate with the help of diagrams the splitting of $^2D_{5/2}$ and $^2D_{3/2}$ levels of sodium when (i) a weak magnetic field, (ii) a strong magnetic field is applied.