

Mid-West University
Examinations Management Office

End Semester Examination 2081

Bachelor level/ B. Sc. /5th Semester

Time: 3 hours

Full Marks: 60

Pass Marks:30

Subject: Physics of Atoms & Molecules Electromagnetism (PHY453)

Candidates are required to give their answer in their own words as far as practicable. The figures in the margin indicate full marks.

Group - A

Answer the following questions (attempt all)

[4x6 = 24]

1. Define spin orbit interaction energy. Also explain the change in total energy of the atom due to spin-orbit coupling. Also obtain the magnetic moment of an electron.
2. What do you understand about Zeeman effect? Explain the quantum mechanical expression of normal Zeeman effect. Also find the total additional energy of an electron from anomalous Zeeman effects.
3. What is Raman effect? Discuss different types of Raman lines. Explain the Quantum theory of Raman effects. Also show that Raman effect is a two step process.

OR

Define Laser. Discuss the laser action. Also explain about the relation between Einstein's Coefficients.

4. The wavelength of the L_{α} X-ray line of platinum (atomic number 78) is $1.321\text{\AA}$. An unknown substance emits L_{α} X-ray of wavelength $4.174\text{\AA}$. Calculate the atomic number of the unknown substance. (Given $b = 7.4$ for L_{α} lines)

Group - B

Answer the following questions (attempt all)

[6x4 = 24]

5. Explain the rotational energy levels of a diatomic molecules. Also show that difference between two consecutive energy levels is not same.
6. Determine the maximum separation of a beam of hydrogen atoms that moves a distance of 20cm with a speed of $2 \times 10^5 \text{ m/s}$ perpendicular to a magnetic field, whose gradient is $2 \times 10^{-24} \text{ T/m}$ and mass of hydrogen is $M_H = 1.67 \times 10^{-27} \text{ kg}$.
7. Find the S, L and J values that correspond to each of the following states: $^2P_{3/2}$, $^2S_{1/2}$ and $^6H_{5/2}$.
8. What voltage must be applied to an X-ray tube for it to emit X-rays with minimum wavelength of 40pm.
9. Calculate the magnitudes of orbital, spin and total angular momenta and also the angle between l and s for a p electron in a one-electron atom.
10. For hydrogen molecule the inter-nuclear distance is $0.74\text{\AA}$, mass of hydrogen atom is $1.6738 \times 10^{-27} \text{ kg}$, calculate the rotational energy levels in electron volts.

OR

The ground state vibrational energy of hydrogen molecule is 0.0273 eV. Find the force constant of the molecule.

Group - C

Answer the following questions (attempt any six)

[6x2 = 12]

11. Differentiate between symmetric and antisymmetric wave functions.
12. Explain the different quantum numbers associated with Vector atom model.

13. Write the limitation of L-S coupling. How it can be solved?
14. Write short notes on Stark Effect.
15. Draw a diagram of rotational vibrational energy levels of diatomic molecules. Also mention the different branch.
16. Differentiate between spontaneous and stimulated emission.
17. How will you represent the states of an atom in spectral notations?
18. Explain why normal Zeeman effect occurs only in atoms with even number of electrons.

The End