24U384 (Pages: 2) Name : .....

Reg. No : .....

THIRD SEMESTER UG DEGREE EXAMINATION, NOVEMBER 2025

(FYUGP)

CC24UPHY3MN204 - ATOMIC STRUCTURE AND SPECTROSCOPY

(Physics - Minor Course)

(2024 Admission - Regular)

Time: 2.0 Hours Maximum: 70 Marks

Credit: 4

Part A (Short answer questions)

Answer ***all*** questions. Each question carries 3 marks.

1. Discuss the tems pair production and pair annihilation. [Level:2] [CO2]
2. State the relation between uncertainties in position and momentum. [Level:1] [CO2]
3. Name the two types of X-rays produced in an X-ray tube. [Level:1] [CO2]
4. Define phase velocity [Level:1] [CO2]
5. List the following in ascending order of wavelength: X-rays, visible light, radio waves [Level:1] [CO1]
6. What is a spectral series? Use the Balmer series as an example. [Level:2] [CO1, CO2, CO3, CO4, CO6]
7. What was the fundamental "wave" condition that Bohr (inspired by de Broglie) imposed on the electron's orbit? [Level:2] [CO2, CO3, CO4, CO5]
8. Identify the condition required for achieving population inversion. [Level:2] [CO5]
9. What is termed as fluorescence? [Level:2] [CO2, CO3, CO4, CO5, CO6]
10. Why anti-Stokes lines are less intense than Stokes lines? [Level:2] [CO1, CO2, CO3, CO4, CO6]

(Ceiling: 24 Marks)

Part B (Paragraph questions/Problem)

Answer ***all*** questions. Each question carries 6 marks.

11. Describe Young’s double-slit experiment and explain how it proves the wave nature of light. [Level:2] [CO2]

12.	List and briefly describe three outcomes of the particle in a box model.	[Level:1]	[CO2]
13.	Starting from the expressions for kinetic and potential energy, show how the total energy (E) of an electron in a hydrogen atom is derived and explain why it is negative. If the orbital radius were to decrease, what would happen to the total energy?	[Level:4]	[CO2, CO3, CO4, CO5]
14.	What is the atomic number, Z? Explain how the Rutherford scattering experiment provided a method to determine this value for different elements.	[Level:3]	[CO1, CO2, CO3, CO4, CO6]
15.	A molecule makes a transition between the ground state and an excited state having a lifetime of 10^-3 s . Find the uncertainty in the excited state energy level and find the width of the associated spectral line.	[Level:1]	[CO5]
16.	The wavelength of mercury green light is 546.1 nm. Find (i) the frequency in Hz and (ii) the wave number in cm^-1 and m^-1	[Level:1]	[CO5]
17.	When CO is dissolved in liquid Carbon tetrachloride, infrared radiation of frequency 6.42*1013 Hz is absorbed.CCl4 by itself is transparent at this frequency ,so the absorption must be due to the CO. (a) What is the force constant of the bond in the CO molecule?(b) What is the spacing between its vibrational energy levels?	[Level:2]	[CO2, CO3, CO4, CO6]
18.	The rotational constant for H35Cl is found to be 10.5909 cm-1. What is the values of B for 2 D35 Cl.	[Level:2]	[CO2, CO3, CO4, CO5, CO6]

(Ceiling: 36 Marks)

Part C (Essay questions)

Answer any ***one*** question. The question carries 10 marks.

19.	Discuss particle diffraction in the context of de Broglie waves. Explain how it demonstrates wave–particle duality and mention applications	[Level:2]	[CO2]
20.	(a) Define Einstein's coefficients? (b) Explain absorption, spontaneous emission, and stimulated emission with suitable diagrams.	[Level:2]	[CO5]

(1 × 10 = 10 Marks)

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