12A

D5BPH1702 (S3) (PAGES 2) **Reg. No.....**

Name: .....

FIFTH SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2022

(Supplementary – 2017 Admission)

PHYSICS

APHY5B07T: QUANTUM MECHANICS

Time: 3 Hours **Maximum Marks: 80**

SECTION A: Answer *all* questions. Each carries 1 mark.

1. If the value of Compton wavelength is λ_c, the maximum Compton wavelength change is _____
2. For $l = 2$, the orbital angular momentum L is _____
3. Write down uncertainty principle-I
4. Orbital angular momentum quantum number can have the values _____
5. Operator correspondence of energy is _____
6. According to Rayleigh-Jeans formula for black body spectrum, the energy density is proportional to _____
7. What is the magnitude of angular momentum due to spin of an electron?
8. Write down the possible values of magnetic quantum number.

(8 × 1 = 8 Marks)

SECTION B: Answer any *six* questions. Each carries 4 marks.

9. Derive steady state Schrodinger equation from time dependent Schrodinger equation
10. Write a short note on scanning tunnelling microscope.
11. Show that group velocity is particle velocity.
12. Distinguish between normal and anomalous Zeeman effect.
13. Explain working of electron microscope using a diagram.
14. What are eigen values and eigen functions?
15. What is meant by normalized and orthogonal wave functions?
16. Show that pair production cannot occur in empty space.
17. Explain Bohr radius of a hydrogen atom. Give the expression for radius of orbits in terms of Bohr radius.

(6× 4 = 24 Marks)

(PTO)

SECTION C: Problems: Answer any *eight* questions. Each carries 4 marks

18. The average period that elapses between the excitation of an atom and the time it emits the radiation is 10^{-9} sec. Determine the width of the excited state.
19. A photon of energy 1.02 MeV undergoes a Compton scattering through 180°. Calculate the energy of the scattered photon.
20. Calculate the energy (in eV) and momentum of an X-ray photon of wavelength 2 Å.
21. Find the expectation value of the momentum of a particle enclosed in a one-dimensional box.
22. A sample of a certain element is placed in a 0.2 T magnetic field and suitably excited. How far apart are the Zeeman components of 450 nm spectral lines of this element?
23. What voltage must be applied to an electron microscope to produce electrons of wavelength of 1.5 Å?
24. Calculate the excitation energy for n = 3 of He^+ atom.
25. Calculate the energy difference between the ground state and first excited state for an electron in one dimensional rigid box of length 10^{-14} m.
26. Calculate the de Broglie wavelength of an electron having kinetic energy of 100 eV.
27. An eigen function of the operator d^2/dx^2 is e^{2x}. Find the corresponding eigen value.
28. What is the shortest wavelength emitted by Balmer series in hydrogen spectrum?
29. What potential difference must be applied to stop fastest photoelectrons emitted by a surface when electromagnetic radiation of frequency 2.5 x 10^{15} Hz is allowed to fall on it. The work function of the surface is 5eV.

(8 × 4 = 32 Mar

SECTION D: Answer any *two* questions. Each carries 8 marks.

30. Describe Stern-Gerlach experiment for verification of space quantisation.
31. Explain Bohr's theory of Hydrogen atom and discuss the spectral series.
32. Obtain the eigen values, normalized eigen functions and probability densities of a particle confined in a one-dimensional rectangular box with infinitely hard walls.
33. Describe Davisson and Germer experiment for the study of diffraction of electrons and show that the results of this experiment are closely in agreement with de Broglie wavelength of electrons.

(2 × 8 = 16 Marks)