



LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – PHYSICS

SIXTH SEMESTER – NOVEMBER 2013

PH 6609/6605/6603/6600 – QUANTUM MECHANICS AND RELATIVITY

Date : 08/11/2013
Time : 1:00 - 4:00

Dept. No.

Max. : 100 Marks

SECTION - A

Answer **ALL** questions:

(10 × 2 = 20 Marks)

1. What is a matter wave?
2. State Heisenberg's uncertainty principle.
3. What is the physical interpretation of wave function?
4. State Ehrenfest theorem.
5. What do you mean by eigenfunctions and eigenvalues?
6. Show that $[x, p_x] = i \hbar$.
7. What are inertial and non-inertial frames?
8. The total energy of a particle is exactly twice its rest energy. Calculate its speed.
9. State the postulates of general theory of relativity.
10. What do you understand by inertial mass and gravitational mass.

SECTION – B

Answer any **FOUR** questions:

(4 × 7.5 = 30 Marks)

11. Describe the construction and working of an electron microscope.(3 ½ +4)
12. (a) What is tunnel effect?(2 ½)
(b) Explain alpha decay. (5)
13. (a) Give the postulates of quantum mechanics.(3)
(b) Prove that eigenvalues of a Hermitian operator are real.(4½)
14. (a) Discuss the significance of mass-energy relationship.(3½)
(b) Explain the relationship with two illustrative examples.(2+2)
15. Discuss the bending of light in a gravitational field.

SECTION – C

Answer any **FOUR** questions:

(4 × 12.5 = 50 Marks)

16. Describe the experiment of G.P. Thomson on the diffraction of electron and explain the results obtained. (10+2½)
17. Establish Schrödinger's equation for a linear harmonic oscillator and solve it to obtain its eigenvalues and eigenfunctions.

18. Write the Schrödinger equation for a rigid rotator. Find its eigenvalues and eigenfunctions.
19. (a) Deduce the formula for relativistic variation of mass with velocity. (9)
(b) Establish the relation $E^2 = p^2c^2 + m_0^2c^4$ for a particle of rest mass m_0 , momentum p and total Energy E . (3½)
20. Write notes on: (i) Einstein's gravitational law. (6)
(ii) Gravitational Red Shift. (6½)

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