STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086.
(For candidates admitted during the academic year 2004-05)

SUBJECT CODE : **PH/MC/QM64**

B.Sc. DEGREE EXAMINATION APRIL 2007
BRANCH III - PHYSICS
SIXTH SEMESTER

REG. No._____

COURSE : **MAJOR – CORE**
PAPER : **QUANTUM MECHANICS**
TIME : **30 MINS.** MAX. MARKS : 30

SECTION - A

TO BE ANSWERED IN THE QUESTION PAPER ITSELF

ANSWER ALL QUESTIONS: (30 x 1 = 30)

I CHOOSE THE CORRECT ANSWER:

1. The uncertainty principle is the direct consequence of
   a) Bohr's correspondence principle b) dual nature of matter
   c) dual nature of waves

2. For a wave group associated with a moving particle, the particle velocity is _____ the group velocity
   a) equal to b) greater than c) less than

3. The wave function for a bound system
   a) remains constant throughout
   b) shoots up to a large value at the boundaries
   c) vanishes at the boundaries

4. The operator for velocity is
   a) $-i\hbar\nabla$ b) $\frac{-i\hbar}{m}\nabla$ c) $i\hbar/m$

5. The energy eigen value of a free particle can range from
   a) $-\infty$ to $+\infty$ b) $-\infty$ to 0 c) 0 to $+\infty$

6. An electron bound to a nucleus in an atom can be compared to
   a) a free particle b) a particle in a box
   c) a linear harmonic oscillator

7. The least energy of a particle in a one-dimentional box is
   a) zero b) $\pi^2\hbar^2/2mL^2$ c) $3\pi^2\hbar^2/2mL^2$

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8. A beam of particles with energy E, impinges on a potential step of height V_0 and $E>V_0$. The fraction of the particles transmitted is given by

a) $\frac{4\alpha\beta}{(\alpha+\beta)^2}$ b) $\frac{4^2\alpha\beta^2}{(\alpha+\beta)^2}$ c) $\frac{(\alpha-\beta)^2}{(\alpha+\beta)^2}$

9. The tunneling through a potential barrier increases if
a) the height and the width of the barrier increased
b) the height and the width are reduced
c) the height is reduced but the width is increased

10. The zero point energy of a linear harmonic oscillator of frequency 50 Hz is
a) $3.31\text{x}10^{-32}$ J b) $0.86\text{x}10^{-32}$ J c) $1.66\text{x}10^{-32}$ J

11. The n^{th} energy level of Hydrogen atom is _____ fold degenerate.
a) n b) 2n+1 c) n^2

12. The commutator of position and momentum operators is
a) $\hbar/i$ b) $-\hbar/i$ c) $-i\hbar$

13. The momentum operator is
a) self adjoint b) unitary c) singular

14. The eigen functions of a Hermitian operator belonging to different eigen values are
a) normalized b) orthogonal c) orthonormal

15. If A and B are two Hermitian operators, their product AB is also Hermitian only if A and B
a) commute b) do not commute
c) are inverse of each other

II STATE WHETHER TRUE OR FALSE:

16. The wave function is said to be normailzed if $\int \Psi^* \Psi d\tau = 0$

17. The function $\Psi = e^{-|x|}$ is an acceptable wave function.

18. A linear operator is the one, which commutes with the Hamiltonian.

19. A unitary operator can be constructed from a Hermitian operator.

20. The energy eigen value of a rigid rotator is given by $h^2\ell(\ell+1)/8\Pi^2 I$

III FILL IN THE BLANKS:

21. Davisson and Germer's experiment is an evidence of _____.

22. If a state of a system is given by a normalized wave function Ψ , the expectation value of total energy is <E> = _____.

23. The condition for a set of functions to be orthogonal wave functions is _____.

24. The spacing between any two successive energy levels of a linear harmonic oscillator is _____.

25. An example of spherically symmetric potential is _____.

IV ANSWER THE FOLLOWING:

26. Why wave nature of matter is not apparent in our daily observations?

27. State the correspondence principle.

28. Give Max Born's interpretation of wave function.

29. What is degeneracy?

30. What are ladder operators?

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