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Reg. No. : .....

Name : .....

Fifth Semester B.Sc. Degree Examination, December 2014
First Degree Programme under CBCSS
PHYSICS
Core Course – VI
PY 1542 : Quantum Mechanics

Time : 3 Hours Weight : 30

SECTION – A

This Section contains **four** bunches **each** of **four** questions. Answer **all** questions. **Each** bunch carries a weightage of **one**.

I. Choose the correct answer :

1) A free particle is one for which ?

a) P. E = 0 b) K. E = 0

c) K.E can be anything d) total energy is discrete

2) The concept of matter waves was first put forward by

a) Heisenberg b) Schrodinger

c) De Broglie d) None of the above

3) The square of a Hermitian operator is

a) Non - Hermitian b) Hermitian

c) Singular d) Parity operator

4) The wave function in the region of infinite potential is

a) infinite b) Oscillatory

c) finite d) zero

P.T.O.

II. 5) Name the principle in quantum mechanics, which explains, that electrons do not exist inside the nucleus.

6) Write down the K.E. operator in Schrodinger formalism.

7) Write down the orthogonal property of eigen function.

8) Name the principle which explains that in the limit $h \rightarrow 0$, quantum mechanical results reduce to classical results.

III. Fill in the blanks :

9) Lowest energy of a one dimensional harmonic oscillator is _____

10) The eigen values of a Hermitian operator are _____ (real / imaginary / complex)

11) _____ effect provides explanations for the phenomena such as emission of electron when light falls on surfaces.

12) According to Einstein electromagnetic waves consist of tiny packets of energy called _____

IV. State whether the following statements are **true** or **false** :

13) Group velocity of the wave packet is same as that of the particle velocity.

14) Uncertainty principle limits the equivalence of quantum and classical mechanics.

15) Eigen functions belonging to distinct eigen values are orthogonal.

16) The physical meaning of normalisation of wave function of a particle is that the wave function is continuous every where.

SECTION – B

Answer **any eight** questions. **Each** question carries a weightage of **one**.

17) What is black body radiation ?

18) Define group velocity and phase velocity.

19) Obtain the commutation relation between Hamiltonian and momentum for a free particle.

20) What can you conclude from the study of photoelectric effect.

21) Explain energy levels of hydrogen atom.

22) What is probability current density ?

23) Define the expectational value of a physical quantity.

24) What is the use of eigen value equation ?

25) What is Compton effect ?

26) What are stationary states ?

27) What are operators ? Give examples.

28) State any two postulates of quantum mechanics.

SECTION – C

Answer **any five** questions. **Each** question carries a weightage of **two**.

29) Calculate the work function in electron volt for sodium metal given that photo electric threshold wavelength is 6800 $\mathring{A}$.

30) Determine the velocity and kinetic energy of a neutron having de Broglie wavelength 1 $\mathring{A}$ (mass of neutron = 1.67×10^{-27} kg, $h = 6.626 \times 10^{-34}$ J – S).

31) Show that momentum operator is Hermitian.

32) The P.E of a simple harmonic oscillator of mass m, oscillating with angular frequency ω is $V(x) = \frac{1}{2} m\omega^2 x^2$. Write the time – independent Schrodinger equation for a S. H. oscillator.

33) What voltage must be applied to an electron microscope to produce electrons of wavelength 1 $\mathring{A}$.

34) Show that if ψ is an eigen function of linear operator A with an eigen value $\wp$, then $k\Psi$ is also an eigen function of A with the same eigen value.