

1180

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Name.....

Reg. No.....

FIFTH SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2011

(CCSS)

Physics—Core Course

PH5B10—QUANTUM MECHANICS

Three Hours

Maximum : 30 Weightage

Section A

Answer all questions.

Planck's radiation formula in terms of wavelength is :

Bohr's quantum condition is :

Einstein's photoelectric equation is \_\_\_\_\_.

The operator correspondence of linear momentum.

The shift in the wavelength in Compton effect depends on :

- (a) Only on the energy of the incident photon.
- (b) Only on the scattering angle.
- (c) Scattering angle as well as energy of the incident beam.
- (d) None of the above.

A Particle whose wave function is given by  $\psi = ax$  is limited to the  $x$ -axis between  $x = 0$  and  $x = 1$ .

The expectation value  $\langle x \rangle$  of the particle is :

- (a)  $\frac{a^2}{4}$
- (b)  $a$
- (c)  $\frac{a}{2}$
- (d)  $0.5$

The ionization potential of hydrogen atom :

- (a)  $-13.6$  ev.
- (b)  $+13.6$  ev.
- (c)  $+1.36$  ev.
- (d)  $-1.36$  ev.

For particle in a box, the quantum number dependence on energy eigen value is :

- (a)  $E_n \propto n$
- (b)  $E_n \propto n^2$
- (c)  $E_n \propto \frac{1}{n^2}$
- (d)  $E_n \propto \frac{1}{n}$

Turn over

9. Write time dependent Schrodinger's equation.
10. Write down the expression for energy eigen value of a one dimensional quantum harmonic oscillator.
11. Write down the Balmer's formula.
12. Who experimentally verified the existence of electromagnetic waves.

(12 × ¼ = 3 weightage)

### Section B

*All questions are compulsory.*

13. Classical theory fails to explain photoelectric effect Explain.
14. Explain Pair production.
15. Write down Heisenberg's uncertainty principle.
16. Write down Bohr's correspondence principle.
17. What are Hermitian operator? Give one example.
18. Does the concept of Bohr orbit violate Heisenberg's uncertainty principle?
19. Write down Pauli's exclusion principle.
20. What is the importance of Frank-Hertz experiment?
21. What is meant by expectation value.

(9 × 1 = 9 weightage)

### Section C

*Answer any five questions.*

22. Write down Bohr's postulates and explain spectral series.
23. Briefly explain Davisson and Germer's experiment.
24. Obtain time independent Schrodinger's equation from time dependent form.
25. Show that the de-Broglie wavelength of a particle of rest mass  $m_0$  and kinetic energy  $T$  is  $\lambda = \frac{hc}{\sqrt{T(T + 2m_0c^2)}}$ .

$$\lambda = \frac{hc}{\sqrt{T(T + 2m_0c^2)}}$$

26. Show that  $\langle \hat{p}_x \rangle$  is real and hence linear momentum operator is Hermitian.
27. Show that the eigenfunctions of particle in one dimensional box are orthogonal.
28. A sample of a certain element is placed in a 0.300 T magnetic field and suitably excited. How far apart are the Zeeman components of 450 nm spectral line of this element.

(5 × 2 = 10 weightage)

**Section D**

*Answer any two questions.*

Explain Compton effect and derive the expression for Compton shift.

Write and explain postulates of Quantum mechanics.

Write down the Schrodinger's equation for linear Harmonic Oscillator and derive the expression for energy eigen value.

(2 × 4 = 8 weightage)