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Reg. No. : .....

Code No. : 41133 E Sub. Code : JMPH 63

B.Sc. (CBCS) DEGREE EXAMINATION, APRIL 2019.

Sixth Semester

Physics – Main

QUANTUM MECHANICS

(For those who joined in July 2016 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer.

1. From a black body the value of energy released at any wavelength \_\_\_\_\_ with increase in temperature.
- (a) constant
  - (b) decreases
  - (c) increases
  - (d) none

2. When the angle of scattering is 90 degree, the Compton shift  $d\lambda$  is = \_\_\_\_\_.

- (a)  $\frac{h}{m_0 c^2}$
- (b)  $\frac{h}{m_0 c}$
- (c)  $\frac{h^2}{m_0 c}$
- (d) none

3. The wave velocity is also called as \_\_\_\_\_ velocity.

- (a) angular
- (b) linear
- (c) phase
- (d) group

4. If  $k$  is the propagation constant, the momentum  $p$  of a particle is given by \_\_\_\_\_.

- (a)  $\frac{h}{k}$
- (b)  $\frac{k}{h}$
- (c)  $hk$
- (d) none



5. According to Heisenberg Uncertainty principle,

\_\_\_\_\_.

(a)  $\Delta x \Delta t \geq \hbar$

(b)  $\Delta x \Delta p \geq \hbar$

(c)  $\Delta x \Delta E \geq \hbar$

(d) none

6. The value of Planck's constant is \_\_\_\_\_.

(a)  $6.626 \times 10^{-14} \text{ JS}$

(b)  $6.626 \times 10^{14} \text{ JS}$

(c)  $6.626 \times 10^{-34} \text{ JS}$

(d) none

7. The potential energy of a free particle in a time independent Schrodinger equation is \_\_\_\_\_.

(a)  $V$

(b)  $0$

(c)  $2V$

(d) none

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8. The value of the commutation bracket  $[x, p_x] =$

(a)  $0$

(b)  $1$

(c)  $i\hbar$

(d)  $-i\hbar$

9. The energy of a particle in a 1-D box is \_\_\_\_\_.

(a)  $\frac{8n^2\hbar^2}{ma^2}$

(b)  $\frac{n^2\hbar^2}{8ma^2}$

(c)  $\frac{\pi^2\hbar^2}{8ma^2}$

(d) none

10. The alpha particle is a nucleus of \_\_\_\_\_.

(a)  ${}^1_1\text{H}$

(b)  ${}^4_2\text{He}$

(c)  ${}^2_4\text{Li}$

(d) none

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PART B — ( $5 \times 5 = 25$  marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Define Photoelectric effect. Give Einsteins explanation for Photoelectric effect.

Or

- (b) State and explain Rayleigh-Jeans law.

12. (a) Derive the expression for group velocity of a wave packet.

Or

- (b) Calculate the deBroglie wavelength of electron accelerated by a voltage of 10000 V.

13. (a) Explain the Heisenberg uncertainty relation between energy and time.

Or

- (b) What are the consequences of Heisenberg uncertainty principle?

14. (a) What are the basic postulates of quantum mechanics?

Or

- (b) Explain the orthogonality of energy Eigen function.

15. (a) Explain Tunnel effect through a rectangular barrier.

Or

- (b) Discuss in detail about particle in one dimensional box.

PART C — ( $5 \times 8 = 40$  marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 600 words.

16. (a) Explain the inadequacy of classical mechanics. What are the observations of black body radiation?

Or

- (b) State Compton effect. Derive the formula for shift in wavelength during Compton scattering.





17. (a) Derive the deBroglie relation for wavelength of a moving particle with the velocity. What are the properties of deBroglie waves?

Or

- (b) Describe Davison and Germer's experiment on electron diffraction.

18. (a) State and prove Heisenberg Uncertainty principle.

Or

- (b) Illustrate Heisenberg uncertainty principle by Thought experiment.

19. (a) Derive time independent 1-D Schrodinger wave equation.

Or

- (b) Obtain the Schrodinger wave equation for the complex conjugate wave function.

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20. (a) Explain the emission of alpha particles from a radioactive element.

Or

- (b) Discuss in detail about 1-D simple harmonic oscillator in quantum mechanics.
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