Quantum Computing and Modern Physics (PHY102)

(For All IT Streams)
Unit-I : Quantum Mechanics

MCQ's

1. An experimental evidence for matter waves is
   (a) photoelectric effect
   (b) compton effect
   (c) electron diffraction
   (d) interference of light
   Ans: c

2. A wave packet is used to represent
   (a) A light wave
   (b) a stationary wave
   (c) Matter wave
   (d) a transverse wave
   Ans: c

3. Wave function associated with matter waves is a quantum mechanical equivalent of
   (a) wavelength of the wave
   (b) frequency of the wave
   (c) amplitude of the wave
   (d) phase of the wave
   Ans: c

4. The concept of matter wave was suggested by_____
   (a) Heisenberg (b) de Broglie (c) Schrodinger (d) Laplace
   Ans: b

5. The function representing matter waves must be _____

(a) complex (b) real (c) zero (d) infinity

Ans: a

6. A particle with rest mass m_o is moving with speed c. The de-broglie wavelength associated with it is

(a) zero (b) infinity (c) $h\gamma/c^2$ (d) m_oc

Ans: a

7. The matter waves are

(a) light waves (b) sound waves (c) probablistic waves (d) e.m.waves

Ans: c

8. The wavelength of matter waves does not depend on

(a) charge (b) mass (c) velocity (d) momentum

Ans: a

9. de Broglie wave length of a body of mass m and kinetic energy E is given by:

(a) $\lambda = \sqrt{2meV}/ h$ (b) $\lambda = h / meV$ (c) $\lambda = h / \sqrt{2meV}$ (d) $\lambda = h/2meV$

Ans: c

10. If the energy of a particle is reduced to one-fourth then the percentage increase in the de-broglie wavelength is

(a) 41% (b) 100% (c) 144% (d) 70%

Ans: b

11. The kinetic energy of electron and proton is the same. The relation between their de-broglie wavelengths λ_e and λ_p is

(a) $\lambda_e = \lambda_p$ (b) $\lambda_e < \lambda_p$ (c) $\lambda_e > \lambda_p$ (d) $\lambda_e = 2\lambda_p$

Ans: c

12. The wave nature associated with electrons in motion was verified by

(a) Photoelectric effect

(b) Compton effect

(c) Diffraction by crystals

(d) incidence of electrons on metallic surface

Ans: c

13. …… of a wave is the velocity with which variations in the shape of modulation or envelop of the wave propagate through space.

a) The elliptical velocity
b) The phase velocity
c) The group velocity
d) The circular velocity

Ans: c

14. The phase and group velocities does not depend on which of the following?

(a) Frequency (b) Wavelength (c) Phase constant (d) Attenuation constant

Ans: d

15. de Broglie wavelength can be assigned to

(a) only electrons
(b) any stationary body
(c) any moving body
(d) only subatomic particles

Ans: c

16. Which one of the following objects, moving at the same speed, has the greatest de Broglie wavelength?

(a) Neutron
(b) Electron
(c) Tennis ball
(d) Foot ball

Ans: b

17. The group velocity of matter waves associated with a moving particle is:

a) The same as phase velocity
b) Less than the particle velocity
c) Equal to the particle velocity

d) More than the particle velocity

Ans: c

18. Uncertainty principle is applicable to

(a) Macroscopic particles

(b) Microscopic particles

(c) gases

(d) None

Ans: b

19. According to Heisenberg uncertainty principle,

(a) $E = mc^2$ (b) $\Delta x \times \Delta p >= h/4\pi$ (c) $\lambda = h / p$ (d) $\Delta x \times \Delta p = h/6\pi$

Ans: b

20. If uncertainty in the position of an electron is zero, the uncertainty in its momentum would be

(a) zero (b) $< h/ 2\lambda$ (c) $> h/ 2\lambda$ (d) Infinite

Ans: d

21. How is the state of a quantum mechanical system completely specified?

a) By its position in space
b) By its time
c) By its wavefunction
d) By its angular momentum

Ans: c

22. The wave function is an acceptable wave function if it is

(a) finite everywhere

(b) continous everywhere

(c) single valued everywhere

(d) having all these properties

Ans: d

23. Schrodinger's time independent equation is applicable for the particles with

(a) constant energy

(b) variable energy

(c) only constant potential energy

(d) all of these

Ans: a

24. The Steady-state form of Schrodinger wave equation is _____

(a) Linear (b) Quadratic (c) Cubic (d) Nonlinear

Ans: a

25. The values of Energy for which Schrodinger's steady state equation can be solved is called as

(a) Eigen Vectors (b) Eigen Values (c) Eigen Functions (d) Operators

Ans: b

26. The Schrodinger wave equation is a

a.) Linear differential equation

b.) Non-linear differential equation

c.) Second-order equation

d.) First-order equation

Ans: a

27. For a quantum wave particle, E = _____

(a) $\hbar$ k (b) $\hbar$ ω (c) $\hbar$ ω/2 (d) $\hbar$ k/2

Ans: b

28. Which of the following can be a wave function?

(a) tan x (b) sin x (c) cot x (d) sec x

Ans: b

29. Which of the following is not a characteristic of wave function?

(a) Continuous (b) Single valued (c) Normalizable (d) Multi valued

Ans: d

30. The total probability of finding the particle in space must be _____

(a) zero (b) unity (c) infinity (d) double

Ans: b

31. The normalized wave function must have _____ norm

(a) Unit (b) zero (c) finite (d) infinite

Ans: a

32. The square of the magnitude of the wave function is called_____

(a) current density (b) probability density (c) Normalization (d) volume density

Ans: b

33. According to the wave function and it first partial derivative should be _____ functions for all values of X

(a) Zero (b) Continous (c) Infinity (d) Discontinous

Ans: b

34. For E > 0, the particle has a _____ kinetic energy

(a) Zero (b) Positive (c) Negative (d) Infinity

Ans: b

35. According to Max Born's interpretation, $|\psi|^2$ represents

(a) energy density

(b) particle density

(c) probability density

(d) charge density

Ans: c

36. In a one dimensional infinite potential well, energy of the particle En =

(a) $n^2h^2/8mL^2$ (b) $n^2\hbar^2/8mL^2$ (c) $n^2h^2/2mL^2$ (d) $n^2h^2/4mL^2$

Ans: a

37. The energy corresponding to the lowest permitted energy level for a particle in an infinite potential well is called

(a) Excited energy

(b) Zero point energy

(c) Metastable state energy

(d) None of these

Ans: b

38. For a particle in the ground state in an one-dimensional potential well of width L and of infinite height, the probability of finding it will be maximum at a distance of

(a) L/2 from the wall

(b) L/4 from the wall

(c) 3L/4 from the wall

(d) L=0 from the wall

Ans: a

39. According to the particle in a box, the wave function of the particle lies in which region?

(a) $x > 0$ (b) $x < 0$ (c) $0 < x < L$ (d) $x > L$

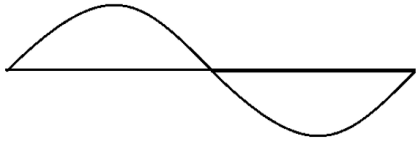
Ans: c

40. The Energy of the particle is proportional to _____

(a) n (b) n^{-1} (c) n^2 (d) n^{-2}

Ans: c

41. The wave function shown in the figure for which quantum state corresponding to



(a) Ground state (b) First excited state (c) Second excited state (d) Third excited state

Ans: b

42. The de Broglie wavelength associated with a particle of mass 6.62×10^{-29} kg travelling with a velocity 10^5 ms^{-1} is equal to

(a) 10 nm

(b) 1 nm

(c) 0.1 nm

(d) 0.01nm

Ans: c

43. What is the energy of electron in terms of its ground state energy (E_1) when it jumps from n = 1 to n = 4 is

(a) $E_1/9$

(b) $E_1/16$

(c) 16 E_1

(d) 4 E_1

Ans: c

44. An electron is trapped in a one dimensional potential well of width 1 Å. How much energy must be supplied to excite the electron from the ground state to second excited state?

(a) 4.82×10^{-17} J

(b) 4.82×10^{-18} J

(c) 1.81×10^{-17} J

(d) 1.81×10^{-18} J

Ans: a

45. Calculate the deBroglie wavelength associated with an electron with a kinetic energy of 2000 eV is

(a) 2.74 Å (b) 0.274 Å (c) 27.4 Å (d) 0.0274 Å

Ans: b

46. The product of phase velocity and group velocity is equal to

a) particle velocity b) velocity of light

c) square of velocity of light d) square root of velocity of light.

Ans: c

47. Calculate the Zero-point energy for a particle in an infinite potential well for an electron confined to a 1 nm atom.

(a) 3.9×10^{-29} J (b) 4.9×10^{-29} J (c) 5.9×10^{-29} J (d) 6.9×10^{-29} J

Ans: c

48. The de Broglie wavelength associated with an electron moving with a speed of 10^5m/s

(a) 0.727 Å (b) 7.27 Å (c) 72.7 Å (d) 727 Å

Ans: c

49. The ratio of energy of a photon with that of a neutron when both are associated with wavelength of 1 Å., given that the mass of neutron is 1.678×10^{-27} Kg.

(a) 2.5×10^5 (b) 1.5×10^5 (c) 0.5×10^5 (d) 3.5×10^5

Ans: b

50. An electron is confirmed to move between two rigid walls separated by 20 Å. The de Broglie wavelength representing the groun state energy of an electron is (assume the potential to be zero)

(a) 0.6 Å (b) 0.2 Å (c) 0.4 Å (d) 0.8 Å

Ans: c

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