Government College of Engineering & Research

Avasari Khurd, Tal. Ambegaon Dist. Pune-412405

MCQ on UNIT III

Class:Fist Year Branch: Computer Engineering

Subject:Engineering Physics (107002)

Instructions:

1. Attempt all questions.
2. Each correct answer carries 1 marks.

---

1. An electron and proton have the same de-Broglie wavelength. Then the kinetic energy of the electron is
   (a) Zero
   (b) Infinity
   (c) Equal to the kinetic energy of the proton
   (d) Greater than the kinetic energy of the proton
2. The concept of matter wave was suggested by
   (a) Heisenberg (b) De Broglie (c) Schrodinger (d) Laplace
3. If an electron and proton have the same de-Broglie wavelength then the relation between kinetic energy of the electron of proton is..
   (a) KE electron = KE Proton (b) KE proton > KE electron
   (c) KE electron > KE proton (d) KE electron = 2 KE proton
4. If the kinetic energies of an electron, a proton a neutron and an alpha particle is identical, then who's de-Broglie wavelength will be maximum
   (a) Electron (b) Proton (c) alpha -particle (d) Neutron
5. A particle which has zero rest mass and non-zero energy and momentum must travel with a speed.
   (a) Equal to C, the speed of light in vacuum
   (b) Greater then C
   (c) Less then C
   (d) Tending to infinity

6. The wavelengths of a photon, an electron and uranium atom are identical. Which of then will have highest energy.
   (a) Photon
   (b) Electron
   (c) Uranium nucleus
   (d) Depends on wavelength and property of particles

7. If there is an increase in linear dimensions of the object, the associated de-Broglie wavelength.
   (a) Increases (b) Decreases
   (c) Remains unchanged (d) Depends on the density of object

8. Matter waves are
   (a) Electromagnetic waves (b) Longitudinal waves
   (c) Probability waves (d) Transverse waves

9. The scanning tunneling microscope (STM) works on the principle of
   (a) Particle theory (b) Matter wave concept
   (c) Uncertainty (d) All of the above

10. If the energy of a particle is reduced to half then the percentage increase in the de-Broglie wavelength is about.
    (a) 41% (b) 50% (c) 29% (d) 100%

11. The wavelength of de Broglie waves is independent of:
    (a) charge (b) momentum (c) velocity (d) mass

12. A particle of mass m kg and charge q coulomb is accelerated from rest through V volt; then the de Broglie wavelength associated with it is given by:
    (a) $\lambda = \frac{h}{\sqrt{2mq}}$ (b) $\lambda = \frac{h}{\sqrt{2mqV}}$ (c) $\lambda = \frac{2mqV}{\sqrt{h}}$ (d) $\lambda = \frac{\sqrt{2mqV}}{h}$

13. The correct relationship between phase and group velocity of material particle if it is moving with non relativistic velocity $(v < c)$
    (a) $V_p = V_g/2$ (b) $2V_p = V_g$ (c) $V_p = V_g$ (d) $V_p = \sqrt{V_g/2}$

14. If De Broglie wavelength of proton and alpha particle are same the ratio of their velocities will be.
    (a) 1:4 (b) 4:1 (c) 1:2 (d) 1:3

15. Which one of the following particle has highest wavelength if all are moving with equal velocity.
    (a) Proton (b) aplha particle (c) neutron (d) electron

16. The de broglie wavelength of material particle in thermal equilibrium at temperature T is proportional to ..

(a) T (b) $T^{1/2}$ (c) T^{-2} (d) $T^{-1/2}$

17. If kinetic energy (E_K) and mass (m) of material particle are known then its De Broglie wavelength is given by relation.

(a) $\lambda = \frac{h}{\sqrt{mE_K}}$ (b) $\lambda = \frac{h^2}{\sqrt{2mE_K}}$ (c) $\lambda = \frac{h}{\sqrt{2mE_K}}$ (d) $\lambda = \frac{h}{\sqrt{mE_K^2}}$

18. The total probability of finding material particle in given space must be — for wave function to be normalized.

(a) zero (b) infinity

(c) unity (d) nothing can be said

19. The square of magnitude of the wave function is called

(a) current density (b) probability density

(c) volume density (d) mass density

20. which of the following are properties of well behaved wave functions.

(a) Normalized, single valued,finite and continuous in region where defined

(b) Normalized, single valued,infinite and continuous in region where defined

(c) Normalized, single valued,finite and non-continuous in region where defined

(d) Non normalized, single valued,infinite and continuous in region where defined

21. The operator Δ^2 is called——-operator

(a) Hamiltonian (b) differentiation (c) Laplacian (d) Poisson

22. Wave function associated with a material particle should be:

(a) finite (b) single valued (c) continuous (d) all of the above

23. Electrons behaves as waves because they can be:

(a) Deflected by an electric field (b) Diffracted by a crystal

(c) Deflected by magnetic field (d) They ionize a gas

24. If the momentum of a particle is increased by four times, the de-Broglie Wave length

(a) 2λ (b) 4λ (c) $\lambda/4$ (d) λ^2

25. Group velocity of wave is equal to

(a) Velocity of light (b) phase velocity

(c) particle velocity (d) none of the above

26. If electron is accelerated through 25 volts de-Brogile wave length of an electron is

(a) 2.452 A^o (b) 0.49 A^o (c) 24.52 A^o (d) .2452 A^o

27. Which of the following statement is correct for matter waves
   (a) Matter waves travel slower than velocity of light
   (b) Matter waves travel at velocity of light
   (c) Matter waves can not travel
   (d) Matter waves travel faster than velocity of light

28. Why the wave property of large, massive objects is not observed
   (a) their speeds are too small (b) their momenta are too small
   (c) their acceleration is too small (d) their mass is very high

29. The velocity with which wave group travels is known as
   (a) phase velocity (b) wave velocity
   (c) group velocity (d) none of the above

30. Relations for group velocity and phase velocity are
   (a) $V_g = \frac{w}{k}$ & $V_p = \frac{dw}{dk}$ (b) $V_g = \frac{dw}{dk}$ & $V_p = \frac{k}{w}$
   (c) $V_g = \frac{dw}{dk}$ & $V_p = \frac{w}{k}$ (d) $V_g = \frac{w}{2k}$ & $V_p = \frac{2dw}{dk}$

31. The Heisenbergs uncertainty principle is represented by
   (a) $\Delta P \times \Delta q \geq \hbar$ (b) $\Delta X \times \Delta P \geq \hbar$ (c) $\Delta m \times \Delta t \geq \hbar$ (d) $\Delta X \times \Delta P \leq \hbar$

32. If uncertainty in position and momentum are equal and $\hbar = h/4\pi$ then uncertainty in velocity is
   (a) $\frac{1}{2m}\sqrt{\frac{h}{\pi}}$ (b) $\frac{h}{2\pi}$ (c) $\frac{1}{m}\sqrt{\frac{h}{\pi}}$ (d) $\frac{h}{4\pi}$

33. If position uncertainty of electron is zero then its momentum is
   (a) infinity (b) zero (c) $< h/2\pi$ (d) $> h/2\pi$

34. If uncertainty in position measurement of electron is $0.1A^o$ then uncertainty in momentum measurement is
   (a) $1.158x10^8$m/s (b) $1.158x10^9$m/s (c) $1.158x10^6$m/s (d) $1.158x10^7$m/s

35. Which among following represents matter waves Mathematically
   (a) Schrodinger equation (b) Bernoulli equation
   (c) Planks equation (d) Boltzman equation

36. Which among following is Schrodinger time independent wave equation
   (a) $\Delta^2\psi + \frac{2m}{\hbar^2}(E-V)\psi = 0$ (b) $\Delta^2\psi - \frac{2m}{\hbar^2}(E-V)\psi = 0$
   (c) $\Delta^2\psi + \frac{m}{\hbar}(E-V)\psi = 0$ (d) $\Delta^2\psi + \frac{2m}{\hbar^2}(E+V)\psi = 0$

37. Which among following represents Schrodinger time dependent wave equation
   (a) $\frac{2m}{\hbar^2}\Delta^2\psi + V\psi = i\hbar\frac{\delta\psi}{\delta t}$ (b) $\frac{\hbar^2}{-2m}\Delta^2\psi + V\psi = i\hbar\frac{\delta\psi}{\delta t}$
   (c) $\frac{-2m}{\hbar^2}\Delta^2\psi + V\psi = i\hbar\frac{\delta\psi}{\delta t}$ (d) $\frac{-m}{\hbar^2}\Delta^2\psi + V\psi = i\hbar\frac{\delta\psi}{\delta t}$

38. Schrodinger wave equation can be used to calculate which of the following for a subatomic particle.

(a) wave function (b) energy (c) probability (d) all above

39. Which among the following is the Laplacian operator in three dimensions

(a) $\frac{\delta^2}{\delta^2 x}+\frac{\delta^2}{\delta^2 y}+\frac{\delta^2}{\delta^2 z}$ (b) $\frac{\delta^3}{\delta^3 x}+\frac{\delta^2}{\delta^2 y}+\frac{\delta^2}{\delta^2 z}$ (c) $\frac{\delta^2}{\delta^2 x}+\frac{\delta^3}{\delta^3 y}+\frac{\delta^2}{\delta^2 z}$ (d) $\frac{\delta^2}{\delta^2 x}+\frac{\delta^2}{\delta^2 y}+\frac{\delta}{\delta z}$

40. The walls of rigid box for a subatomic particle are supposed to be

(a) Small but infinitely hard (b) Soft and Small

(c) Infinitely large but soft (d) Infinitely hard and infinitely large

41. If quantum particle is confined inside a rigid box of length L then,the wave function of the particle lies in which region?

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

42. According to De Broglie hypothesis electron is having wave like behavior and it is confined inside a rigid box then its energy is proportional to

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

43. For a particle inside a rigid box, the potential is maximum at

(a) x=L (b) x=3L (c) x=2L (d) x=L/2

44. The Eigen value of wave function of a particle inside a rigid box of length L is

(a) L/2 (b) 2/L (c) $\sqrt{L/2}$ (d) $\sqrt{2/L}$

45. If a quantum particle is restricted to move inside infinitely rigid box then the minimum energy possessed by particle is

(a) $\frac{\pi^2\hbar^2}{2mL^2}$ (b) $\frac{\pi^2\hbar^2}{4mL^2}$ (c) $\frac{\hbar^2}{2mL^2}$ (d) zero

46. The normalized wave function for a particle inside a rigid box of length 2L is given by

(a) $\sqrt{L/2}sin(\frac{n\pi\ x}{2L})$ (b) $\sqrt{L}sin(\frac{n\pi\ x}{2L})$ (c) $\sqrt{2/L}sin(\frac{n\pi\ x}{L})$ (d) $\sqrt{L}sin(\frac{n\pi\ x}{L})$

47. The probability of finding the particle in infinite potential well of length L in ground state is maximum at

(a) x=L (b) x=L/3 (c) x=L/4 (d) x=L/2

48. If quantum particle is confined inside a non rigid box then probability of finding particle just outside the box is

(a) unity (b) very small (c) zero (d) $>$ 50%

49. In a finite Potential well, the potential energy outside the box is–

(a) Zero (b) Infinite (c) Constant (d) Variable

50. The depletion layer of tunnel diode is very small because–

(a) its abrupt and has high dopants (b) uses positive conductance property

(c) its used for high frequency ranges (d) tunneling effect

51. Tunnel diode is capable of performing very fast operation in which of the following region.

(a) gamma frequency region (b) microwave frequency region

(c) ultraviolet frequency region (d) radio frequency region

52. The tunnel diode is usually used ..

(a) To control the power (b) For rectification

(c) For very high speed of switching (d) For fact chopping

53. Scanning Tunneling Microscope (STM) works on

(a) photoelectric effect (b) Hall effect

(c) Seebeck effect (d) Tunneling effect

54. Which behavior of electron is used in Scanning Tunneling Microscope (STM)

(a) particle like (b) wave like (c) photon like (d) none of above

55. STM is used to scan the surface of material under study about

(a) few meter (b) few A^o (c) few mm (d) few μm

Answer key

1. (d) Greater than the kinetic energy of the proton

2. (b) De Broglie

3. (c) KE electron > KE proton

4. (a) Electron

5. (a) Equal to C, the speed of light in vacuum

6. (b) Electron

7. (b) Decreases

8. (c) Probability waves

9. (b) Matter wave concept

10. (a) 41%

11. (a) charge

12. (b) $\lambda = \frac{h}{\sqrt{2mqV}}$

13. (a) $V_p = V_g/2$

14. (b) 4:1

15. (d) electron

16. (d) $T^{-1/2}$

17. (c) $\lambda = \frac{h}{\sqrt{2mE_K}}$

18. (c) unity

19. (b) probability density

20. (a) Normalized, single valued,finite and continuous in region where defined

21. (c) Laplacian

22. (d) all of the above

23. (b) Diffracted by a crystal

24. (c) $\lambda/4$

25. (c) particle velocity

26. (a) 2.452 A^o

27. (d) Matter waves travel faster than velocity of light

28. (d) their mass is very high

29. (c) group velocity

30. (c) $V_g = \frac{dw}{dk}$ & $V_p = \frac{w}{k}$

31. (a) $\Delta P \times \Delta q \geq \hbar$

32. (a) $\frac{1}{2m}\sqrt{\frac{h}{\pi}}$

33. (a) infinity

34. (d) $1.158x10^7$m/s

35. (a) Schrodinger equation

36. (a) $\Delta^2\psi + \frac{2m}{\hbar^2}(E-V)\psi = 0$

37. (b) $\frac{\hbar^2}{-2m}\Delta^2\psi + V\psi = i\hbar\frac{\delta\psi}{\delta t}$

38. (d) all above

39. (a) $\frac{\delta^2}{\delta^2 x} + \frac{\delta^2}{\delta^2 y} + \frac{\delta^2}{\delta^2 z}$

40. (d) Infinitely hard and infinitely large

41. (b) 0 < X< L

42. (d) n^2

43. (a) x=L

44. (d) $\sqrt{2/L}$

45. (a) $\frac{\pi^2\hbar^2}{2mL^2}$

46. (b) $\sqrt{L}sin(\frac{n\pi\ x}{2L})$

47. (d) x=L/2

48. (b) very small

49. (c) Constant

50. (a) its abrupt and has high dopants

51. (b) microwave frequency region

52. (c) For very high speed of switching

53. (d) Tunneling effect

54. (b) wave like

55. (b) few A^o