Engineering Physics (PH1001-1)
MCQ Questions

Unit-I : Wave Mechanics, Crystallography & X-rays

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. In a waveguide, which of the following condition is true always?

(a) phase velocity = c

(b) group velocity = c

(c) phase velocity > c

(d) phase velocity < c

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. deBroglie 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. Uncertainty principle is applicable to

(a) Macroscopic particles

(b) Microscopic particles

(c) gases

(d) None

Ans: b

18. 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

19. 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

20. 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

21. 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

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

(a) Linear (b) Quadratic (c) Differential equation (d) Derivable

Ans: a

23. 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

24. For a quantum wave particle, E = _____

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

Ans: b

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

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

Ans: b

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

(a) Continuous (b) Single valued (c) Differentiable (d) Physically Significant

Ans: d

27. Any wave function can be written as a linear combination of _____

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

Ans: c

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

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

Ans: b

29. The normalized wave function must have _____ norm

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

Ans: a

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

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

Ans: b

31. 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

32. If the particle moving in a _____ potential then the solution of the wave equation are describe as a stationary states

(a) time independent

(b) time dependent

(c) velocity dependent

(d) velocity independent

Ans: a

33. V_o/Δ is a measure the _____ of the potential

(a) Height (b) Width (c) Strength (d) Length

Ans: c

34. For non-localized states of the square well potential _____

(a) $E = 0$ (b) $E = \alpha$ (c) $E < 0$ (d) $E > 0$

Ans: d

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

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

Ans: b

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

(a) energy density

(b) particle density

(c) probability density

(d) charge density

Ans: c

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

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

Ans: a

38. 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

39. 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

40. The wave function of the particle lies in which region?

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

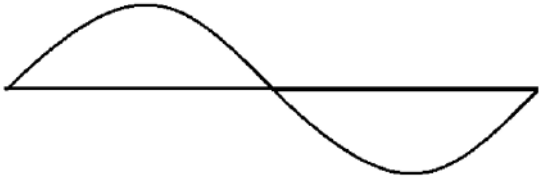
Ans: c

41. The Energy of the particle is proportional to _____

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

Ans: c

42. The wave function for which quantum state is shown in the figure?



(a) 1 (b) 2 (c) 3 (d) 4

Ans: b

43. 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

44. 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

45. 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

46. 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

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 x10^{-29} J (b) 4.9 X 10^{-29} J (c) 5.9 X 10^{-29} J (d) 6.9 X 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: a

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 x 10^{-27} Kg.

(a) 2.5 x10^5 (b) 1.5 X 10^5 (c) 0.5 X 10^5 (d) 3.5 X 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: d

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UNIT – I: Crystallography & X-rays

1. If the atoms or molecules in a solid are periodical at regular intervals of distances in three dimensions, then that solid is known as:
   (a) crystalline solid
   (b) amorphous solid
   (c) liquid crystals
   (d) none

   Ans: (a)

2. The smallest portion of a crystal which when repeated in different directions generates the entire crystal is called:
   a) Lattice points
   b) Crystal lattice
   c) Unit cell
   d) None of the mentioned

   Ans: (c)

3. The complete three-dimensional arrangement of particles within a crystal is known as the _____, while the smallest repeating unit in the lattice is called the _____.
   (a) unit cell; atom
   (b) crystal structure; unit cell
   (c) crystal structure; molecule
   (d) lattice; element

   Ans: (b)

4. Number of atoms per unit cell in case of primitive unit cell.
   a. (a) 0 (b) 1 (c) 2 (d) 3

   Ans: (b)

5. Number of atoms per unit cell in case of non-primitive unit cell.
   b. (a) 0 (b) 1 (c) more than one (d) less than one

   Ans: (c)

6. The number of crystal systems are:
   (a) 5
   (b) 7
   (c) 14
   (d) 21

   Ans: (b)

7. The number of Bravais lattices is:
   (a) 256
   (b) 7

(c) 14
(d) 37

Ans: (c)

8. A cubic crystal system is represented by:
   (a) $a = b = c\ \alpha = \beta = \gamma \neq 90°$
   (b) $a = b \neq c\ \alpha = \beta = \gamma = 90°$
   (c) $a = b = c\ \alpha = \beta = \gamma = 90°$
   (d) $a \neq b \neq c\ \alpha = \beta = \gamma = 90°$

   Ans: (c)

9. In a triclinic crystal:
   a. $a = b = c, \alpha = \beta = \gamma \neq 90°$
   b. $a \neq b = c, \alpha = \beta = \gamma = 90°$
   c. $a \neq b \neq c, \alpha \neq \beta \neq \gamma \neq 90°$
   d. $a \neq b \neq c, \alpha = \beta = 90° \gamma \neq 90°$

   Ans: (c)

10. Which of the following are the CORRECT axial distances and axial angles for rhombohedral system?
    (a) $a = b = c, \alpha = \beta = \gamma \neq 90°$
    (b) $a = b \neq c, \alpha = \beta = \gamma = 90°$
    (c) $a \neq b \neq c, \alpha = \beta = \gamma = 90°$
    (d) $a \neq b \neq c, \alpha \neq \beta \neq \gamma \neq 90°$

    Ans: (a)

11. Monoclinic crystal has dimensions _____.

    (a) $a \neq b \neq c, \alpha = \beta = 90°, \gamma \neq 90°$
    (b) $a = b = c, \alpha = \beta = \gamma = 90°$
    (c) $a = b \neq c, \alpha = \beta = \gamma = 90°$
    (d) $a \neq b \neq c, \alpha \neq \beta \neq \gamma \neq 90°$

    Ans: (a)

12. If 'a' stands for the edge length of the cubic systems: simple cubic, body centred cubic and face centred cubic, then the ratio of the radii of the spheres in these systems will be respectively:
    (a) $\frac{1}{2}a : \frac{\sqrt{3}}{4}a : \frac{1}{2\sqrt{2}}a$
    (b) $\frac{1}{2}a : \sqrt{3}a : \frac{1}{\sqrt{2}}a$
    (c) $\frac{1}{2}a : \frac{\sqrt{3}}{2}a : \frac{\sqrt{2}}{2}a$

(d) $1a : \sqrt{3}a : \sqrt{2}a$

Ans: (a)

13. In a face-centered cubic lattice, a unit cell is shared equally by how many unit cells?
    (a) 2
    (b) 4
    (c) 6
    (d) 8

    Ans: (c)

14. If R is the radius of the atom in a crystal, crystallizing in the simple cubic structure, then the nearest neighbor distance is

    (a) R/2 (b) 4R (c) 2R (d) $2\sqrt{2}$R

    Ans: (c)

15. The effective number of atoms belonging to the unit cell of FCC structure is

    (a) 1 (b) 2 (c) 3 (d) 4

    Ans: (d)

16. The packing efficiency in simple cubic unit cell is _____.

    (a) 52%

    (b) 68%

    (c) 74%

    (b) 80%

    Ans: (a)

17. The packing factor of the BCC structure is

    (a) 52% (b) 72% (c) 64% (d) 68%

    Ans: (d)

18. The maximum percentage of available volume that can be filled in a face centered cubic system by an atom is _____.

    (a) 74% (b) 68% (c) 34% (d) 26%

    Ans: (a)

19. Percentage of free space in a body centred cubic unit cell is

    (a) 32%
    (b) 34%
    (c) 28%

(d) 20%

Ans: (a)

20. A family of directions is represented by

(a) (hkl) **(**b) <uvw> (c) {hkl} (d) [uvw]

Ans: (b)

21. The Miller indices of the plane parallel to the X and Y axes and intersecting Z axis at 1unit are

(a) (1 0 0) (b) (0 1 0) (c) (0 0 1) (d) (1 1 0)

Ans: (c)

22. The Miller indices of the plane parallel to the X and Z axes and intersecting one unit along Y axis are

(a) (1 0 0) (b) (0 1 0) (c) (0 0 1) (d) (1 1 0)

Ans: (b)

23. The Miller indices of the plane parallel to the Y and Z axes and intersecting one unit along X axis are

(a) (1 0 0) (b) (0 1 0) (c) (0 0 1) (d) (1 1 0)

Ans: (a)

24. The Miller indices of the plane parallel to the Y axis and intersecting one unit along both X and Z axes are

(a) (1 0 0) (b) (0 1 0) (c) (0 0 1) (d) (1 0 1)

Ans: (d)

25. The Miller indices of the plane parallel to the X axis and intersecting one unit along both Y and Z axes are

(a) (1 0 0) (b) (0 1 0) (c) (0 1 1) (d) (1 0 1)

Ans: (c)

26. The Miller indices of the plane parallel to the Z axis and intersecting one unit along both X and Y axes are

(a) (1 0 0) (b) (1 1 0) (c) (0 0 1) (d) (1 0 1)

Ans: (b)

27. Which plane is perpendicular to a [100] direction?

(a) (001) b) (010) c) (100) d) (011)

Ans: (c)

28. Co-ordination number of a crystalline solid is:
    a) Number of particles in the unit cell
    b) Number of nearest neighbours of a particle
    c) Number of octahedral voids in a unit cell
    d) Number of tetrahedral voids in a unit cell
    Ans: (b)
29. Packing efficiency of a crystal structure is the ratio of:
    a) Volume occupied by atoms to the total volume of the unit cell
    b) Volume occupied by atoms to that by voids
    c) Total volume of the unit cell to the volume occupied by atoms
    d) Volume occupied by voids to that by atoms
    Ans: (a)
30. Which of the following is a property of amorphous solids?
    a) Sharp melting point
    b) Isotropy
    c) Long range order
    d) Definite heat of fusion
    Ans: (b)

31. Which of the following is a crystalline solid?
    a) Copper wire
    b) Glass bottle
    c) Polythene bag
    d) Rubber ball
    Ans: (a)

32. In a face centred cubic (fcc) arrangement, the number of atoms per unit cell is
    (a) 1
    (b) 2
    (c) 3
    (d) 4
    Ans: (d)

33. If (3 2 6) are the Miller indices of a plane, the intercepts made by the plane on the three crystallographic axes are

    (a) (2a, 3b, c) (b) (a, b, c) (d) (a, 2b, 3c**)** (d) none of these

    Ans: (d)

34. A plane intercepts at a, b/2, 3c in a simple cubic unit cell. The Miller indices of the plane are

    (a) (1 3 2) (b) (2 6 1) (c) (3 6 1) (d) (1 2 3)

Ans: (d)

35. Find the Miller indices of a set of planes which makes the intercepts in the ratio 3a:4b on the x and y axis, and are parallel to the z axis

(a) (3 4 0) (b) (4 3 0) (c) (0 4 3) (d) (4 0 3)

Ans: (b)

36. The crystal system with lattices a = b = c and interfacial angles $\alpha = \beta = \gamma \neq 90°$ represents

(a) Triclinic system (b) Monoclinic system (c) Tetragonal system (d) Rhombohedral system

Ans: (d)

37. The nearest neighbor distance between two atoms in case of BCC structure is

(a) $a\sqrt{3}/2$ (b) $2a/\sqrt{3}$ (c) $a\sqrt{2}/2$ (d) $2a/\sqrt{2}$

Ans: (a)

38. Wavelength of the X-ray ranges between … to …

(a) 0.1Å - 100Å (b) 0.1μm – 100μm (c) 0.1mm – 100 mm (d) 0.1m – 100m

Ans: (a)

39. When a beam of fast moving electrons strikes a solid target, then rays produced are

(a) alpha rays (b) beta rays (c) gamma rays (d) x-rays

Ans: (d)

40. **X-rays have**

(a) Short wavelength (b) high frequency (c) both (a) and (b) (d) none

Ans: (c)

41. When a filament (incident) electron knocks out a K shell electron from the target atom, it leads to what?

(a) A characteristic x-ray photon
(b) A continuous x-ray photon
(c) Both continuous characteristic x-ray photon
(d) None of the above.

Ans: (a)

42. _____ is an energetic characteristic x-rays.

(a) K alpha (b) K beta (c) K gamma (d) L alpha

Ans: (b)

43. L-alpha characteristic x-rays are due to

(a) L shell to K shell transition

(b) K shell to L shell transition

(c) M shell to L shell transition

(d) N shell to L shell transition

Ans: (c)

44. K beta characteristic x-rays are due to

(a) L shell to K shell transition

(b) M shell to K shell transition

(c) N shell to K shell transition

(d) K shell to L shell transition

Ans: (b)

45. In x-rays lower wavelength limit (λ_{min}) is depends on

(a) Acceleration Voltage

(b) Distance between filament and target material.

(c) Atomic number of the target material

(d) Thickness of the target material.

Ans: (a)

46. Intensity of x-rays increases with increase in

(a) Temperature

(b) Acceleration voltage

(c) Pressure

(d) None

Ans: (b)

47. X-ray diffraction is based on

(a) Bragg's law

(b) Newton's Laws

(c) Coulomb's Law

(d) Pascal's Law

Ans: (a)

48. Hard x-rays are

(a) L series x-rays

(b) K series x-rays

(c) L series and K series x-rays

(d) None

Ans: (b)

49. Bragg's law is

(a) $4d\sin\theta = n\lambda$

(b) $2d\cos\theta = n\lambda$

(c) $2d\sin\theta = n\lambda$

(d) $4d\cos\theta = n\lambda$

Ans: (c)

50. X-ray spectrometer is based on

(a) Pascal's Law
(b) Newton's Laws
(c) Coulomb's Law
(d) Bragg's law

Ans: (d)

51. Crystal structure determination and analysis is done with
(a) alpha rays (b) beta rays (c) gamma rays (d) x-rays

Ans: (d)

52. Condition for constructive interference in x-ray diffraction

(a) Path difference is integral multiple of λ

(b) Path difference is integral multiple of $\lambda/2$

(c) Path difference is integral multiple of $\lambda/3$

(d) Path difference is integral multiple of $\lambda/4$

Ans: (a)