



Multiple Choice Questions
Engineering Physics (PHY 109)

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1. Fermi energy level
 - (a) is the top most filled energy level at 0K temperature
 - (b) is the top most filled energy level at 0°C temperature
 - (c) separates valance band and conduction band
 - (d) none of the above
2. Which of the following is true regarding to the position of Fermi level?
 - (a) lies exactly in the middle between bottom of the conduction band and top of the valance band in *intrinsic semiconductor*
 - (b) nearer to the conduction band in *N-type semiconductor*
 - (c) nearer to the valance band in *P-type semiconductor*
 - (d) all the above.
3. Fermi-Dirac statistics explains
 - (a) how electrons are distributed among different energy levels
 - (b) the probability of an energy level to be occupied by electrons
 - (c) the probability of an energy level to be occupied by quantum mechanical particles
 - (d) how quantum mechanical particles are distributed in different energy level.
4. Fermi-Dirac (FD) statistics governs
 - (a) fermions
 - (b) free electrons
 - (c) gas molecules
 - (d) All the above

5. The Fermi-Dirac distribution function is given by

(a) $f(E) = \frac{1}{\exp\left(\frac{E-E_f}{KT}\right)}$

(b) $f(E) = \frac{1}{e^{\left(\frac{E-E_f}{KT}\right)}}$

(c) $f(E) = \frac{1}{e^{\left(\frac{E-E_f}{KT}\right)} + 1}$

(d) $f(E) = \frac{1}{\exp\left(\frac{E-E_f}{KT}\right)+1}$

6. In free electron gas theory, electrons

(a) can move anywhere inside the metal.

(b) are considered as a gas.

(c) pairs with holes and become neutral.

(d) All the above.

7. Which of the following can be explained by using free electron theory

(a) copper

(b) Gold

(c) Silver

(d) Sodium

8. Free electron theory gas is applicable to

(a) metals

(b) gas

(c) solids

(d) all the above.

9. Free electron gas theory assumes

(a) electrons are free from Coulomb force

(b) the Coulomb force of repulsion is negligible.

(c) Electrons are free to move anywhere.

(d) All the above.

10. For a semiconductor based light source, it should be a

(a) direct band gap semiconductor

(b) indirect direct band gap semiconductor

(c) either direct band gap or indirect band gap

- (d) semiconductor can not be used as a light source
11. In an indirect band gap semiconductor, transition between conduction band and valance band results in
 - (a) heat
 - (b) light
 - (c) both
 - (d) none of the above.
 12. In a direct band gap semiconductor
 - (a) The two points of intersection of a vertical line with E-K curve of both valance band and conduction band are at same momentum.
 - (b) The two points of intersection of a vertical line with E-K curve of both valance band and conduction band are having same wave vector.
 - (c) The K value of lowest point of conduction band is equal to the K value of highest point of valance band.
 - (d) The transitions of electrons take place directly.
 13. Which of the following is true?
 - (a) In an indirect band gap semiconductor, emission of photons is not possible
 - (b) In a direct band gap semiconductor emission of both light and heat is possible.
 14. In an indirect band gap semiconductor, emission of light does not occur because of the fact that
 - (a) momentum is not conserved in case of direct transition
 - (b) electrons are trapped in defects before making transition.
 15. Which of the following is an indirect band gap semiconductor?
 - (a) silica
 - (b) germanium
 - (c) carbon
 - (d) all the above.
 16. Which of the following is a radiative semiconductor
 - (a) Silica
 - (b) Gallium Arsenide
 - (c) Germanium
 - (d) None of the above

17. Diffusion current occurs due to
- (a) charge density gradient
 - (b) electric field
 - (c) nonuniform distribution of electron and holes
 - (d) all the above
18. The shape of E-K diagram of conduction band and valance band is
- (a) horizontal
 - (b) vertical
 - (c) parabolic
 - (d) none of the above.
19. The curvature of E-K diagram
- (a) is higher in conduction band than valance band
 - (b) is lower in valence band than conduction band
 - (c) is negative in conduction band
 - (d) b and c
20. The symbol K in Fermi energy represents
- (a) Maxwell-Boltzmann constant
 - (b) Boltzmann constant
 - (c) Wave vector
 - (d) None of the above.
21. Hertz is the unit of
- (a) frequency of ultrasound
 - (b) frequency of AC
 - (c) frequency of waves
 - (d) all the above.
22. Effective mass of a charge carrier
- (a) is directly proportional to curvature of E-K curve
 - (b) is inversely proportional to curvature of E-K curve
 - (c) is positive near the bottom of the conduction band
 - (d) is negative near the top of the valance band
23. An expression for effective mass is given by

- (a) $m^* = \frac{\hbar^2}{\left(\frac{d^2 E}{dK^2}\right)}$
- (b) $m^* = -\frac{\hbar^2}{\left(\frac{d^2 E}{dK^2}\right)}$
- (c) $m^* = \frac{h}{\left(\frac{d^2 K}{dE^2}\right)}$
- (d) $m^* = \frac{\hbar^2}{\left(\frac{d^2 K}{dE^2}\right)}$

24. Electronic bands are formed due to

- (a) split-up of energy levels
- (b) to satisfy Pauli's exclusion principle
- (c) Shift in energy levels
- (d) All the above

25. An electronic band is

- (a) Any range of energy levels
- (b) Energy levels where free electrons exist
- (c) A range of energy level which is characterized by the existence of electrons.
- (d) All the above.

26. The interaction of different atoms leads to the formation of

- (a) electronic band
- (b) electronic bond
- (c) none of the above
- (d) all the above

27. A forbidden band

- (a) is the one where electrons are forbidden
- (b) is the one where energy is forbidden
- (c) is not there in between the conduction and valence band in conductors
- (d) all the above.

28. Current flow is in the direction of

- (a) electric field
- (b) opposite to the flow of electrons
- (c) flow of holes
- (d) all the above

29. Dopant for N-type semiconductor
- (a) should be a pentavalent impurity
 - (b) should be a trivalent impurity
 - (c) either a or b
 - (d) depends on the number of valance electrons in the host atom
30. Hall voltage is developed due to the
- (a) change in magnetic field
 - (b) change in electric field
 - (c) polarization of charges
 - (d) none of the above.
31. In Hall effect, electrons experience
- (a) electrostatic force
 - (b) magnetic force
 - (c) Lorentz force
 - (d) all the above
32. The force acting on moving electrons due to a perpendicular magnetic field is in the direction
- (a) parallel to the magnetic field
 - (b) perpendicular to magnetic field and parallel to the direction of electrons
 - (c) perpendicular to the direction of electrons and parallel to the magnetic field
 - (d) Opposite to the magnetic field.
33. Which of the following is true?
- (a) The number of electrons is given by $n = N_c \exp - \left(\frac{E_c - E_f}{KT} \right)$
 - (b) The number of holes is given by $p = N_v \exp - \left(\frac{E_f - E_v}{KT} \right)$
 - (c) both a and b
 - (d) neither a nor b
34. Which of the following is true?
- (a) The condition for constructive interference is given by $\delta = n\lambda$
 - (b) The condition for destructive interference is given by $\delta = n\lambda + \frac{1}{2}\lambda$
 - (c) For destructive interference, the crest and trough should be superimposed.

- (d) All the above.
35. For constructive interference
- (a) The phase difference should be constant
 - (b) The phase difference should be zero
 - (c) The two waves should be out of phase
 - (d) None of the above
36. Interference is
- (a) the addition of two waves
 - (b) superimposition of two waves
 - (c) disturbance of a wave using another wave.
 - (d) All the above.
37. Which of the following method is used to produce sound of frequency more than 20 KHz?
- (a) Magnetostriction method
 - (b) Piezo-electric method
 - (c) Inverse piezo-electric method
 - (d) Ultrasonic interferometer
38. In magnetostriction method, a ferromagnet substance changes its shape and size when placed in a
- (a) magnetic field
 - (b) alternating current
 - (c) electric field
 - (d) all the above
39. Which of the following is true?
- (a) In magnetostriction method, magnetic dipoles make orientation according to the magnetic field.
 - (b) In piezoelectric method, electric dipoles aligns towards electric field.
 - (c) In piezoelectric effect, an electric field produce mechanical vibrations.
 - (d) In inverse piezoelectric method, mechanical pressure produce an electric field.
40. In magnetostriction method of ultrasonic sound production
- (a) a magnetic rod is used
 - (b) a magnetic cube is used

- (c) a dielectric rod is used
 - (d) a conducting rod is used.
41. In magnetostriction method
- (a) an electric field should be perpendicular to the magnetic rod.
 - (b) a magnetic field should be perpendicular to the magnetic rod.
 - (c) a magnetic field should be parallel to the magnetic rod.
 - (d) none of the above.
42. A device which is used to convert electrical energy into ultrasonic sound and vice-versa is called
- (a) Ultrasonic interferometer
 - (b) Ultrasonic transducer
 - (c) Piezoelectric device
 - (d) All the above.
43. Which of the following uses ultrasonic sound waves?
- (a) anemometer
 - (b) SONAR
 - (c) Ultrasonography
 - (d) Non-destructive testing
 - (e) All the above.
44. Absorption of ultrasonic waves results in emission of
- (a) light
 - (b) heat
 - (c) both light and heat
 - (d) electrical energy
45. Dispersion of ultrasonic waves occurs due to
- (a) wavelength dependent variation of refractive index
 - (b) variation of density in the medium
 - (c) prism
 - (d) all the above
46. Which of the following method is used to detect ultrasonic waves?
- (a) Piezoelectric method
 - (b) Sensitive tube method

- (c) Kundt's tube method
 - (d) all the above.
47. In sensitive flame method,
- (a) a flame is produced by ultrasonic sound.
 - (b) a flame is used to produce ultrasonic sound
 - (c) a flame is used to detect ultrasonic sound
 - (d) all the above.
48. A sensitive flame can be used to detect ultrasonic waves because
- (a) it is sensitive to mechanical pressure
 - (b) it is sensitive to density variation
 - (c) a and b
 - (d) none of the above
49. In sensitive flame method,
- (a) the flame is on during the node of the sound wave
 - (b) the flame is off during the anti-node of the sound wave
 - (c) the flame is off during the node of the sound wave
 - (d) the flame is on during the anti-node of the sound wave.
50. In Kundt's tube method,
- (a) talcum powder is used
 - (b) a vertical glass tube is used
 - (c) Lycopodium powder can be used
 - (d) All are correct.
51. In Kundt's tube method,
- (a) particle in a powder makes displacement according to the pressure of sound waves
 - (b) The displacement is maximum at the antinode of sound wave.
 - (c) The displacement is in horizontal direction
 - (d) The displacement is maximum at the node of the wave
52. Which of the following is true?
- (a) $\frac{d\rho}{d\lambda} = 0$ for a dispersive sound medium, where ρ is the density of a medium.
 - (b) $\frac{dn}{d\lambda} = 0$ for a non-dispersive light medium, where n is the refractive index.

- (c) $\frac{dn}{d\lambda}$ can be both negative or positive.
 - (d) All are wrong.
53. *Density of states* gives
- (a) The number of unoccupied energy states in a given interval of energy.
 - (b) The number of energy levels in a given interval of energy.
 - (c) The number of occupied energy levels in a given interval of energy
 - (d) none of the above.
54. The current produced due to an external applied potential is called as
- (a) drift current
 - (b) diffusion current
 - (c) eddy current
 - (d) All the above
55. Which of the following phenomenon could not be explained by classical mechanics?
- (a) Photoelectric effect
 - (b) Black body radiation
 - (c) Specific heat of solids
 - (d) All the above
56. Classical mechanics fails because
- (a) it is based on macroscopic observations
 - (b) it does not fail
 - (c) it considers physical quantities as continuous variables
 - (d) none of the above
57. Photoelectric effect can be explained by quantum mechanics by
- (a) by observing the phenomenon using a microscope
 - (b) assuming emission and absorption taking place in discrete manner.
 - (c) using wave theory
 - (d) all the above
58. Which of the following phenomenon asserts light can have particle nature?
- (a) Compton effect
 - (b) Photoelectric effect
 - (c) Black body radiation

- (d) All the above
59. Which of the following phenomenon asserts particles can have wave properties?
- (a) Interference of light
 - (b) interference of electrons
 - (c) both (a) and (b)
60. Which of the following exhibits dual characters?
- (a) light waves
 - (b) sound waves
 - (c) particles
 - (d) air
61. What are the conditions for a physical entity to be eligible for particle?
- (a) it should have momentum
 - (b) it should have mass
 - (c) any one of its variable should be discrete.
 - (d) all the above.
62. De-Broglie's wavelength is applicable to
- (a) electrons
 - (b) photons
 - (c) matter waves
 - (d) All the above
63. De-Broglie's wavelength is given by (P-momentum and p-position)
- (a) $\lambda = \frac{p}{h}$
 - (b) $\lambda = \frac{h}{p}$
 - (c) $\lambda = \frac{h}{P}$
 - (d) $\lambda = \frac{h^2}{p^2}$
64. Which of the following gives the energy-position relationship?
- (a) $E = \frac{P^2}{2m}$
 - (b) $E = \frac{\hbar^2 K^2}{2m}$
 - (c) $E^2 = \frac{P^4}{4m^2}$
 - (d) All the above

65. Which of the following is a function of temperature?
- (a) Fermi level
 - (b) Density of states
 - (c) No of free electrons
 - (d) All the above.
66. In P-type semiconductor which of the following is (are) charge careers?
- (a) holes
 - (b) electrons
 - (c) ions
 - (d) all the above.
67. An intrinsic semiconductor is
- (a) *free electron* free
 - (b) defect free
 - (c) dopant free
 - (d) all the above.

Answers

1. a and c
2. d
3. All are correct.
4. a and b
5. a and b (both e^x and $\exp(x)$ represent same notations).
Option d is the Maxwell-Boltzmann (M-B) distribution function.
6. a and b
7. All are correct since all are metals which contain free electrons.
8. a and c. a is more accurate answer.
9. b. Electrons are free to move inside the metal only.
10. a
11. a
12. All are correct.
13. b. Option a is not true. Emission of photons is possible with less probability.

14. a and b
15. d
16. b. Radiative semiconductor is the one which emits light.
17. a and c. option b is drift current.
18. c
19. a and b. Curvature is negative in valance band.
20. b. K is wave vector or propagation constant in wave function.
21. d
22. b, c, d. Effective mass may be positive or negative according to the sign of curvature. The curvature may be positive or negative in both conduction band and valance band.
23. a
24. a and b
25. c
26. a and b
27. a and c
28. d
29. a
30. c
31. c
32. All are wrong. Perpendicular to both electric and magnetic field.
33. c
34. d
35. b. c is the condition of destructive interference.
36. d
37. a and c. Ultrasonic interferometer is not a method but an instrument. Moreover, its main objective is not to generate ultrasonic waves though generation of ultrasonic waves is a part of it.
38. a and b
39. a and b.

- 40. a
- 41. c
- 42. d. (a is not more accurate)
- 43. e
- 44. b
- 45. b
- 46. a and c, sensitive flame method.
- 47. c
- 48. c
- 49. a and b
- 50. a and c. Horizontal glass tube is used.
- 51. a and b. displacement is in the vertical direction to the propagation of sound wave.
- 52. b and c
- 53. a
- 54. a
- 55. d
- 56. a and c
- 57. b and c
- 58. d
- 59. b
- 60. a, b, c (Sound waves can behave like particles called phonons.)
- 61. d
- 62. a
- 63. b
- 64. d
- 65. b and c
- 66. d
- 67. d