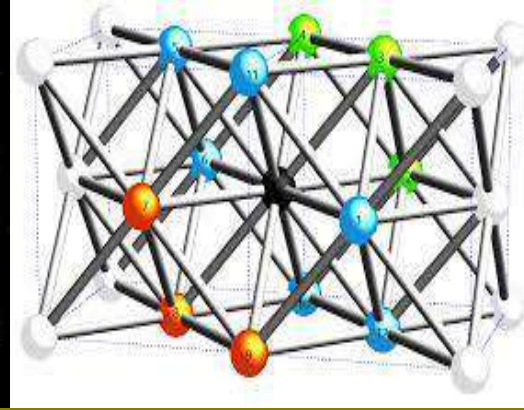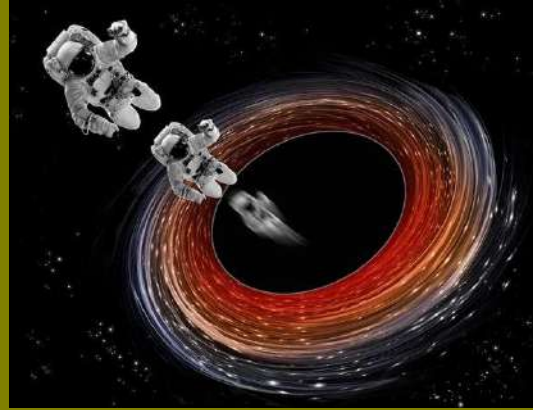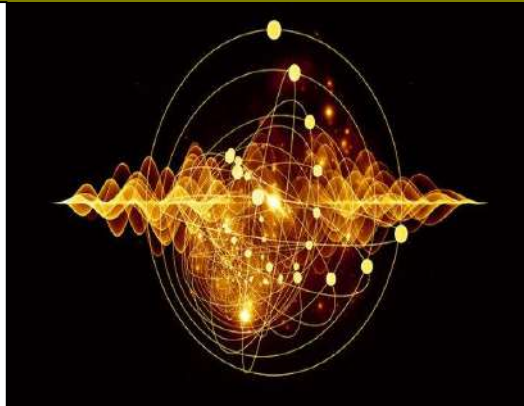# Question Bank

on

Quantum Mechanics & Relativity, Solid State Physics and Allied physics-I

Topics to be Covered
- Dual Nature of Matter
- Wave Mechanics
- Relativity
- Crystal Structure
- Magnetism & Superconductivity
- Dielectrics & Solid Properties
- Properties of Matter
- Mechanics
- Heat

Mrs. S. Saranya M.Sc., M.Phil.,

Question Bank

On

Quantum Mechanics & Relativity,
Solid State Physics and Allied Physics-I

Mrs. S. SARANYA M.Sc., M.Phil.,

DEPARTMENT OF PHYSICS

St. JOSEPH'S COLLEGE OF ARTS AND SCIENCE FOR WOMEN, HOSUR

Affiliated to Periyar University, Salem

CONTENTS

St. Joseph's College of Arts and Science for Women, Hosur

Quantum Mechanics & Relativity

Unit-I
Dual Nature of Matter

Multiple Choice Questions:

1. The de-Broglie wavelength of a particle of mass' m' and momentum 'p' is given by

a) $\lambda = h/p$

b) $\lambda = p/h$

c) $\lambda = h/2p$

d) $\lambda = 2p/h$

Answer : a

2. The group velocity is given by _____.

a) $v_g - v_p$

b) $v_g = \lambda v_p$

c) $v_g = v_p - \lambda (dv_p/d\lambda)$

d) $v_p = v_g - (dv_p/d\lambda)$

Answer : d

3. The phase velocity of the de Broglie wave is given by _____.

a) $v_p = v/c$

b) $v_p = c/v$

c) $v_p = c^2/v$

d) $v_p = v/c^2$

Answer : c

4. Which one of the following is true?

a) $\Delta J \Delta \theta \geq h$

b) $\Delta J \Delta x \geq h$

c) $\Delta J \Delta p \geq h$

d) $\Delta J \Delta k \geq h$

Answer : a

5. De- Broglie wavelength for thermal neutrons_____.

a) $\lambda = h/3mkT$

b) $\lambda = h/\sqrt{2mkT}$

c) $\lambda = h/mkT$

d) $\lambda = h/\sqrt{mkT}$

Answer : a

6. The classical mechanics deals with the study of ------------------ things.

a) Macroscopic

b) Microscopic

c) Both

d) None

Answer : a

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7. Plank's constant has a SI unit of _____.

   a) J

   b) S

   c) J-S

   d) J/S

   Answer : c

8. The motion of a wave packet is similar to _____.

   a) Photons

   b) Waves

   c) Classical particle

   d) Quantum particle

   Answer : c

9. Davison and Germer experiments show that the electron has a behavior

   a) Like particle

   b) Like wave

   c) Both

   d) None of the these

   Answer : b

10. The first founder of quantum theory

   a) Max Planck

   b) Bohr

c) Sommerfeld

d) Davison

Answer : a

11. What type of nature do electromagnetic waves have?

a) Dual nature

b) Wave nature

c) Particle nature

d) Photon nature

Answer : a

12. The magnitude of which of the following is proportional to the frequency of the wave?

a) Electrons

b) Neutrons

c) Photons

d) Protons

Answer : c

13. Identify the de – Broglie expression from the following.

a) $\lambda = h \times p$

b) $\lambda = h/p$

c) $\lambda = h+p$

d) $\lambda = h-p$

Answer : b

14. When the wavelength of an electron increases, the velocity of the electron will also increase.

a) True
b) False
Answer : b

15. While comparing the alpha particle, neutron, and beta particle, the alpha particle has the lowest de – Broglie wavelength.

a) True
b) False
Answer : a

16. According to de Broglie's relation if velocity

of particle is infinite, wavelength will be…

a) Infinite
b) Small
c) Large
d) Zero
Answer : d

17. 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

Answer : c

18. The phase velocity refers to a group of waves and the group velocity refers to a single wave. State true/false.

   a) True

   b) False

Answer : b

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

   a) Frequency

   b) Wavelength

   c) Phase constant

   d) Attenuation constant

Answer : d

20. The distance between two successive points in a waveguide is the

   a) Guided wavelength

   b) 2 x guided wavelength

c) Guided wavelength/2

d) (guided wavelength)/4

Answer : c

21. A non-dispersive media has

a) Group velocity = Phase velocity

b) Phase velocity ≤ Group velocity

c) Group velocity ≤ Phase velocity

d) None

Answer : a

22. In dispersive medium group velocity is

a) Less than phase velocity

b) Greater than Phase velocity

c) Equal to Phase velocity

d) Equal to group velocity

Answer : a

23. Which of the following is used in the Davisson – Germer experiment?

a) Double slit

b) Single slit

c) Electron gun

d) Electron microscope

Answer : c

24. Which theory is confirmed by the Davisson –

 Germer experiment?
   a) De – Broglie theory
   b) Newton's theory
   c) Einstein's theory
   d) Planck's theory
   Answer : a

25. Which crystal is used in the Davisson – Germer experiment?
   a) Aluminum
   b) Nickel
   c) Cobalt
   d) Zinc
   Answer : b

26. Intensity is different for different angles of scattering in the Davisson – Germer experiment.
   a) True
   b) False
   Answer : a

Five mark Questions:
1. Describe the relation of group velocity.
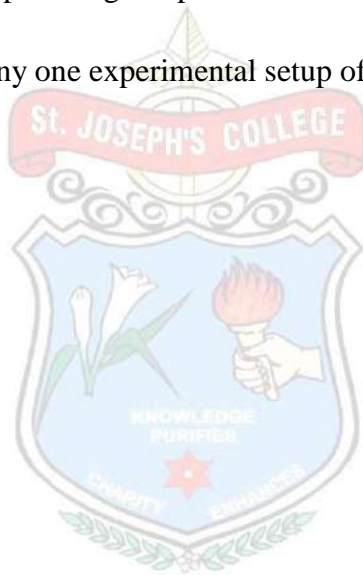2. Briefly discuss about dual nature of matter.
3. Discuss briefly about Inadequacy of classical mechanics.

4. Derive de Broglie relation for matter waves.

Ten mark Questions:

1. Explain Davisson and Germer's experiment.
2. Discuss about G.P Thomson experiment.
3. What is Vp and Vg? Explain the relation betweenVp and Vg.
4. Explain any one experimental setup of Matter Waves

Unit-II

Wave Mechanics

Multiple Choice Questions:

1. What is the distance between two consecutive crests or troughs of a wave called?

    a) Amplitude
    b) Frequency
    c) Wavelength
    d) Phase
    Answer : c

2. In which type of wave do particles of the medium move perpendicular to the direction of the wave?

    a) Longitudinal wave
    b) Transverse wave
    c) Standing wave
    d) Mechanical wave
    Answer : b

3. The phenomenon of interference in waves is a result of:

a) Reflection
b) Refraction
c) Superposition
d) Diffraction

Answer : c

4. Which equation represents the relationship between the speed (v), frequency (f), and wavelength (λ) of a wave?

a) $v = f\lambda$
b) $v = f/\lambda$
c) $v = \lambda/f$
d) $v = f + \lambda$

Answer : a

5. The principle stating that a wave can exhibit both wave-like and particle-like behavior is called:

a) Wave dispersion
b) Particle dualism
c) Quantum entanglement
d) Wave-particle duality

Answer : d

6. What is the name for the minimum energy required to eject an electron from a material's surface using light?

    a) Work function

    b) Quantum state

    c) Wave function

    d) Uncertainty principle

    Answer : a

7. Diffraction occurs when a wave encounters:

    a) A boundary and changes direction

    b) A medium and changes speed

    c) An obstacle and bends around it

    d) A reflective surface and changes phase

    Answer : c

8. Which type of wave consists of oscillations that occur in the same direction as the wave's propagation?

    a) Longitudinal wave

    b) Transverse wave

    c) Surface wave

    d) Electromagnetic wave

    Answer : a

9. The Schrödinger equation is a fundamental equation in:

a) Classical mechanics

b) Relativity theory

c) Quantum mechanics

d) Electromagnetism

Answer : c

10. Which term refers to the ability of a wave to bend when it passes through an opening or around an obstacle?

a) Reflection

b) Refraction

c) Diffraction

d) Dispersion

Answer : c

11. The process of mode-locking is commonly used to generate:

a) Continuous waves

b) Longitudinal waves

c) Ultrashort laser pulses

d) Mechanical vibrations

Answer : c

12. What phenomenon occurs when two waves with equal frequency and amplitude travel in opposite directions and appear to be stationary?

a) Superposition

b) Resonance

c) Doppler effect

d) Standing wave

Answer : d

13. The concept of quantization of energy levels is a key feature of:

a) Classical mechanics

b) Special relativity

c) Quantum mechanics

d) Electromagnetic theory

Answer : c

14. Which phenomenon involves the bending of waves as they pass from one medium to another due to a change in their speed?

a) Reflection

b) Dispersion

c) Refraction

d) Diffraction

Answer : c

15. The color of light is determined by its:

a) Amplitude

b) Frequency

c) Wavelength

d) Speed

Answer : c

16. The operator representation of p is_____.

a) $p = -i\hbar$

b) $p = -ih$

c) $p = ih$

d) $p = 0$

Answer : a

17. The values of energy for which Schrodinger's steady –state equation can be solved are called.

a) Eigen values

b) Eigen functions

c) Probability density

d) None

Answer : a

18. If there is more than one linearly independent wave function belonging to the same energy Eigen value E, the energy level is said to be_____.

a) Non-degenerate

b) Degenerate

c) Eigen function

d) None

Answer : b

19. The function of energy for which Schrodinger's steady state equation can be solved by_____ .

    a) Eigen values

    b) Eigen functions

    c) Probability density

    d) None

    Answer : b

Five mark Questions

1. Give any 5 postulates of wave mechanics.

2. Find the non-existence of free electrons in the nucleus.

3. Describe Linear operators.

4. Listout the properties of linear operator.

5. Give any 2 example and find the Eigen value and operator.

Ten mark Questions

1. Explain Heisenberg's Un-certainty principle with their illustrations.

2. Give the applications and Postulates of wave mechanics.

3. Explain about Eigen values and Eigen function.

4. Determine the position with gamma-ray microscope.

5. Explain the diffraction of a beam of electron.

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Unit-III

Schrodinger's Wave equation 1D Problem

Multiple Choice Questions

1. What is the Schrödinger equation?
a) An equation describing the motion of particles in a classical fluid

b) An equation describing the behavior of waves on a string

c) An equation describing the behavior of particles as waves in quantum mechanics

d) An equation describing the behavior of electromagnetic waves

Answer : c

2. Schrödinger's wave equation is fundamental to which branch of physics?
a) Classical mechanics

b) Relativity theory

c) Quantum mechanics

d) Thermodynamics

Answer : c

3. The time-independent Schrödinger equation describes:

a) The evolution of a quantum system with time

b) The energy states and wave functions of a quantum system

c) The motion of particles in a classical fluid

d) The behavior of waves on a string

Answer : b

4. Which physical quantity does the wave function in Schrödinger's equation represent?

a) Particle's momentum

b) Particle's energy

c) Particle's position

d) Probability amplitude

Answer : d

5. In the Schrödinger equation, what does the operator "H" represent?

a) Planck's constant

b) Particle's position

c) Particle's energy operator

d) Momentum operator

Answer : c

6. The solutions of Schrödinger's equation provide information about:

a) The exact position of a particle

b) The trajectory of a particle

c) The probability distribution of finding a particle at different positions

d) The speed of a particle

Answer : c

7. The term "wave function collapse" refers to:

a) The collapse of a quantum system into a classical state

b) The sudden disappearance of a particle's wave function

c) The process of converting wave-like behavior into particle-like behavior

d) The narrowing down of a particle's possible states when measured

Answer : d

8. The uncertainty principle, formulated by Heisenberg, is related to the limitations on the simultaneous measurement of:

a) Position and energy

b) Momentum and velocity

c) Position and momentum

d) Energy and velocity

Answer : c

9. Schrödinger's equation can be solved analytically for which systems?

   a) Complex many-particle systems

   b) Simple one-dimensional systems

   c) Any quantum system regardless of complexity

   d) Systems involving only classical mechanics

   Answer : b

10. The Schrödinger equation is a cornerstone of quantum mechanics and allows us to predict:

   a) The exact position of a particle at a specific time

   b) The exact energy of a particle at a specific time

   c) The probabilities of finding particles in various states

   d) The deterministic behavior of particles in all situations

   Answer : c

11. The phenomenon describing the finite probability of the particle penetrating the barrier is called _____.

   a) Schotky effect

   b) Tunnel effect

   c) Probability density

   d) None

Answer : b

12. The walls of a particle in a box are supposed to be _____

a) Small but infinitely hard

b) Infinitely large but soft

c) Soft and Small

d) Infinitely hard and infinitely large

Answer : d

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

a) $x > 0$

b) $x < 0$

c) $0 < X < L$

d) $x > L$

Answer : c

14. The particle loses energy when it collides with the wall.

a) True

b) False

Answer : b

15. The Energy of the particle is proportional to _____

a) n

b) n^{-1}

c) n^2

d) n^{-2}

Answer : c

16. For a particle inside a box, the potential is maximum at x = _____

a) L

b) 2L

c) L/2

d) 3L

Answer : a

17. The Eigen value of a particle in a box is _____
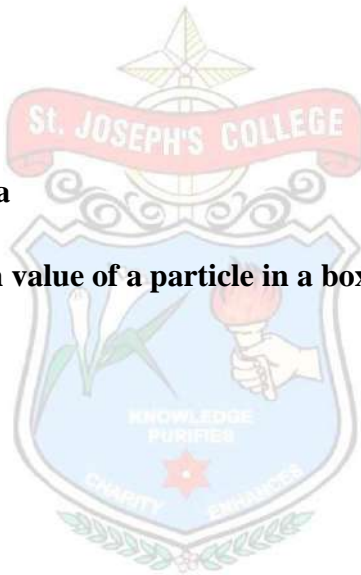
a) L/2

b) 2/L

c) $\sqrt{L}/2$

d) $\sqrt{2}/L$

Answer : d

18. Particle in a box can never be at rest.

a) True

b) False

Answer : a

19. What is the minimum Energy possessed by the particle in a box?

   a) Zero

   b) $\pi^2\hbar^2/2mL^2$

   c) $\pi^2\hbar^2/2mL$

   d) $\pi^2\hbar/2mL$

   Answer : b

20. 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

   Answer : c

Five mark Questions:

1. Listout the physical significance of schrodinger's wave function.

2. Listout the properties of schrodinger's wave function.

3. Describe 1-D problem for Particle in a Box.

4. Discuss Tunneling effect.

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Ten mark Questions:

1. Derive Schrodinger's time dependent wave equation in one Dimension.

2. Derive Schrodinger's time independent wave equation in 1-D.

3. Derive zero point energy by explaining about SHO.

4. Provide an example of solving the time-independent equation for a particle in a potential well. Explain Tunneling.

5. Explain Barrier penetration problem.
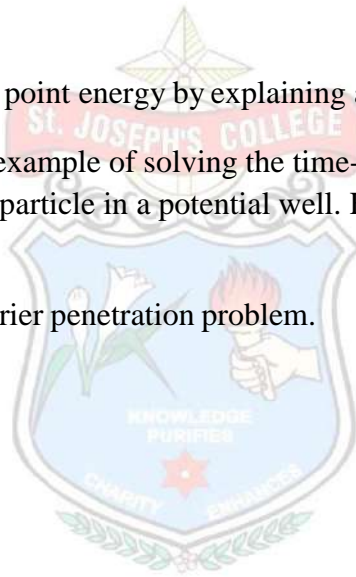
Unit-IV

Schrodinger's Wave equation 3D Problem

Multiple Choice Questions

1. What is the most basic atomic structure that can be described using the Schrödinger's equation?

   a) Helium atom

   b) Hydrogen atom

   c) Carbon atom

   d) Oxygen atom

   Answer : b

2. The energy levels of the hydrogen atom are quantized. This quantization arises due to

   a) Electromagnetic interactions

   b) Strong nuclear force

   c) Quantum mechanics and wave-particle duality

   d) Random fluctuations in energy

   Answer : c

3. The principal quantum number (n) in the hydrogen atom represents:

   a) Angular momentum

   b) Energy level

c) Spin of the electron

d) Magnetic quantum number

Answer : b

4. The Balmer series in the hydrogen spectrum corresponds to transitions involving electrons:

a) Jumping from higher energy levels to the first energy level

b) Jumping from the second energy level to higher energy levels

c) Jumping between all energy levels

d) Jumping to the second energy level from higher energy levels

Answer : b

5. The angular momentum quantum number (l) specifies:

a) The energy level of the electron

b) The shape of the electron's orbital

c) The spin of the electron

d) The mass of the electron

Answer : b

6. Which of the following statements about the hydrogen atom is true?

a) The electron is stationary in its orbit

b) The electron's energy remains constant over time

c) The electron's position and velocity can be simultaneously measured with high precision

d) The electron's energy levels are discrete and quantized

Answer : d

7. The magnetic quantum number (m) corresponds to:

a) The orientation of the electron's spin

b) The shape of the electron's orbital

c) The principal energy level of the electron

d) The orientation of the electron's orbital in space

Answer : d

8. The probability density function (PDF) of finding an electron in a hydrogen atom is described by:

a) Schrödinger's wave equation

b) Heisenberg's uncertainty principle

c) Planck's equation

d) Einstein's mass-energy equivalence equation

Answer : a

9. The phenomenon of electron spin in the hydrogen atom:

   a) Is not considered in quantum mechanics

   b) Is explained by classical physics

   c) Is an intrinsic quantum property of electrons?

   d) Only occurs in excited states

   Answer : c

10. The ground state of the hydrogen atom corresponds to which set of quantum numbers?

   a) $n = 1, l = 0, m = 0$

   b) $n = 1, l = 1, m = 0$

   c) $n = 2, l = 0, m = 0$

   d) $n = 2, l = 1, m = 0$

   Answer : a

11. Hydrogen atom consists of a _____ around which the electron revolves.

   a) Proton

   b) Neutron

   c) Electron

   d) Neutrino

   Answer : a

12. For a quantum wave particle, $E =$ _____

a) $\hbar$ k

b) $\hbar$ ω

c) $\hbar$ ω/2

d) $\hbar$ k/2

Answer : b

13. Schrodinger Wave equation can be derived from Principles of Quantum Mechanics.

a) True

b) False

Answer : b

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

a) tan x

b) sin x

c) cot x

d) sec x

Answer : b

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

a) Continuous

b) Single valued

c) Differentiable

d) Physically Significant

Answer : d

16. dΨ/dx must be zero.

   a) True

   b) False

   Answer : b

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

   a) Eigen Vectors

   b) Eigen Values

   c) Eigen Functions

   d) Operators

   Answer : c

18. The Schrödinger is a differential equation.

   a) True

   b) False

   Answer : b

19. The Schrodinger wave equation is a mathematical depression describing-

   a) Energy of the electron

   b) Momentum of the electron

   c) Position of the electron

   d) All of the above

   Answer : d

20. In general, the solution of the Schrodinger wave equation is-

   a) Real

   b) Imaginary

   c) Complex

   d) Complex, with real part always greater than the magnitude of the imaginary part.

   Answer : c

21. The Schrodinger wave equation is a-

   a) Linear differential equation

   b) Non-linear differential equation

   c) Second-order equation

   d) First-order equation

   Answer: a

22. The quantum numbers clearly explained in terms of the Schrodinger wave equation are-

   a) Principal quantum number

   b) Angular quantum number

   c) Magnetic quantum number

   d) All of the above

   Answer : d

23. The square of the wave function's magnitude is referred to as-

   a) Current density
   b) Zero density
   c) Probability density
   d) Volume density

Answer : c

24. In the Schrodinger wave equation, ψ represents-

   a) Orbitals
   b) Wave functions
   c) Amplitude functions
   d) Both (b) and (c)

Answer : b

Five mark Questions:

1. Derive Radial wave equation of H-atom and its solution.
2. Give the solution of polar wave equation.
3. Discuss azimuthal wave equation and its solution in H-atom
4. Discuss wave equation of electron energy value

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<u>Ten mark Questions:</u>

1. Explain Rigid rotator of rotational energy levels in 3d wave equation.

2. Derive Schrodinger's time dependent wave equation in 3D.

3. Derive Schrodinger's time independent wave equation in 3D.

4. Explain Hydrogen atom problem with quantum numbers and find separation of variables.

5. Explain about Wave equation for the motion of an electron in H-atom.

Unit-V
Relativity

One mark Questions:

1. Which scientist formulated the special theory of relativity?

  a) Isaac Newton

  b) Albert Einstein

  c) Niels Bohr

  d) Max Planck

  Answer : b

2. The special theory of relativity is based on two postulates. What are they

  a) The constancy of energy and the existence of absolute time

  b) The equivalence of mass and energy, and the principle of causality

  c) The constancy of the speed of light and the principle of relativity

  d) The conservation of momentum and the law of universal gravitation

  Answer : c

3. According to the special theory of relativity, how does the speed of light in a vacuum compare to the speed of light in any other reference frame?

a) The speed of light is faster in other reference frames.

b) The speed of light is slower in other reference frames.

c) The speed of light is the same in all reference frames.

d) The speed of light is inversely proportional to the observer's speed.

Answer : c

4. What is time dilation in the context of special relativity?

a) The stretching of time due to gravitational forces

b) The slowing down of time for a moving observer compared to a stationary one

c) The speeding up of time for a moving observer compared to a stationary one

d) The complete cessation of time in a vacuum

Answer : b

5. The formula E=mc2 is associated with:

a) Planck's constant

b) The speed of light

c) The law of conservation of energy

d) The mass-energy equivalence principl

Answer : d

6. General relativity explains gravity as:

a) A force between masses

b) A result of electromagnetic interactions

c) Curvature of spacetime caused by mass and energy

d) A consequence of dark matter

Answer : c

7. The bending of light when it passes through a gravitational field is known as:

a) Dispersion

b) Diffraction

c) Refraction

d) Gravitational lensing

Answer : d

8. In the theory of relativity, "spacetime" refers to

a) The combination of space and time into a four-dimensional continuum

b) The separation of space and time into distinct entities

c) The transformation of energy into space and time

d) The expansion of the universe

Answer : a

9. Which phenomenon occurs as an object approaches the speed of light according to the theory of special relativity?

a) The object becomes infinitely massive

b) The object's length contracts along its direction of motion

c) The object's mass decreases

d) The object's kinetic energy decreases

Answer : b

10. What is the fundamental idea behind Einstein's theory of relativity?

a) Energy and momentum conservation

b) Absolute space and time

c) Gravity as a force between masses

d) The laws of physics are the same for all non-accelerating observers

Answer : d

11. Mass – Energy relation, E = _____.

a) mc

b) mc^2

c) m^2c

d) m^2c^2

Answer : b

12. Accelerated frame of reference is called _____ frames.

   a) Non-inertial

  b) Inertial

  c) Unaccelerated

  d) None

  Answer : a

13. The contraction in the length of an object along its direction of motion is known as_____ .

   a) Lorentz- Fitzgerald contraction

   b) Time dilation

   c) Relativity of simultaneity

   d) None

  Answer : a

14. As an object approaches the speed of light, it's mass becomes _____

   a) Zero

   b) Double

   c) Remains Same

   d) Infinite

  Answer : d

15. The orbit of mercury is changing slightly due to the sun's gravity.

   a) True

   b) False

Answer : a

16. According to Einstein's Special Theory of Relativity, laws of physics can be formulated based on

   a) Inertial Frame of Reference

   b) Non-Inertial Frame of Reference

   c) Both Inertial and Non-Inertial Frame of Reference

   d) Quantum State

Answer : a

17. For Einstein's relation, $E^2 - p^2c^2 =$ _____

   a) $m_o c^2$

   b) $m_o^2 c^4$

   c) $m_o c^4$

   d) $m_o^2 c^6$

Answer : b

18. A frame of reference has four coordinates, x, y, z, and t is referred to as the_____

   a) Inertial frame of reference

   b) Non-inertial frame of reference

   c) Space-time reference

   d) Four-dimensional plane

Answer : c

19. In the case v << c, Lorentz transformation is the same as _____

   a) Einstein's transformation

   b) Galilean transformation

   c) Maxwell's transformation

   d) Planck's transformation

   Answer : b

20. When a particle is moving with a velocity of light c relative to S, its velocity as observed by an observer in the frame S' is _____

   a) Zero

   b) 0.5 c

   c) 0.75 c

   d) c

   Answer : d

21. Lorentz transformations are based on the principle of consistency of the velocity of light.

   a) True

   b) False

   Answer : a

22. In Lorentzian relativity, if two events are simultaneous for one observer, they will be

simultaneous for all other observers as well.

a) True

b) False

Answer : b

23. For u$^{'}$ < c and v < c the equation becomes

a) u $= u'+vu'vc^2$

b) u $= u'+v1+u'v$

c) u $= 1+u'vc^2$

d) u $=$ u' $+$ v

Answer : d

24. According to the special theory of relativity, physical laws are the same in frames of reference which?

a) Move at Uniform Velocity

b) Accelerate

c) Move-in Circles.

d) Move-in Ellipses

Answer : a

25. Clocks in a moving reference frame, compared to identical clocks in a stationary reference frame, appear to run

a) Slower

b) At the Same Rate

c) Faster

d) Backward in Time

Answer : a

26. The term "relativistic" refers to effects that are

a) Observed when speeds are near the speed of light.

b) Noticed a moving object.

c) Observed when objects move backward in time.

d) Measured by stationary observers only.

Answer : a

27. The purpose of the Michelson-Morley experiment was to

a) Determine the velocity of light.

b) Detect possible motion of the Earth relative to the sun.

c) Detect possible motion of the sun relative to the ether.

d) Detect possible motion of the Earth relative to the ether

Answer : d

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Five mark Questions

1. Discuss Minkowski four dimensional time continuum.
2. Discuss Galilean Transformation.
3. Briefly write about Newtonian relativity.
4. Discuss about interpretation of Negative result of Michelson Experiment.
5. Discuss Length contraction.
6. Discuss Time Dilation.
7. Derive $E=MC^2$

Ten mark Questions

1. Explain Einstein's special theory of relativity.
2. Explain relativistic formula for the variation of Mass with velocity.
3. Explain General theory of Relativity.
4. Explain Lorentz Transformation equation to find new concept of the invariance of light velocity in free space, also find inverse Lorentz transformation equation.
5. Explain Michelson Morley Experiment with neat diagram and discuss about it's result.
6. Explain Addition of velocities and length contraction of Einstein's special theory of relativity.

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SOLID STATE PHYSICS

MULTIPLE CHOICE QUESTIONS

UNIT-I

Crystal Structure

1. Crystal Structure defined as _____

   a) Lattice + Basis

   b) Unit cell + Lattice

   c) Basis

   d) Basis + Unit cell

  Answer : a

2. The number of lattice points in a primitive cell are

   a) 1

   b) 2

   c) 1/2

   d) 3/2

  Answer : a

3. Which of the following metals crystallizes in FCC structure?

   a) Al

   b) Zinc

c) Sodium

d) Cscl

Answer : a

4. The packing factor of diamond cubic crystal structure is

a) 60%

b) 56%

c) 90%

d) 34%

Answer : d

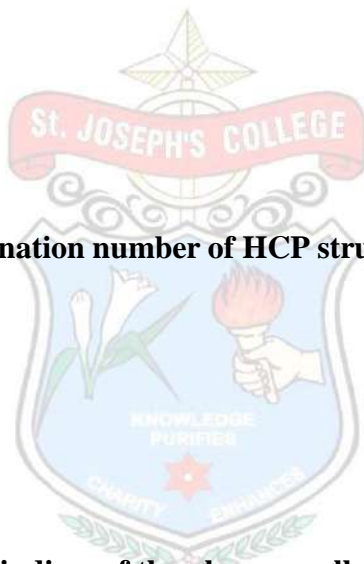**5. The coordination number of HCP structure is**

a) 8

b) 12

c) 2

d) 6

Answer : b

6. The miller indices of the plane parallel to the x and y-axes are

a) (1 0 0)

b) (0 1 0)

c) (0 0 1)

d) (1 1 1)

Answer : c

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

  a) 2a 3b c
  b) a b c
  c) a 2b 3c
  d) None
  Answer : a

8. A plane parallel to one of the coordinate axes has an intercept of infinity,

  a) Yes
  b) No
  Answer : a

9. The number of equidistant nearest neighbouring atoms called

  a) Atomic radius
  b) Coordination number
  c) PF
  d) All
  Answer : b

10. Half of the distance between the nearest neighbouring atom is

a) Atomic radius

b) Coordination number

c) No. of atom

d) None

Answer : a

11. Amorphous solids have_____ structure.

a) Regular

b) Linear

c) Irregular

d) Periodic

Answer : c

12. A unit cell that contains lattice points only at the corners is known as

a) Primitive cell

b) Non-Primitive

c) Space lattice

d) Basis

Answer : a

13. How many carbon atoms are present in a unit cell of a diamond?

a) 1

b) 6

c) 8

d) 4

Answer : c

14. What is the percentage of free space in a BCC unit cell?

a) 28%

b) 34%

c) 32%

d) 30%

Answer : c

15. The colour in solid alkali metal halides appears due to

a) F- centres

b) Interstitial Positions

c) Frenkel defect

d) Schottky defect

Answer : a

16. What are interfacial axes and inter axial angles of cubic crystal system

a) a=b=c & α=β=γ=90̊

b) a=b=c & α=β=γ≠90̊

c) a=b≠c& α=β≠γ≠90̊

d) a≠b≠c& α≠β≠γ≠90̊

Answer : a

17. What are interfacial axes and inter axial angles of Tetragonal crystal system

a) $a \neq b \neq c$ & $\alpha \neq \beta \neq \gamma \neq 90°$

b) $a = b = c$ & $\alpha = \beta = \gamma \neq 90°$

c) $a = b \neq c$ & $\alpha = \beta \neq \gamma \neq 90°$

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

Answer : d

18. What are interfacial axes and inter axial angles of Hexagonal crystal system

a) $a \neq b \neq c$ & $\alpha \neq \beta \neq \gamma \neq 90°$

b) $a = b = c$ & $\alpha = \beta = \gamma \neq 90°$

c) $a = b \neq c$ & $\alpha = \beta = 90°$; $\gamma = 120°$

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

Answer : c

19. APF =

a) Volume occupied by atom in unit cell/ Volume of unit cell

b) Volume of unit cell / Volume occupied by atom

c) Volume occupied by atom × Volume of unit cell

d) Volume occupied by atom **-** Volume of unit cell

Answer : a

20. Number of atoms per unit cell in BCC structure

a) 1 atom

b) 2 atom

c) 4 atom

d) 0 atom

Answer : b

21. Coordination number of BCC structure

a) 4

b) 7

c) 6

d) 8

Answer : d

21. Distance between nearest neighboring atoms (Atomic Radius) of FCC structure

a) $r = a \frac{\sqrt{2}}{4}$

b) $a = r \frac{\sqrt{2}}{4}$

c) $r = a \frac{4}{\sqrt{2}}$

d) None

Answer : a

22. Coordination number of HCP structure

a) 10

b) 12

c) 6

d) 8

Answer : b

23. Number of atoms per unit cell in HCP structure

a) 1

b) 8

c) 2

d) 6

Answer : d

24. The ratio of c/a is

a) $\frac{\sqrt{8}}{\sqrt{3}}$

b) $\frac{\sqrt{3}}{\sqrt{8}}$

c) 8.3

d) $\sqrt{\frac{8}{3}}$

Answer : a & d

25. The value of $\sqrt{\frac{8}{3}}$ is

a) 1.833

b) 1.633

c) 1.333

d) 1.366

Answer : b

26. The difference between the number of atoms in a unit cell of a BCC crystal and an FCC crystal is
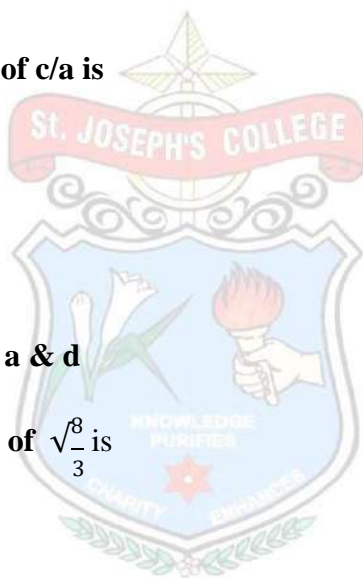
a) 1

b) 2

c) 4

d) 6

Answer : b

27. When BCC iron is heated, it changes to FCC iron resulting in

a) Contraction in volume

b) Increase in volume

c) No change in volume

d) Crack in the material

 Answer : a

28. In a silicon crystal, the arrangements of atoms are repeated periodically. This type of material is classified as

(a) Amorphous and non-crystalline

(b) Non-crystalline and epitaxial

(c) Epitaxial and single crystal

(d) Amorphous and single crystal

Answer : c

29. Which one of the following statements is correct?

(a) Hard and brittle

(b) Soft and elastic

(c) Hard and corrosive

(d) Soft and inflammable

Answer : a

30. Which one of the following exhibits the most well defined X-ray diffraction pattern?

(a) A polycrystalline aggregate

(b) An amorphous material

(c) A single crystalline material

(d) A plastically deformed crystal

Answer : c

31. In a crystal lattice, what are the vacancies created by the absence of certain atoms known as?

a) Hertz defects

b) Schottky defects

c) Pauli defects

d) Crystal defect

Answer : b

32. Epitaxial lll-V group semiconductor compounds have which one of the following crystal structures?

a) BCC

b) FCC

c) Hexagonal

d) Zinc blends

Answer : d

33. In ionic crystal, electrical conductivity is

a) Very high

b) Depends on the material

c) Depends on temperature

d) Practically zero

Answer : d

34. The crystal in which atoms are chemically highly inactive and they do not form compounds with other atoms is

a) Ionic crystal

b) Metal

c) Valance crystal

d) Van der walls crystal

Answer : d

35. The coordination number and the atomic packing factor for Hexagonal closely packed (HCP) and face-centered cubic crystal structure are respectively

a) 8 and 0.74

b) 12 and 0.68

c) 8 and 0.68

d) 12 and 0.74

Answer : d

36. The atomic packing factor for dace centered cubic (FCC) crystal structure is

    a) 0.63
    b) 0.74
    c) 7.4
    d) 6.3
    Answer : b

37. The ratio of ionic of cations i.e. r_c and that of Anions i.e. r_A for stable and unstable ceramic crystal structure, is

    a) Less than unity
    b) Greater than unity
    c) Unity
    d) Either lesser or greater than unity
    Answer : a

Five mark questions

1. Draw the structure of seven crystal system.
2. Calculate the atomic packing factor for diamond structure.
3. Describe Miller indices.
4. Draw the plane for (0 0 1), (1 0 $\bar{1}$), (1 0 0), (1 1 1), (0 1 0)
5. Derive c/a ratio value of HCP structure.
6. Discuss APF of HCP structure.

7. Describe Atomic radius, coordination number, Number of atoms per unit cell, APF.

8. Describe APF for FCC structure.

9. Find the packing factor for perovskite structure.

10. Discuss about sodium chloride & Zinc Blende structure.

Ten Mark Questions:

1. Draw neatly 14 Bravais Lattice structures with their parameters.

2. Explain SC structure with neat diagram and their parameters.

3. Explain the structure of FCC with APF.

4. Explain HCP structure with neat diagram and find the c/a ratio value.

5. Explain the HCP structure with neat diagram and find the APF in %

6. Explain the characteristics of Diamond Structure with APF.

7. Explain the structure of BCC with APF.

UNIT-II

Crystallography and Crystal Imperfections

MULTIPLE CHOICE QUESTIONS

1. X- Ray crystallography requires the formation of pure crystals to acquire accurate results.

a) False

b) True

Answer : b

2. Which among the following is not a method to generate X-rays?

a) Synchrotron

b) Radioactive

c) Bombarding metal source with electron

d) Bombarding metal source with electromagnetic radiation

Answer : d

3. What is the device on which the crystal is mounted known as?

a) X- Ray source

b) Collimator

c) Goniometer

d) Refractometer

Answer : c

4. Bragg Equation is

a) $n\lambda = 2$

b) $n = 2d$

c) $n\lambda = 2d$

d) $n\lambda = 2f$

Answer : c

5. Which of the following is a point defect in crystals?

a) Edge dislocation

b) Interstitials

c) Grain boundaries

d) Cracks

Answer : b

6. The defect that occurs due to a displacement of an ion is known as_____

a) Vacancy defect

b) Schottky defect

c) Frankel defect

d) Interstitials

Answer : c

7. _____ occurs when a foreign substance replaces an atom in a crystal.
   a) Vacancy defect
   b) Frankel defect
   c) Interstitials
   d) Substitutional

   Answer : d

8. In screw dislocation, the Burger's vector lies _____ to the dislocation line.
   a) Perpendicular
   b) Parallel
   c) At an angle
   d) Sideways

   Answer : b

9. What are the 2D defects?
   a) Boundary defect
   b) Point defect
   c) Line defect
   d) Volume defect

   Answer : a

10. How is the Dislocation energy defined?
   a) m^{-1}

b) m^{-2}

c) m^2

d) Nm^{-1}

Answer : a

11. As the atomic number increases, the frequency of X-Ray from a target material

a) Increases

b) Same

c) Decreases

d) Varying

Answer : a

12. Bragg's law is the special case of

a) Laue diffraction

b) In-elastic scattering

c) Rayleigh's scattering

d) Newton's scattering

Answer : a

13. Twin boundaries are which type of crystal defect?

a) Line defect

b) Point defect

c) Surface defect

d) None

Answer : c

14. In screw dislocation, the Burger vector lies _____ to the dislocation line.

    a) Perpendicular

    b) Parallel

    c) Tangential

    d) all of these

    Answer : b

15. Point defects are _____ dimensional.

    a) One

    b) Zero

    c) Two

    d) Three

    Answer : b

16. Which of the following is the main filament used in the Coolidge tube?

    a) Magnesium

    b) Platinum

    c) Tungsten

    d) All of these

    Answer : c

17. Which of the following rays are used in the powder method of crystals?

    a) Gamma rays

b) α-rays

c) β-rays

d) Monochromatic X-rays

Answer : d

18. The relationship between minimum wavelength of X-radiation generated from a target metal and applied voltage is given by

   a) Bragg's equation

   b) Moseley equation

   c) Illkovik equation

   d) Duane-Hunt equation

   Answer : d

19. As the applied voltage increases, the minimum wavelength of X-radiation from a metal

   a) Increases

   b) Decreases

   c) Remains same

   d) Variable with metal

   Answer : b

20. Which of the following has long wavelength

   a) $K_{\alpha 1}$

   b) $K_{\beta 1}$

   c) $K_{\alpha 2}$

d) $K_{\beta2}$

Answer : a

21. In goniometer, if analyzing crystal rotates at angle of 30 º, the detector should rotate at an angle of

a) 15 º
b) 30 º
c) 45 º
d) 60º

Answer : d

22. As the atomic number increases, the frequency of X-radiation from a target material

a) Increases
b) Decreases
c) Remains same
d) Variable with metal

Answer : a

23. A disturbance in a region between two ideal parts of a crystal is known as _____
a) Boundary defect
b) Point defect
c) Line defect
d) Volume defect

Answer : c

24. _____occurs when a foreign substance replaces an atom in a crystal.

   a) Vacancy defect

   b) Substitutional impurity

   c) Frankel defect

   d) Interstitial impurity

   Answer : b

25. A disturbance in a region between two ideal parts of a crystal is known as _____

   a) Boundary defect

   b) Point defect

   c) Line defect

   d) Volume defect

   Answer : c

26. In screw dislocation, the Burger's vector lies _____to the dislocation line.

   a) Perpendicular

   b) Parallel

   c) At an angle

   d) Sideways

   Answer : b

27. Generation of dislocations can be identified using

a) Schottky mechanism

b) Burger's vector

c) Twist

d) Frank-Read mechanism

Answer : d

28. What are one-dimensional defects?

a) Boundary defect

b) Point defect

c) Line defect

d) Volume defect

Answer : c

29. What are two-dimensional defects?

a) Boundary defect

b) Point defect

c) Line defect

d) Volume defect

Answer : a

30. Beneficial property of foreign particles

a) Reduces density

b) Act as stress raisers

c) Obstructs dislocation motion

d) None

Answer : c

31. Requirement for cross-slip movement of dislocation

a) Preferred slip plane

b) Preferred slip direction

c) No preferred slip plane

d) No preferred slip direction

Answer : c

32. Average frequency of atomic vibrations in a solid (in Hz)

a) 10^{-12}

b) 10^{13}

c) 10^{-13}

d) 10^{-14}

Answer : b

33. Conservative movement of dislocations

a) Slip

b) Climb

c) Both slip and climb

d) None

Answer : a

34. Taylor dislocation can not move by the following way

a) Slip

b) Climb

c) Cross-slip

d) All

Answer : b

35. Thermodynamically stable defects

a) Point defects

b) Line defects

c) Surface defects

d) Volume defects

Answer : a

36. Figure out the odd one in the following

a) Frenkel defect

b) Tilt boundary

c) Twist boundary

d) Stacking fault

Answer : a

37. Following is not the 2-dimensional imperfection

a) Twin boundary

b) Dislocation

c) Surface

d) Grain boundary

Answer : b

38. In a crystal, if a fault exists in the arrangement at a point, it is called as _____

    a) Space defect
    b) Single defect
    c) Point defect
    d) Primary defect
    Answer : c

39. Stainless steel is a/an_____alloy.

    a) Vacant
    b) Interstitial
    c) Substitution
    d) Pure
    Answer : b

40. Schottky defects are observed in solids with cations and anions of similar sizes. Which of the following compounds, therefore, isNOT likely to have a Schottky defect?

    a) NaCl
    b) AgCl
    c) CsCl
    d) KCl
    Answer : b

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Five Mark Questions

1. Explain Bragg's law of X-ray diffraction.
2. Explain about line defects.
3. Describe Bragg's Law.
4. Describe Point Defects.
5. Describe Powder Photograph method.
6. Discuss about surface Defects.
7. Discuss about volume Defects.

Ten Mark Questions

1. Describe about Powder crystal technique.
2. Explain about crystal imperfections and its classifications.
3. Explain Bragg's Experiment with neat diagram.
4. Explain Rotating crystal method.

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UNIT-III

Magnetism and Superconductivity

MULTIPLE CHOICE QUESTIONS

1. Which of the following is the correct expression for curie's law?

  a) $\lambda = C / T$

  b) $\lambda = 1 / T$

  c) $\mu = C / T$

  d) $\mu = 1 / T$

Answer : a

2. Curie's law is applicable at every point on a paramagnetic material.

  a) True

  b) False

Answer : b

3. The phenomenon of perfect diamagnetism is called

  a) Superconductivity

  b) Diamagnetic effect

  c) Kelvin effect

  d) Meissner effect

Answer : d

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4. Magnetic Susceptibility χ is

    a) Dipole moment per unit volume

    b) Torque per unit area

    c) Magnetization per unit field intensity

    d) None

    Answer : c

5. In ferromagnetic material, susceptibility is

    a) Very small & + ve

    b) Very small & - ve

    c) Very large & + ve

    d) Very large & - ve

    Answer : c

6. The unit of magnetic permeability is

    a) H/m

    b) H m

    c) Wb m

    d) H/s

    Answer : a

7. Which of the following material does not have permanent dipoles

    a) Paramagnetic

    b) Diamagnet

    c) Ferromagnet

d) Antiferro

Answer : b

8. Curie - Weiss Law is

a) $\chi_m = C/T$
b) $\chi_m = C/\theta$
c) $\chi_m = C/(T - \theta)$
d) $\chi_m = C/(T + \theta)$

Answer : c

9. Material in which magnetization persists even after the field has been removed are

a) Diamagnetic
b) Paramagnetic
c) Soft Ferro magnet
d) Hard ferro magnet

Answer : d

10. At high temperature a ferro magnet becomes_____

a) Diamagnetic
b) Paramagnetic
c) Soft Ferro magnet
d) Hard ferro magnet

Answer : b

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11. When ferromagnetic rod is placed in a solenoid with current, what happens in rod?

   a) Retentivity increases

   b) Permanently Magnetized

   c) Coercivity increases

   d) None

   Answer : b

12. Ferrites are materials that have

   a) Low permeability

   b) High Permeability

   c) High energy

   d) Low Volt

   Answer : b

13. The materials having very small susceptibility at all temperatures are

   a) Antiferromagnetic

   b) Diamagnetic

   c) Ferromagnetic

   d) Paramagnetic

   Answer : a

14. Susceptibility in Antiferromagnetic material is

a) Decreases

b) Increases

c) Small

d) Large

Answer : a

15. Susceptibility at all temperatures in Antiferromagnetic material is

a) High

b) Zero

c) Small

d) Infinity

Answer : c

16. Below critical temperature superconducting material shows

a) Zero resistivity

b) High resistivity

c) Small resistivity

d) None

Answer : a

17. Current passed into a superconductor is reduced below its critical temperature, the voltage measured across it would be

a) Unstable

b) Stable

c) Zero

d) None

Answer : c

18. If the temperature of a superconductor is reduced below its critical temperature, its resistivity

a) Decreases

b) Increases

c) Zero

d) None

Answer : c

19. Below critical temperature, Superconductor is

a) Perfect Diamagnetic

b) Paramagnetic

c) Ferromagnetic

d) Metal

Answer : a

20. The Meissner effect is--------- of magnetic flux within the superconductor

a) Reduced

b) Expulsion

c) Attraction

d) Increased

Answer : b

21. Transition temperature of Mercury is

  a) 0K

  b) 4K

  c) 4.18K

  d) 100K

 Answer : c

22. The phenomena of superconductivity was first discovered by

  a) Neils Bohr

  b) H. KamerlinghOnnes

  c) Richard smalley

  d) Lehman

 Answer : b

23. Which of the following is the unit of magnetic flux density?

  a) Weber/meter^2

  b) Tesla

  c) Newton/ampere-metre

  d) All of the above

 Answer: b

24. The magnetism of a magnet is due to

a) Earth

b) Cosmic rays

c) Due to pressure of big magnet inside the earth

d) Spin motion of electrons

Answer: d

25. Which of the following materials is the most suitable for making a permanent magnet?

a) Soft Iron

b) Nickel

c) Copper

d) Steel

Answer: d

26. A long magnet is cut into two parts such that the ratio of their lengths is 2:1. What is the ratio pole strength of both the section?

a) 1:2

b) 2:1

c) 4:1

d) Equal

Answer: d

27. A sensitive magnetic field instrument can be effectively shielded from the external magnetic field by placing it inside which of the following materials?

a) Plastic Material

b) Teak Wood

c) Soft Iron of high permeability

d) A metal of high conductivity

Answer: c

28. What happens to the magnetic moment if a hole is made at the center of a bar magnet?

a) Decreases

b) Increases

c) Not a change

d) None of the above

Answer: c

29. Magnetic lines of force of a bar magnet do not intersect because

a) The lines have similar charges hence they repel each other

b) The lines always diverge from a single point

c) A point always has a single net magnetic field

d) The lines need magnetic lenses to intersect

Answer: c

30. A horse-shoe magnet is an example of _____.

a) Natural magnet

b) Artificial magnet

c) Neither natural nor artificial

d) None of these options

Answer: b

31. A permanent magnet has the capacity to attract

a) All substances

b) Some substances

c) Only ferromagnetic substances

d) None of these options

Answer: c

32. The SI unit of magnetic flux is

a) Dyne

b) Tesla

c) Weber

d) Ohm

Answer: c

33. Susceptibility is positive for

a) Ferromagnetic material

b) Paramagnetic material

c) Diamagnetic material

d) Option (a) and (b)

Answer: d

34. In superconductivity the conductivity of a material becomes

a) Zero

b) Finite

c) Infinite

d) None of the above

Answer: c

35. In superconductors, the Fermi energy level is

a) Below the ground state

b) Midway between the ground state and first excited state

c) Above first excited state

d) At first excited state

Answer: b

36. Which of the following are the properties of superconductors?

a) They are diamagnetic in nature

b) They have zero resistivity

c) They have infinite conductivity

d) All of the above

Answer: d

37. The minimum amount of current passed through the body of superconductor in order to destroy the superconductivity is called

a) Induced current

b) Critical current

c) Eddy current

d) Hall current

Answer: b

38. The energy required to break a cooper pair is _____ the energy gap of superconductor.

a) One half

b) Equal to

c) Twice

d) Thrice

Answer: b

39. There are three important lengths which enter the theory of superconductivity except

a) London penetration length

b) Intrinsic coherence length

c) Normal electron mean free length

d) Mean path length

Answer: d

40. The magnetic lines of force cannot penetrate the body of a superconductor, a phenomenon is known as

a) Isotopic effect

b) BCS theory

c) Meissner effect

d) London theory

Answer: c

41. The phenomena of super conductors was first discovered by _____

a) Kammerlingh Onnes

b) Neils bohr

c) Richard Smalley

d) Otto lehman

Answer: a

42. Super conductors are discovered in the year _____
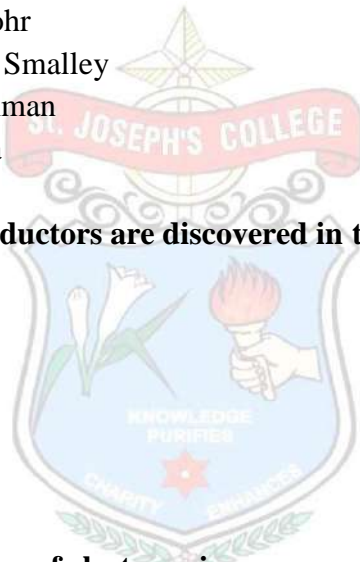
a) 1900

b) 1991

c) 1911

d) 1905

Answer: c

43. The shifting of electrons in super conductors is prevented by _____

a) Quantum effect

b) Threshold energy level

c) Energy barrier

d) Orbitals

Answer: a

44. The normal metal passes into super conducting state at _____

   a) High temperature

   b) Low temperature

   c) Critical temperature

   d) No temperature

Answer: c

45. Based on magnetic response super conductors are of _____ types.

   a) 1

   b) 2

   c) 3

   d) 4

Answer: b

46. Ideal super conductors completely become _____ at super conducting state.

   a) Diamagnetic

   b) Ferromagnet

   c) Ferrimagnetism

   d) Paramagnet

Answer: a

47. The hard super conductors are those in which the ideal behaviour is seen up to a _____ Critical magnetic field.

   a) Higher
   b) Lower
   c) Moderate
   d) Zero

Answer: b

48. This functions as a super conductor at a critical temperature of _____

   a) $30^{\circ}K$
   b) $60^{\circ}K$
   c) $90^{\circ}K$
   d) $120^{\circ}K$

Answer: c

49. Type-I superconductors can produce a magnetic field of the order of......

   a) 100 Tesla
   b) 10 Tesla
   c) 5 Tesla
   d) 0.1 Tesla

Answer: d

50. The transition temperature of mercury is.....

a) 7.5 K
b) 12 K
c) 4.8 K
d) 4.2 K
Answer: d

51. SQUIDS are used to measure..........associated with brain and chest.
a) Power
b) Energy
c) Stress
d) Voltages
Answer: d

52. Maglev trains are constructed based on effect.
a) Gravitation
b) Electrical
c) Meissner
d) None
Answer: c

53. The cooper pair is
a) Two electrons moving in the same direction
b) Two electrons with resultant spin-zero
c) Two electrons connected like a boson
d) Two electrons connected through a phonon

Answer: d

54. Mercury has its transition temperature of 4.185 K when its isotopic mass is

a) 208.7 u
b) 199.5 u
c) 192.3 u
d) 203.4 u

Answer: b

55. Super conductivity is exhibited by

a) Hydrogen at 4.2 K
b) Mercury at 4.0 K
c) Mercury at 4.2 K
d) Potassium at 4.2 K

Answer: c

Five Mark Questions:

1. Explain Meissner effect.
2. Discuss the Classical theory of diamagnetism.
3. Differentiate the type I & II superconductor.
4. Discuss the Classical theory of Paramagnetism.
5. Describe the structure of ferrites.
6. Classify about the magnetic materials.

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Ten Mark Questions:

1. Discuss in detail about quantum theory of Ferromagnetism.
2. Explain about the Langevin's theory of diamagnetism.
3. Explain about the Langevin's theory of Paramagnetism.
4. Explain Weiss theory of Paramagnetism.
5. List out the properties of superconductor.
6. List out the application of superconductor
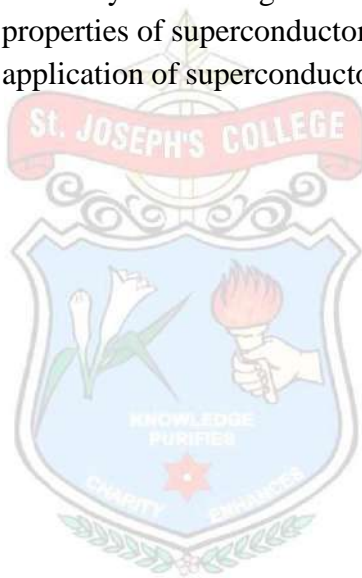
UNIT-IV

Dielectrics

Multiple Choice Questions:

1. Dielectric material is also called
   a) Insulator
   b) Conductor
   c) Semiconductor
   d) All
   Answer: a

2. When electric field increases, polarization will be
   a) Increases
   b) Decreases
   c) Zero
   d) Not defined
   Answer: a

3. Polar molecule has electric dipole moment, at E=0
   a) Yes
   b) No
   Answer: a

4. In a dielectric, the power loss is proportional to
   a) ω

b) ω^2

c) $1/\omega$

d) $1/\omega^2$

Answer: a

5. Example for dielectric material

a) AC

b) Fridge

c) Capacitor

d) Transformer

Answer: c & d

6. Which of the following term is not valid for dielectric materials

a) Dielectric constant

b) Permittivity

c) Polarization

d) Permeability

Answer: d

7. Dielectric constants of liquid dielectrics are _____ gaseous.

a) Smaller than

b) Larger than

c) Equal to

d) None

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Answer: a

8. Dielectric constants of liquid dielectrics are _____ Solid.

  a) Smaller than

  b) Larger than

  c) Equal to

  d) None

Answer: b

9. Dielectrics have no free electrons.

  a) Yes

  b) No

  Answer: a

10. An ionic polarization is characterized by _____

    a) Shifting of electron cloud

    b) Orientation of dipole moment

    c) Formation of positive negative ions

    d) None

    Answer: c

11. Which of the following is not a dielectric material?

    a) Paper

    b) Ceramic

    c) Air

d) Wood

Answer: d

12. Which of the following material is an insulating material but not the dielectric

a) Rubber

b) Ceramic

c) Air

d) All

Answer: a

13. A good dielectric material is characterized by

a) High value of loss tangent

b) Low value of loss tangent

c) Moderate value of Loss tangent

d) None

Answer: b

14. The forbidden energy gap of dielectrics is_____

a) Less than 1.2 eV

b) 0.2 – 0.5 eV

c) Less than 3 eV

d) More than 3 eV

Answer: d

15. What is the SI unit of dielectric constant?

a) C/m^2

b) F/m

c) V / m

d) Ohm

Answer: b

16. The electronic polarisabilityα_e of a mono-atomic gas atom is

a) $4\pi\varepsilon_0$

b) $4\pi\varepsilon_0 R$

c) $4\pi\varepsilon_0 R^2$

d) $4\pi\varepsilon_0 R^3$

Answer: d

17. Unit of dielectric constant is

a) N/m

b) m

c) No unit

d) Coulomb

Answer: c

18. In which type of breakdown, an avalanche of electrons is formed?

a) Defect Breakdown

b) Thermal Breakdown

c) Intrinsic Breakdown

d) Electrochemical Breakdown

Answer: c

19. Dielectric materials do not have

a) Free electrons
b) Bound charge
c) Proton
d) Neutron

Answer : a

20. How can a dielectric be converted to a conductor?

a) Compression
b) Heating
c) Expanding
d) Freezing

Answer : b

21. The dielectric constant cannot be

a) Infinity
b) 5
c) 6
d) 7

Answer : a

22. What causes ionic polarization?

a) Ion splitting
b) Magnetic field passing
c) Cation and anion displacement
d) Never occurs
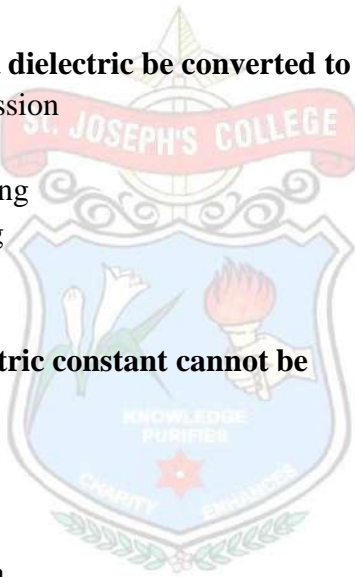
Answer : c

23. Which of the below polarizations occurs rapidly?

a) Electronic polarization

b) Ionic polarization

c) Space charge polarization

d) Orientation polarization

Answer : a

24. Which of the following term is not valid for dielectric materials?

a) Dielectric constant

b) Permittivity

c) Polarization

d) Permeability

Answer: d

25. Dielectric constants of liquid dielectrics are _____ gaseous dielectrics.

a) Smaller than

b) Larger than

c) Equal to

d) None of these

Answer : a

26. A lossy dielectric's equivalent circuit can be represented by

a) Capacitance only

b) Pure capacitance in series with inductance

c) Pure capacitance in parallel with resistance

d) None of the above

Answer : c

27. Materials having low dielectric constant are used in

a) Permanent magnet

b) Lasers

c) PCBs

d) Microwave applications

Answer : d

28. Which of the following restricts the flow of electrical energy?

a) Superconductors

b) Passive dielectrics

c) Polar molecules

d) Active dielectric

Answer : b

29. Polar molecules have permanent dipole moments even in the absence of an electric field.

a) False

b) True

Answer : b

30. When does a dielectric become a conductor?

    a) At avalanche breakdown

    b) At high temperature

    c) At dielectric breakdown

    d) In the presence of magnetic field

   Answer : c

Five Mark Questions

1. Discuss abut basic definitions of dielectrics.

2. Discuss about dielectric loss and mention V-I characteristics.

3. Give the properties of dielectric materials.

4. Discuss the types of insulating materials.

5. Derive electronic polarization of dielectrics.

6. Derive Ionic Polarization of dielectrics.

7. Briefly discuss about the frequency and temperature effects on polarization.

Ten Mark Questions

1. Define Local Field and deduce an expression for the internal field in a solid dielectric.

2. Obtain Clausius – Mosotti relation.

3. Discuss in detail the various types of dielectric polarization mechanism.

4. Explain in detail, the various types of dielectric breakdown mechanisms.

5. Explain the uses of dielectric materials in capacitors and transformers.

UNIT-V

Thermal & Electrical Properties of Solids

Multiple Choice Questions:

1. At lower temperatures the lattice specific heat varies as

  a) T^3

  b) $1/T$

  c) T

  d) $1/T^3$

  Answer : a

2. Which of the following relation gives Wiedemann-Franz Law?

  a) $\sigma_T/\sigma = LT$

  b) $\sigma/\sigma_T = LT$

  c) $\sigma_T/\sigma = L/T$

  d) $\sigma/\sigma_T = L/T$

  Answer: a

3. Highest occupied energy level of a material at absolute 0K

  a) Acceptor level

  b) Donor Level

  c) Fermi Energy

d) Zero energy

Answer: c

4. The temperature............. during the melting of solid.

   a) Increases

   b) Decreases

   c) Does not change

   d) Depending on the nature of the solid, it may increase or decrease.

   Answer : a

5. Choose the least thermal conductivity from the following?

   a) Air

   b) Diamond

   c) Water

   d) Iron

   Answer : a

6. During the phase change, heat given to the substance is called as……..

   a) Thermal capacity

   b) Latent heat

   c) Specific heat

   d) None of the above

   Answer : b

7. Thermal conductivity is the rate of heat transfer

  a) Per unit area per unit thickness

  b) Per unit area per unit temperature difference and per unit wall thickness

  c) Per unit area per unit temperature difference

  d) None of the above

  Answer : b

8. The dimensions of thermal conductivity can be expressed in

  a) Temperature

  b) Length

  c) Mass

  d) All of the above

  Answer : d

9. Steady state heat conduction takes place in

  a) Solids only

  b) Viscous liquid only

  c) Liquids only

  d) Gases only

  Answer : a

10. Basic techniques for measuring thermal conductivity

  a) Steady-state methods

  b) Transient or non-steady-state methods

   c) Both (1) and (2)

   d) None of the above

   Answer : c

11. Transient heat conduction depends upon

   a) Temperature & time

   b) Time, temperature & space

   c) Time and space

   d) None

   Answer : c

12. Which of the following is time consuming method used for measurement of thermal conductivity?

   a) Hot-wire method (THW)

   b) Guarded hot plate method (GHP)

   c) Laser flash method

   d) Hot-strip technique

   Answer : b

13. Which one of the following forms of water have the highest value of thermal conductivity?

   a) Boiling water

   b) Steam

   c) Solid ice

   d) Melting ice

Answer : c

14. Most metals are good conductor of heat because of

a) Transport of energy
b) Free electrons and frequent collision of atoms
c) Lattice defects
d) Capacity to absorb energy

Answer : b

15. The SI unit of specific heat capacity is

a) $J \, kg^{-1} \, K^{-1}$
b) $J \, kg \, k$
c) $J \, kg^{-1}$
d) $J \, kg^{-1} \, k$

Answer : a

16. In the isolated system temperature of the system

a) Increases
b) Decreases
c) Remains constant
d) No change

Answer : d

17. The change of state from liquid to solid is called as

a) Melting
b) Boiling
c) Vaporisation
d) Freezing

Answer : d

18. The temperature at which liquid and the vapour states of the substance co-exist is called as

a) Melting point
b) Freezing point
c) Boiling point
d) None

Answer : c

19. The SI unit of thermal conductivity is

a) $J\ s^{-1}\ m^{-1}\ K^{-1}$
b) $W\ m^{-1}\ K^{-1}$
c) Both a and b
d) None

Answer : b

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Five Mark Questions:

1. Define
    (i) Electron Drift
    (ii) Mobility
    (iii) Mean free path
    (iv) Relaxation ions
    (v) Fermi energy

2. Derive an expression for electrical conductivity of metal.

3. Derive an expression for thermal conductivity of metal.

4. Discuss Wiedmannfranz law.

Ten Mark Questions

1. Derive an expression for the specific heat capacity by Dulong and petit law.

2. Derive an expression for Einstein's theory of specific heat capacity of solids.

3. What conclusion can be drawn by comparing the Debye and Einstein model to explain the low temperature behavior of lattice heat capacity in solids?

4. Why Einstein theory could not explain the experimentally observed low temperature specific heat of solids.

5. Explain Debye's Approximation.

6. Derive an expression for electrical and thermal conductivity of metals.

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ALLIED PHYSICS - I

UNIT-I
Properties of Matter

MULTIPLE CHOICE QUESTIONS

1. The dimensional formula for stress is
   a) $ML^{-1}T^{-2}$
   b) MLT
   c) MLT^{-1}
   d) $ML^{-1}T^{-1}$
   Answer : a

2. The unit of Surface Tension
   a) Nm^{-1}
   b) Nm
   c) m/N
   d) $1/Nm$
   Answer : a

3. The limit beyond which permanent deformation occurs is
   a) Stress
   b) Strain
   c) Elastic limit
   d) Force

Answer : c

4. Torsion of a body involves in _____ modulus

  a) Bulk

  b) Rigidity

  c) Bending

  d) Young's

  Answer : b

5. The excess pressure inside a curved surface in case of Spherical liquid drop

  a) σ/r

  b) $2\sigma/r$

  c) $\sigma/2r$

  d) $4\sigma/r$

  Answer : b

6. The knowledge of coefficient of viscosity of organic liquids used to determine their

  a) Atomic weight

  b) Atomic Number

  c) Molecular weight

  d) Molecular number

  Answer : c

7. The work done in twisting wire is stored up as a _____energy

a) Kinetic

b) Rotating

c) Potential

d) Twisting

Answer : c

8. The Ratio of linear stress to linear strain is called

a) Bulk Modulus

b) Rigidity Modulus

c) Poisson's Ratio

d) Young's Modulus

Answer : b

9. Young's Modulus of a perfectly Rigid body is

a) 0

b) +ve

c) –ve

d) Infinity

Answer : d

10. If material is heated up, it's Elastic Modulus

a) Decreases

b) Increases

   c) Remains Constant

   d) None

   Answer : a

11. What happens to the viscosity of liquid with the increase in temperature?

   a) It increases

   b) It Decreases

   c) No Change

   d) Zero

   Answer : b

12. At the critical temperature, the surface tension of the liquid

   a) Zero

   b) Infinity

   c) Can't determine

   d) Negative

   Answer : a

13. Surface tension of salt water is

   a) Increases

   b) Decreases

   c) No Change

   d) Increase (or) Decrease

   Answer : a

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Five Mark Questions:

1. Obtain Expression for bending moment.
2. Explain couple per unit twist.
3. Derive Poisulle's equation.
4. Discuss about surface tension and viscosity.
5. Describe Rigidity Modulus.

Ten Mark Questions:

1. Derive an expression for young's modulus by uniform bending.
2. Derive an expression for young's modulus by non-uniform bending method.
3. Derive an expression for excess pressure inside curved surface, spherical and cylindrical drops.
4. Explain Poiseilles flow method.

UNIT-II

Mechanics

Multiple Choice Questions:

1. The acceleration due to gravity in the moon is
   a) 1/2 g
   b) 1/3 g
   c) 1/4 g
   d) 1/6 g
   Answer : d

2. The gravitational force between sun and earth is
   a) 10^{10}N
   b) 10^{27}N
   c) 10^{40}N
   d) None
   Answer : b

3. The value of acceleration due to gravity _____ with increase in height
   a) Increases
   b) Decreases
   c) Normal
   d) Zero
   Answer : b

4. At which point of the Earth is there no gravity?

a) At north and South Pole

b) At equator

c) On the ocean surface

d) At center of the Earth

Answer : d

5. The mass of the Earth is_____

a) 6×10^{-23} kg

b) 6×10^{23} kg

c) 6×10^{-24} kg

d) 6×10^{24} kg

Answer : d

6. The point where entire weight of an object acts, is called

a) Edge

b) Centre of gravity

c) Central point

d) Anywhere in body

Answer : b

7. According to law of periods

a) $T \infty\, r$

b) $T^2 \infty\, r$

c) $T^2 \infty\, r^2$

d) $T^2 \propto r^3$

Answer : d

8. Kepler's 1st law states that the orbits of the planets are avail in shape

   a) Ellipse

   b) Circle

   c) Square

   d) Triangle

   Answer : a

9. If the velocity changes in both speed and direction during circular motion

   a) Uniform circular motion

   b) Non-uniform circular motion

   c) Straight line motion

   d) Rotation motion

   Answer : b

10. The value of acceleration due to gravity____with decrease in height

   a) Increases

   b) Decreases

   c) Normal

   d) Zero

   Answer : a

11. G-boy's value is

a) $6.657 \times 10^{-11} \, \text{Nm}^2 \text{Kg}^{-2}$

b) $6.657 \times 10^{-11} \, \text{Nm}^2$

c) 6.657

d) None

Answer : a

Five Mark Questions

1. Explain Newton's Law of gravitation.
2. Explain about the variation of 'g' with altitude.
3. Explain about the variation of 'g' with depth.
4. State Kepler's Law of motion.
5. Discuss about Circular motion.
6. Discuss about non circular motion.

Ten Mark Questions

1. Derive an expression for maximum height, horizontal range for projectile under an angular projection.
2. Deduce Newton's law from Kepler's law of planetary motion.
3. Discuss G boy's experiment for the determination of gravitational constant.
4. Derive time of flight, horizontal range and resultant velocity, speed of projectile of horizontal projection.
5. Explain Kepler's law of gravitational motion.

UNIT-III

Mechanical Waves

MULTIPLE CHOICE QUESTIONS:

1. The speed of sound is _____ to temperature
   a) Equal
   b) Inversely varies
   c) Directly varies
   d) None
   Answer : c

2. Which of the following instrument can't produce ultrasonic waves?
   a) Galton whistle
   b) Magnetostriction effect
   c) Piezo-electric effect
   d) Sonometer
   Answer : d

3. Application of ultrasonics
   a) Detection of aircraft
   b) Signaling
   c) Depth of sea
   d) All the above
   Answer : c

4. Which of the following instrument can produce ultrasonic waves?

  a) Meissner

  b) Thomson effect

  c) Piezo-electric effect

  d) Sonometer

  Answer : c

5. Human Audible range of sound waves

  a) Above 20 KHz

  b) 20 Hz

  c) 20 KHz

  d) 20 Hz-20 KHz

  Answer : d

6. The speed of sound is _____ of pressure for a fixed temperature

  a) Independent

  b) Dependent

  c) Increases

  d) Decreases

  Answer : a

7. The temperatures are not same at top and bottom of a mountain, because the speed of sound is _____

  a) Different at Different points

b) Always increases

c) Always Decreases

d) None

Answer : a

8. The velocity of sound in a gas is _____ to the square root of the density of the gas.

a) Directly proportional

b) Inversely proportional

c) Both a & b

d) Equal

Answer : b

9. The reverberation time of an auditorium should be brought to the _____

a) Critical Level

b) Equal Level

c) Random Level

d) Optimum Level

Answer : d

10. The acoustics of the buildings are also affected by

a) Resonance

b) Phase

c) Amplitude

d) None

Answer : a

11. For a sound of frequency 512Hz, the best time of reverberation was found to be

   a) 1 to 1.5 sec

   b) 1.5 to 2 sec

   c) 0 to 1 sec

   d) 2.1 to 3 sec

   Answer : a

12. Who studied about the acoustics of a building?

   a) William

   b) Bohr

   c) W.C Sabine

   d) None

   Answer : c

13. Another name of acoustics of building is

   a) Structured building

   b) Artificial building

   c) Architectural Acoustics

   d) All

   Answer : c

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Five Mark Questions

1. List out the good acoustical design of buildings.
2. Derive an expression for velocity of transverse wave.
3. Explain measurement of absorption co-efficient.
4. Write Properties of ultrasonic wave.
5. What are essential features for good acoustics?
6. List out the effects of velocity of sound in gas.

Ten Mark Questions

1. Explain production of ultrasonic waves. Discuss piezoelectric oscillator.
2. Derive Sabine's formula for reverberation time.
3. List out the applications of Ultrasonic wave.
4. Explain about the requisites for good auditorium.
5. Explain velocity of transverse wave along a stretched string.

UNIT-IV

HEAT

MULTIPLE CHOICE QUESTIONS:

1. The vanderwaal's gas equation is

   a) PV=RT

   b) PV = nRT

   c) PV=0

   d) PV/nRT

   Answer : b

2. Which of the following has large intermolecular distances?

   a) Solid

   b) Liquid

   c) Gases

   d) All the Above

   Answer : a

3. When the temperature is higher than the temperature of inversion, the gas would be

   a) Heated

   b) Cooled

   c) Liquefied

   d) Normal

Answer : a

4. At critical point, the rate of change of pressure with volume is

   a) High
   b) Infinity
   c) Zero
   d) Negative

   Answer : c

5. Joule Thomson Effect proves the existence of _____ in gases.

   a) Temperature
   b) Volume
   c) Pressure
   d) Intermolecular attraction

   Answer : d

6. The number of thermometers used in Lee's Disc method

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

   Answer : b

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7. Heat is a form of _____

  a) Work

  b) Energy

  c) Power

  d) Heat

Answer : b

8. The intermolecular distances of gases are much _____ than that of a solid and liquid

  a) Smaller

  b) Zero

  c) Larger

  d) Lighter

Answer : c

9. Gas molecule has no _____

  a) Mass

  b) Weight

  c) Free electrons

  d) Shape & Size

  Answer : d

10. Which is a good conductor?

   a) Ebonite

b) Wood

c) Metal

d) Glass

Answer : c

11. The thermal conductivity of bad conductor is deducted by

a) Lee's Disc Method

b) Boy's method

c) Sonometer

d) None of these

Answer : a

12. Which is bad conductor?

a) Metal

b) Wood

c) Iron

d) Nickel

Answer : b

13. No heat energy is supplied to the gas from outside since the entire apparatus is thermally_____

a) Insulated

b) Isolated

c) Transmitted

d) Heated

Answer : a

14. The temperature of inversion for hydrogen is
_____
   a) -80 Degree Celsius
   b) 80 Degree Celsius
   c) 120 Degree Celsius
   d) -120 Degree Celsius
   Answer : a

15. The temperature of inversion for helium is _____
   a) -80 Degree Celsius
   b) 258 Degree Celsius
   c) -258 Degree Celsius
   d) -120 Degree Celsius
   Answer : c

16. Below the critical temperature the gas is termed as_____and above the critical temperature it is a____
   a) Gas & Gas
   b) Vapour & Gas
   c) Gas & Vapour
   d) Liquid & Gas
   Answer : b

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Five mark questions:

1. Give the process of the liquefaction of Hydrogen.
2. Explain Joule Thomson Effect.
3. Derive expression for critical constant.
4. Give the theory of porous plug experiment.
5. State vaanderwaal's equation.
6. State thermal conductivity and coefficient of thermal conductivity.

Ten Mark Questions:

1. Give the theory of Porous plug Experiment. Derive an equation for the temperature of inversion.
2. Define thermal conductivity. Explain about the thermal conductivity of bad conductor using lee's Disc method.
3. Derive equation for the fall in temperature of a vanderwaals gas by joule- Thomson effect.
4. Explain vanderwaal's gas equation of state
5. Explain joule-kelvin effect.

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<u>UNIT-V</u>

<u>Electricity and Magnetism</u>

<u>Multiple Choice Question</u>

1. Flux leakage in transformer is minimized by
   a) Transformer in very thin core
   b) Wires of large diameter
   c) Winding coils one over other
   d) Using thick wires

   Answer : c

2. The SI unit of magnetic flux
   a) Tm^2
   b) T
   c) $Wb\ m^2$
   d) Watt

   Answer : a

3. Type-II superconductor are
   a) Hard
   b) Soft
   c) Soft & Hard
   d) None

   Answer : a

4. Total charge of the conductor reduces near the sharp edge is

   a) Discharge

   b) Corona discharge

   c) Lighting

   d) Point discharge

   Answer : b

5. Efficiency range of transformer

   a) 0%

   b) 100%

   c) 96-99%

   d) 50%

   Answer : c

6. A switch should have

   a) High insulation resistance

   b) Low insulation resistance

   c) Contact insulation

   d) None

   Answer : a

7. DPDT full form

   a) Double pull double throw

   b) Double pole double throw

   c) Double pull dual throw

   d) Dual pole dual throw

Answer : b

8. A toggle switch operates through which mechanism?

 a) Sliding

 b) Pivoting

 c) Rotating

 d) Pushing

 Answer : b

9. Fuses can serve upto a current of

 a) 25A

 b) 50A

 c) 75A

 d) 100A

 Answer : d

10. HRC fuses has

 a) High rating of current

 b) High rupturing capacity

 c) High resistance capacity

 d) None

 Answer : b

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Five Mark Questions

1. Discuss about Coulomb's law and Faraday's law.
2. Differentiate open and closed circuit.
3. Describe types of fuses.

Ten Mark Questions

1. Explain types of switches.
2. Explain construction and working of Transformer.
3. List out losses in transformer.
4. Explain different types of fuses in transformer.
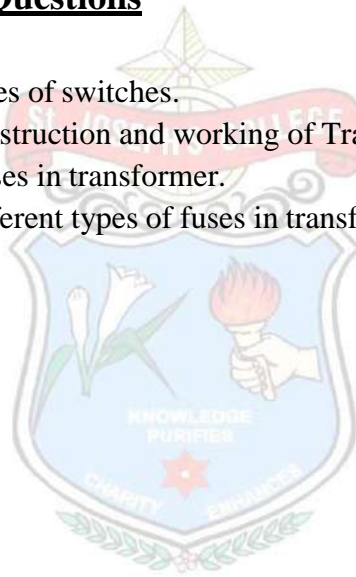
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