

23 Lecture— ELECTROSTATICS II

1. How is the electric field calculated when charges are continuously distributed over some region of space?

- A) By using Coulomb's Law only
- B) By breaking up the region into small pieces and summing their contributions
- C) By ignoring the distribution and treating it as a point charge
- D) By neglecting the electric field of the distributed charges

****Answer: B) By breaking up the region into small pieces and summing their contributions****

2. Which of the following defines charge density for linear charge distribution?

- A) ($\lambda = dq / ds$)
- B) ($\lambda = dq / dA$)
- C) ($\alpha = dq / ds$)
- D) ($\alpha = dq / dA$)

****Answer: A) ($\lambda = dq / ds$)****

3. What is the electric field from a uniform ring of charge at a point P?

- A) Zero
- B) Depends on the distance from the ring
- C) Independent of the distance from the ring
- D) Cannot be determined

****Answer: B) Depends on the distance from the ring****

4. In a continuous charge distribution along a wire, what is the direction of the non-cancelling component of the electric field?

- A) Along the x-axis
- B) Along the y-axis
- C) Along the z-axis
- D) Along the wire

****Answer: A) Along the x-axis****

5. What is the measure of the "flow" or penetration of electric field vectors through an imaginary fixed surface?

- A) Charge density
- B) Electric potential
- C) Flux
- D) Capacitance

****Answer: C) Flux****

6. According to Gauss's Law, what is the total electric flux leaving a closed surface equal to?

- A) Charge enclosed by the surface divided by the electric field
- B) Charge enclosed by the surface divided by the electric flux
- C) Charge enclosed by the surface divided by the electric permittivity
- D) Charge enclosed by the surface divided by the vacuum permittivity

****Answer: D) Charge enclosed by the surface divided by the vacuum permittivity****

7. What is the electric field inside a hollow sphere with charges only on the surface?

- A) Zero
- B) Depends on the radius of the sphere
- C) Directly proportional to the charge on the surface
- D) Inversely proportional to the charge on the surface

****Answer: A) Zero****

8. Gauss's Law is a fundamental principle in electromagnetism that:

- A) Determines the motion of charged particles in a magnetic field
- B) Relates the electric field to the distribution of electric charges
- C) States that magnetic monopoles exist in nature
- D) Explains the behavior of electric charges in a conductor

****Answer: B) Relates the electric field to the distribution of electric charges****

9. When charges are continuously distributed over a surface, the charge density is defined as:

- A) ($\lambda = dq / ds$)
- B) ($\lambda = dq / dA$)
- C) ($\alpha = dq / ds$)
- D) ($\alpha = dq / dA$)

****Answer: D) ($\alpha = dq / dA$)****

10. What is the mathematical expression for Gauss's Law?

- A) ($\oint_S \vec{E} \cdot d\vec{A} = \frac{q_{enc}}{\epsilon_0}$)
- B) ($\oint_S \vec{B} \cdot d\vec{A} = \frac{q_{enc}}{\epsilon_0}$)
- C) ($\oint_S \vec{E} \cdot d\vec{l} = \frac{q_{enc}}{\epsilon_0}$)

$$D) \left(\oint_S \vec{B} \cdot d\vec{l} = \frac{q_{enc}}{\epsilon_0} \right)$$

$$** \text{ Answer : A) } \left(\oint_S \vec{E} \cdot d\vec{A} = \frac{q_{enc}}{\epsilon_0} \right) **$$

11. What is the total electric flux leaving a closed surface according to Gauss's Law?

- A) Charge enclosed by the surface divided by the electric field
- B) Charge enclosed by the surface divided by the electric flux
- C) Charge enclosed by the surface divided by the electric permittivity
- D) Charge enclosed by the surface divided by the vacuum permittivity

****Answer: D) Charge enclosed by the surface divided by the vacuum permittivity****

12. How does the electric field from a continuous charge distribution change with distance from the source?

- A) It decreases linearly with distance
- B) It increases linearly with distance
- C) It decreases with the square of the distance
- D) It remains constant regardless of distance

****Answer: C) It decreases with the square of the distance****

13. What is the purpose of dividing a volume into little cubes when applying Gauss's Law?

- A) To calculate the charge enclosed by each cube
- B) To simplify the computation of the electric flux
- C) To ensure that Gauss's Law holds true for all shapes
- D) To visualize the distribution of electric charges

****Answer: A) To calculate the charge enclosed by each cube****

14. Which principle states that the total electric flux leaving a closed surface is equal to the charge enclosed by the surface divided by a constant?

- A) Coulomb's Law
- B) Ampere's Law
- C) Faraday's Law
- D) Gauss's Law

****Answer: D) Gauss's Law****

15. How is the electric flux leaving a closed surface related to the charge enclosed by the surface?

- A) Directly proportional
- B) Inversely proportional
- C) Proportional to the square of the charge

D) Independent of the charge

****Answer: A) Directly proportional****

16. In Gauss's Law, what is the significance of the term ϵ_0 ?

- A) Electric charge density
- B) Electric flux density
- C) Vacuum permittivity
- D) Electric potential

****Answer: C) Vacuum permittivity****

17. How does the electric field behave inside a conductor according to Gauss's Law?

- A) It is always zero
- B) It is directly proportional to the charge density
- C) It is inversely proportional to the charge density
- D) It depends on the surface area of the conductor

****Answer: A) It is always zero****

18. Which mathematical operation is used to calculate the electric flux through a closed surface?

- A) Line integral
- B) Surface integral
- C) Volume integral
- D) Dot product

****Answer: B) Surface integral****

19. What is the electric flux leaving a closed surface proportional to?

- A) Charge enclosed by the surface
- B) Electric field inside the surface
- C) Permittivity of the medium
- D) Surface area of the closed surface

****Answer: A) Charge enclosed by the surface****

20. In Gauss's Law, what is the role of the closed surface?

- A) To enclose the electric charges
- B) To determine the direction of the electric field
- C) To define the shape of the electric field lines
- D) To establish the magnitude of the electric flux

****Answer: A) To enclose the electric charges****

24 – ELECTRIC POTENTIAL ENERGY

1. What is the definition of potential energy when considering a force acting over a displacement?

- A) Work done multiplied by the displacement
- B) Force multiplied by the displacement
- C) Change in potential multiplied by the displacement
- D) Work done against the force

****Answer: A) Work done multiplied by the displacement****

2. Why is the electrostatic force considered conservative?

- A) Because it depends on the charge magnitude
- B) Because it depends on the distance between charges
- C) Because it doesn't depend on the path taken
- D) Because it's always directed towards the negative charge

****Answer: C) Because it doesn't depend on the path taken****

3. Where does the negative sign in the expression for the work done to bring a unit charge from infinity to a point come from?

- A) The repulsion between charges
- B) The direction of the force exerted on the charge
- C) The magnitude of the charges
- D) The gravitational force acting on the charge

****Answer: B) The direction of the force exerted on the charge****

4. How is the electric potential due to a point charge calculated at a distance r from the charge?

- A) $(U(r) = \frac{q}{4\pi\epsilon_0 r^2})$
- B) $(U(r) = \frac{q}{\epsilon_0 r})$
- C) $(U(r) = \frac{q}{2\pi\epsilon_0 r})$
- D) $(U(r) = \frac{q}{\epsilon_0 r^2})$

**** Answer : D) $(U(r) = \frac{q}{\epsilon_0 r^2})$ ****

5. What is the potential energy formula for two charges in an electric field?

$$A) (U(r) = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2})$$

$$B) (U(r) = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r})$$

$$C) (U(r) = \frac{1}{2\pi\epsilon_0} \frac{q_1 q_2}{r})$$

$$D) (U(r) = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^3})$$

$$** \text{Answer : } A) (U(r) = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r}) **$$

6. What determines the direction of the electric field due to a system of charges?

- A) The magnitude of the charges
- B) The distance between the charges
- C) The potential energy of the system
- D) The potential difference between points

****Answer: D) The potential difference between points****

7. How is the electric potential at a point calculated due to multiple charges?

- A) By taking the average potential of all charges
- B) By summing the potentials from each charge
- C) By finding the maximum potential among the charges
- D) By taking the potential of the closest charge

****Answer: B) By summing the potentials from each charge****

8. What is the electric potential at the center of a dipole?

- A) Zero
- B) Maximum
- C) Minimum
- D) Indeterminate

****Answer: A) Zero****

9. What is the electric potential due to a uniformly spread charge over a ring?

- A) Dependent on the distance from the center of the ring
- B) Independent of the distance from the center of the ring
- C) Directly proportional to the radius of the ring
- D) Inversely proportional to the radius of the ring

****Answer: A) Dependent on the distance from the center of the ring****

10. What is the relationship between potential energy and the direction of charges?

- A) Charges always move towards regions of higher potential
- B) Charges always move towards regions of lower potential
- C) Charges move randomly with respect to potential
- D) Charges don't move with respect to potential

****Answer: A) Charges always move towards regions of higher potential****

11. What is the standard unit of potential energy?

- A) Joule
- B) Volt
- C) Coulomb
- D) Electron-volt

****Answer: A) Joule****

12. How is the potential difference defined in terms of electric potential?

- A) The difference in electric field strength between two points
- B) The difference in electric potential energy between two points
- C) The difference in electric charge between two points
- D) The difference in electric potential between two points

****Answer: D) The difference in electric potential between two points****

13. Why does a system seek to minimize its potential energy?

- A) To maximize its stability
- B) To increase its kinetic energy
- C) To reach a state of equilibrium
- D) To reduce its gravitational potential

****Answer: C) To reach a state of equilibrium****

14. What property ensures that the electric potential exists?

- A) Conservative nature of the electric force
- B) Magnitude of the electric charges
- C) Distance between the charges
- D) Direction of the electric field

****Answer: A) Conservative nature of the electric force****

15. How is the potential energy of a system of charges computed?

- A) By integrating the force over distance
- B) By differentiating the force over distance

- C) By summing the forces acting on each charge
- D) By calculating the average force over distance

****Answer: A) By integrating the force over distance****

16. What does it mean for a force to be conservative?

- A) The work done is independent of the path
- B) The work done is dependent on the path
- C) The work done is always zero
- D) The work done is always positive

****Answer: A) The work done is independent of the path****

17. How is the potential energy of a charge related to the force acting on it?

- A) Directly proportional
- B) Inversely proportional
- C) No relation
- D) Depends on the distance

****Answer: B) Inversely proportional****

18. What does the negative sign in the potential energy formula signify?

- A) Attraction between charges
- B) Repulsion between charges
- C) No charge interaction
- D) Unstable equilibrium

****Answer: A) Attraction between charges****

19. What happens to the potential as the distance from a charge increases?

- A) Potential increases
- B) Potential decreases
- C) Potential remains constant
- D) Potential becomes negative

****Answer: B) Potential decreases****

20. What determines the potential energy of two charges in an electric field?

- A) Magnitude of the charges
- B) Distance between the charges
- C) Direction of the electric field
- D) Presence of other charges

****Answer: B) Distance between the charges****

25 – CAPACITORS AND CURRENTS

1. What is the definition of capacitance?

- A) The charge stored on a capacitor
- B) The ratio of charge stored to voltage across a capacitor
- C) The energy stored in a capacitor
- D) The potential difference between two plates of a capacitor

ans. B) The ratio of charge stored to voltage across a capacitor

2. How is the capacitance of a capacitor affected if the distance between the plates increases?

- A) Increases
- B) Decreases
- C) Remains constant
- D) Becomes zero

2. B) Decreases

3. What happens to the capacitance of a parallel-plate capacitor if the area of the plates increases?

- A) Increases
- B) Decreases
- C) Remains constant
- D) Depends on the material between the plates

3. A) Increases

4. When capacitors are connected in parallel, what happens to the total capacitance?

- A) Increases
- B) Decreases
- C) Remains constant
- D) Becomes zero

4. A) Increases

5. How does the energy stored in a capacitor change if the voltage across it doubles?

- A) Increases by a factor of 2
- B) Increases by a factor of 4
- C) Decreases by a factor of 2
- D) Remains constant

5. B) Increases by a factor of 4

6. What effect does a dielectric have on the capacitance of a capacitor?

- A) Decreases capacitance
- B) Increases capacitance
- C) No effect on capacitance
- D) Increases the charge stored

6. B) Increases capacitance

7. When capacitors are connected in series, what happens to the total capacitance?

- A) Increases
- B) Decreases
- C) Remains constant
- D) Becomes zero

7. B) Decreases

8. The energy stored in a capacitor is directly proportional to:

- A) Voltage squared
- B) Charge stored
- C) Capacitance
- D) Electric field strength

8. C) Capacitance

9. What is the SI unit of capacitance?

- A) Ohm
- B) Volt
- C) Farad
- D) Coulomb

9. C) Farad

10. What property of a dielectric material determines its effect on capacitance?

- A) Conductivity
- B) Permittivity
- C) Resistance
- D) Voltage

10. B) Permittivity

26 – ELECTRIC POTENTIAL ENERGY

1. What is the definition of electric current?

- A) The flow of protons in a circuit
- B) The flow of electrons in a circuit
- C) The resistance in a circuit
- D) The voltage across a circuit

****Answer: B) The flow of electrons in a circuit****

2. If a charge of 5 coulombs flows in 2 seconds, what is the current?

- A) 10 amperes

- B) 2.5 amperes
- C) 5 amperes
- D) 2 amperes

****Answer: B) 2.5 amperes****

3. According to Ohm's Law, what is the relationship between voltage (V), current (I), and resistance (R)?

- A) $V = IR$
- B) $I = VR$
- C) $R = VI$
- D) $V = RI$

****Answer: A) $V = IR$ ****

4. What is the SI unit of resistance?

- A) Volt
- B) Ampere
- C) Ohm
- D) Coulomb

****Answer: C) Ohm****

5. When resistors are connected in series, what happens to the total resistance?

- A) Increases
- B) Decreases
- C) Remains constant
- D) Becomes zero

****Answer: A) Increases****

6. When resistors are connected in parallel, what happens to the total resistance?

- A) Increases
- B) Decreases
- C) Remains constant
- D) Becomes zero

****Answer: B) Decreases****

7. What is the relationship between power (P), voltage (V), and current (I) in an electrical circuit?

- A) $P = IV$
- B) $P = V/I$
- C) $P = VI$
- D) $P = I/V$

****Answer: A) $P = IV$ ****

8. What is Kirchhoff's Voltage Law (KVL) used to analyze in an electrical circuit?

- A) The total resistance
- B) The total current
- C) The sum of potential differences in a closed loop
- D) The rate of charge flow

****Answer: C) The sum of potential differences in a closed loop****

9. What is the time constant of an RC circuit?

- A) The time taken for the voltage to reach its maximum value
- B) The time taken for the current to reach its maximum value
- C) The time taken for the charge to reach 63.2% of its maximum value
- D) The time taken for the resistance to change

****Answer: C) The time taken for the charge to reach 63.2% of its maximum value****

10. How does a dielectric material affect the capacitance of a capacitor?

- A) Decreases capacitance
- B) Increases capacitance
- C) No effect on capacitance
- D) Decreases the voltage

****Answer: B) Increases capacitance****

11. What is the SI unit of capacitance?

- A) Volt
- B) Ampere
- C) Farad
- D) Ohm

****Answer: C) Farad****

12. What is the direction of conventional current flow?

- A) Opposite to the flow of electrons
- B) Same as the flow of electrons
- C) Along the resistance
- D) Perpendicular to the voltage

****Answer: A) Opposite to the flow of electrons****

13. What is the formula for calculating power in a circuit using Ohm's Law?

- A) $P = IV$
- B) $P = V/I$
- C) $P = VI$
- D) $P = I/V$

****Answer: A) $P = IV$ ****

14. According to Kirchhoff's Current Law (KCL), what happens to the total current at a junction in a circuit?

- A) Increases
- B) Decreases
- C) Remains constant
- D) Becomes zero

****Answer: C) Remains constant****

15. What does the time constant of an RC circuit depend on?

- A) Resistance only
- B) Capacitance only
- C) Both resistance and capacitance
- D) Voltage

****Answer: C) Both resistance and capacitance****

16. What happens to the potential difference across a resistor when current flows through it?

- A) Increases
- B) Decreases
- C) Remains constant
- D) Becomes zero

****Answer: B) Decreases****

17. What law states that the sum of the potential differences in a closed loop is zero?

- A) Ohm's Law
- B) Kirchhoff's Voltage Law
- C) Kirchhoff's Current Law
- D) Faraday's Law

****Answer: B) Kirchhoff's Voltage Law****

18. What is the relationship between current density (J), current (I), and cross-sectional area (A) in a conductor?

- A) $J = I/A$
- B) $J = A/I$

- C) $I = J/A$
- D) $A = J/I$

****Answer: A) $J = I/A$ ****

19. What is the relationship between charge (Q), current (I), and time (t)?

- A) $Q = It$
- B) $I = Qt$
- C) $Q = I/t$
- D) $I = Q/t$

****Answer: A) $Q = It$ ****

20. How is power related to the rate of change of charge with respect to time?

- A) $P = dQ/dt$
- B) $P = Q/dt$
- C) $P = Q + dt$
- D) $P = dQ * dt$

****Answer: A) $P = dQ/dt$ ****

27 – THE MAGNETIC FIELD

1. What is the direction of the force experienced by a charge moving in a magnetic field?

- A) Parallel to the magnetic field
- B) Opposite to the direction of motion
- C) Perpendicular to both the direction of motion and the magnetic field
- D) Along the direction of motion

****Answer: C) Perpendicular to both the direction of motion and the magnetic field ****

2. What is the SI unit of magnetic field strength?

- A) Joule
- B) Newton
- C) Tesla
- D) Coulomb

****Answer: C) Tesla ****

3. What is the formula for the Lorentz force experienced by a charge moving in both electric and magnetic fields?

- A) $(F = qE)$
- B) $(F = qB)$
- C) $(F = q(E + B))$
- D) $(F = q(E \times B))$

**** Answer : D) $(F = q(E \times B))$ ****

4. What is the condition for particles to remain undeflected in a velocity selector using magnetic and electric fields?

- A) $v = \frac{E}{B}$
- B) $(v = \frac{B}{E})$
- C) $(v = EB)$
- D) $v = \frac{E \times B}{2}$

**** Answer : A) $(v = \frac{E}{B})$ ****

5. What prevents a magnetic field from increasing or decreasing the energy of a charged particle?

- A) Magnetic force is zero
- B) Magnetic force does not change the direction of motion
- C) Magnetic force and direction are orthogonal
- D) Magnetic force increases energy

****Answer: C) Magnetic force and direction are orthogonal****

6. What determines the radius of a charged particle's orbit in a magnetic field?

- A) Mass of the particle
- B) Charge of the particle
- C) Magnetic field strength
- D) All of the above

****Answer: D) All of the above****

7. What is responsible for shielding the Earth from the harmful effects of the solar wind?

- A) Gravitational force
- B) Magnetic field
- C) Atmospheric pressure
- D) Solar radiation

****Answer: B) Magnetic field****

8. What is the fundamental principle behind the operation of a mass spectrometer?

- A) Magnetic deflection of charged particles
- B) Electrostatic force on charged particles
- C) Gravitational pull on charged particles
- D) Electric discharge of charged particles

****Answer: A) Magnetic deflection of charged particles****

9. What is the force per unit length experienced by a current-carrying wire in a magnetic field?

- A) $(F = I \times B)$
- B) $(F = \frac{I}{B})$
- C) $(F = B \times nAe)$
- D) $(F = I \times nAe)$

**** Answer : C) $(F = B \times nAe)$ ****

10. What is the magnetic moment of a current loop?

- A) $(\mu = IA)$
- B) $(\mu = \frac{IA}{z})$
- C) $(\mu = IAz)$
- D) $(\mu = \frac{IAz}{2})$

**** Answer : A) $(\mu = IA)$ ****

11. According to Ampere's Law, what is the integral of the magnetic field around a closed loop?

- A) Zero
- B) Non-zero
- C) Depends on the shape of the loop
- D) Depends on the current enclosed by the loop

****Answer: D) Depends on the current enclosed by the loop****

12. What is the magnetic field inside and outside a long, straight current-carrying wire?

- A) Magnetic field is zero inside and non-zero outside
- B) Magnetic field is non-zero inside and zero outside
- C) Magnetic field is non-zero both inside and outside
- D) Magnetic field is zero both inside and outside

****Answer: B) Magnetic field is non-zero inside and zero outside****

13. What does Ampere's Law help calculate regarding the magnetic field around a current-carrying wire?

- A) Magnitude of the magnetic field
- B) Direction of the magnetic field
- C) Both magnitude and direction of the magnetic field
- D) Magnitude of the electric field

****Answer: C) Both magnitude and direction of the magnetic field****

28 – ELECTROMAGNETIC INDUCTION

1. What is the formula for the magnetic flux (Φ) passing through an area (A) when the magnetic field (B) is not constant over the area?

- A) $\Phi = BA$
- B) $\Phi = \int B \cdot dA$
- C) $\Phi = B \cdot A$
- D) $\Phi = B \times A$

**** Answer : B) $\Phi = \int B \cdot dA$ ****

2. What does Faraday's Law state regarding induced electromotive force (emf) in a circuit?

- A) The induced emf is proportional to the magnetic flux
- B) The induced emf is inversely proportional to the rate of change of flux
- C) The induced emf is proportional to the rate of change of flux
- D) The induced emf is independent of the magnetic flux

****Answer: C) The induced emf is proportional to the rate of change of flux****

3. How does the induced emf change in a coil when the flux through it changes?

- A) It decreases
- B) It remains constant
- C) It increases

D) It fluctuates randomly

****Answer: C) It increases****

4. What is the SI unit of magnetic flux?

- A) Tesla
- B) Weber
- C) Henry
- D) Coulomb

****Answer: B) Weber****

5. According to Lenz's Law, the direction of the induced electromotive force is such that it:

- A) Supports the change in magnetic flux
- B) Opposes the change in magnetic flux
- C) Neutralizes the magnetic flux
- D) Has no effect on the magnetic flux

****Answer: B) Opposes the change in magnetic flux****

6. What is the net flux through a closed surface according to a fundamental law of magnetism?

- A) Always positive
- B) Always negative
- C) Always zero
- D) Depends on the shape of the surface

****Answer: C) Always zero****

7. What is the formula for calculating induced $emf((\varepsilon))$ in a coil with (N) turns when the magnetic $flux((\Phi))$ changes with $time((t))$?

- A) $(\varepsilon = \frac{d\Phi}{dt})$
- B) $(\varepsilon = N \frac{d\Phi}{dt})$
- C) $(\varepsilon = \frac{dN}{dt})$
- D) $(\varepsilon = \frac{N}{dt})$

*** * Answer : B) $(\varepsilon = N \frac{d\Phi}{dt})$ * ***

8. What happens to the induced emf in a wire loop when the loop is stretched and its area changes?

- A) Induced emf decreases
- B) Induced emf increases
- C) Induced emf remains constant
- D) Induced emf fluctuates

****Answer: B) Induced emf increases****

9. What is the direction of the induced current in a wire loop when the magnetic field through it decreases?

- A) Clockwise
- B) Counterclockwise
- C) Alternating
- D) No current is induced

****Answer: A) Clockwise****

10. According to Faraday's Law, what factor determines the magnitude of induced emf in a circuit?

- A) Change in magnetic field strength
- B) Resistance of the circuit
- C) Change in electric potential
- D) Number of turns in the coil

****Answer: A) Change in magnetic field strength****

29 – ALTERNATING CURRENT

1. What type of current is Alternating Current (AC)?

- A) Current that flows only in one direction
- B) Current that flows first in one direction, then in the reverse direction
- C) Current that flows continuously in both directions
- D) Current that flows randomly in different directions

****Answer: B) Current that flows first in one direction, then in the reverse direction****

2. What is the average value of an AC wave?

- A) Equal to its peak value
- B) Always positive
- C) Always zero
- D) Zero for sine waves, nonzero for cosine waves

****Answer: C) Always zero****

3. What is the root mean square value of an AC wave?

- A) Half the peak value
- B) Equal to the peak value
- C) Equal to zero
- D) Twice the peak value

****Answer: A) Half the peak value****

4. AC is generated by:

- A) A static magnetic field
- B) A stationary coil
- C) A rotating coil in a magnetic field
- D) A constant voltage source

****Answer: C) A rotating coil in a magnetic field****

5. What component enables transformers to step up or step down voltages?

- A) Capacitors
- B) Inductors
- C) Resistors
- D) Cores

****Answer: D) Cores****

6. What is the unit of inductance?

- A) Ampere
- B) Henry
- C) Volt
- D) Ohm

****Answer: B) Henry****

7. The inductance of a long coil wound with (n) turns per unit length is given by:

- A) $(L = \frac{n^2}{\mu_0})$
- B) $(L = n \times \mu_0)$
- C) $(L = \frac{\mu_0}{n})$
- D) $(L = \frac{n\mu_0 A}{l})$

*** * Answer : D) $(L = \frac{n\mu_0 A}{l})$ * ***

8. What happens when the current changes through an inductor?

- A) It induces a magnetic field
- B) It induces an emf across the coil
- C) It dissipates energy
- D) It reduces the inductance

****Answer: B) It induces an emf across the coil****

9. What is the time constant in an inductor?

- A) Time for the current to reach its maximum value
- B) Time after which the current approaches 63% of its final value
- C) Time for the inductor to reach full charge
- D) Time taken for the inductor to discharge completely

****Answer: B) Time after which the current approaches 63% of its final value****

10. The energy stored in an inductor is proportional to:

- A) The resistance of the circuit
- B) The current passing through it
- C) The voltage across it
- D) The capacitance of the circuit

****Answer: B) The current passing through it****

11. When an inductor carries current, it requires:

- A) Energy dissipation
- B) Work to be done
- C) Resistance to flow
- D) Voltage drop

****Answer: B) Work to be done****

12. The total energy in an LC circuit remains constant during:

- A) Discharging
- B) Charging
- C) Oscillation
- D) Damping

****Answer: C) Oscillation****

13. What happens when a capacitor discharges in an LC circuit?

- A) It creates a current that transfers energy to the inductor
- B) It dissipates energy as heat
- C) It increases the resistance in the circuit

- D) It reduces the voltage across the inductor

****Answer: A) It creates a current that transfers energy to the inductor****

14. What causes electromagnetic oscillations in an LC circuit?

- A) Resistance
- B) Capacitance
- C) Inductance
- D) Voltage drop

****Answer: C) Inductance****

15. In an LC circuit, what parameter oscillates with frequency ω ?

- A) Resistance
- B) Voltage
- C) Capacitance
- D) Charge

****Answer: D) Charge****

16. What is the frequency of oscillation in an LC circuit determined by?

- A) Capacitance
- B) Resistance
- C) Inductance
- D) Both capacitance and inductance

****Answer: D) Both capacitance and inductance****

17. What is the work done in passing current through an inductor proportional to?

- A) The resistance of the inductor
- B) The rate of change of current
- C) The voltage across the inductor
- D) The capacitance of the circuit

****Answer: B) The rate of change of current****

18. What is the primary function of a transformer?

- A) To store energy
- B) To generate electricity
- C) To step up or step down voltages
- D) To convert AC to DC

****Answer: C) To step up or step down voltages****

19. What is the unit of inductance?

- A) Ohm
- B) Henry
- C) Volt
- D) Ampere

****Answer: B) Henry****

20. In an LC circuit, what happens to the total energy during oscillations?

- A) It increases
- B) It decreases
- C) It remains constant
- D) It oscillates

****Answer: C) It remains constant****

30 – ELECTROMAGNETIC WAVES

1. Before Maxwell's investigations, which law(s) of electromagnetism were known?

- A) Gauss' law of electricity only
- B) Gauss' law of magnetism only
- C) Faraday's law of induction only
- D) Gauss' law of electricity and magnetism, Faraday's law, Ampere's law

****Answer: D) Gauss' law of electricity and magnetism, Faraday's law, Ampere's law****

2. What inconsistency did Maxwell find in Ampere's law?

- A) Ampere's law gave different results depending on the loop surface chosen
- B) Ampere's law didn't account for changing magnetic fields
- C) Ampere's law contradicted Faraday's law
- D) Ampere's law didn't apply to circuits with capacitors

****Answer: A) Ampere's law gave different results depending on the loop surface chosen****

3. What modification did Maxwell make to Ampere's law?

- A) Added a constant term
- B) Introduced the concept of displacement current
- C) Removed the integral term
- D) Changed the direction of the magnetic field

****Answer: B) Introduced the concept of displacement current****

4. What does the changing electric field in the gap between capacitor plates act as?

- A) A source of charge
- B) A source of resistance
- C) A source of magnetic field
- D) A source of current

****Answer: C) A source of magnetic field****

6. What did Maxwell's equations provide a complete description of?

- A) Electrostatic phenomena only
- B) Magnetic phenomena only
- C) Electromagnetic phenomena, including waves
- D) Quantum phenomena

****Answer: C) Electromagnetic phenomena, including waves****

7. What property characterizes electromagnetic waves?

- A) Amplitude and wavelength
- B) Frequency and resistance
- C) Voltage and capacitance
- D) Current and inductance

****Answer: A) Amplitude and wavelength****

8. Which statement about electromagnetic waves is true?

- A) They require a medium to travel through
- B) Their speed of propagation depends on frequency
- C) There is no limit to their amplitude or frequency
- D) They propagate slower than sound waves

****Answer: C) There is no limit to their amplitude or frequency****

9. How are electromagnetic waves produced?

- A) By heat
- B) By sound
- C) By forcing current to vary rapidly in a conductor
- D) By chemical reactions

****Answer: C) By forcing current to vary rapidly in a conductor****

10. What property of electromagnetic waves allows them to be received by antennas?

- A) Electric field
- B) Magnetic field

- C) Wavelength
- D) Amplitude

****Answer: A) Electric field****

11. What is polarization in the context of electromagnetic waves?

- A) The direction of propagation
- B) The orientation of the source
- C) The phase difference between waves
- D) The orientation of the electric field

****Answer: D) The orientation of the electric field****

12. How can electromagnetic waves be polarized?

- A) By passing through a vacuum
- B) By changing their frequency
- C) By passing through a polarizer
- D) By increasing their amplitude

****Answer: C) By passing through a polarizer****

13. What does a metal plate with slits act as in polarization?

- A) An amplifier
- B) A capacitor
- C) A polarizer
- D) A resistor

****Answer: C) A polarizer****

14. What does the changing electric field in a gap between capacitor plates create?

- A) A changing magnetic flux
- B) A changing electric flux
- C) A constant magnetic field
- D) A constant electric field

****Answer: A) A changing magnetic flux****

15. In which direction is the electric field of an electromagnetic wave typically oriented?

- A) Along the direction of propagation
- B) Perpendicular to the direction of propagation
- C) Parallel to the magnetic field
- D) Along the axis of polarization

****Answer: B) Perpendicular to the direction of propagation****

16. What causes the amplitude of electromagnetic waves to decrease with distance?

- A) Increasing resistance
- B) Decreasing wavelength
- C) Divergence of power
- D) Polarization effects

****Answer: C) Divergence of power****

17. What property of electromagnetic waves allows them to travel through empty space?

- A) Their wavelength
- B) Their polarization
- C) Their frequency
- D) Their oscillation

****Answer: D) Their oscillation****

18. What is the speed of propagation of electromagnetic waves in a vacuum?

- A) $3 \times 10^8 \text{ meters per second}$
- B) $3 \times 10^6 \text{ meters per second}$
- C) $3 \times 10^{10} \text{ meters per second}$
- D) $3 \times 10^4 \text{ meters per second}$

*** * Answer : A) $3 \times 10^8 \text{ meters per second}$ * ***

19. What is the primary function of a polarizer in the context of electromagnetic waves?

- A) To amplify waves
- B) To filter out unwanted frequencies
- C) To change the direction of propagation
- D) To control the orientation of the electric field

****Answer: D) To control the orientation of the electric field****

20. Which electromagnetic waves require a medium to propagate?

- A) Radio waves
- B) Microwaves
- C) Infrared waves
- D) Gamma rays

****Answer: A) Radio waves****

31 – LIGHT

1. How did Roemer estimate the speed of light in 1675?

- A) By observing the eclipse of Jupiter's moon Io
- B) By measuring the duration of solar eclipses
- C) By studying the reflection of light off mirrors
- D) By analyzing the refraction of light through prisms

****Answer: A) By observing the eclipse of Jupiter's moon Io****

2. What property of light determines its color?

- A) Amplitude
- B) Velocity
- C) Frequency
- D) Wavelength

****Answer: D) Wavelength****

3. Why do most objects appear colored to us?

- A) Because they emit light of different frequencies
- B) Because they absorb light of certain frequencies and reflect others
- C) Because they emit light with equal intensity across all frequencies
- D) Because they refract light in unique ways

****Answer: B) Because they absorb light of certain frequencies and reflect others****

4. What principle states that light will always take the path that requires the least time?

- A) Newton's Law of Motion
- B) Kepler's Law of Planetary Motion
- C) Fermat's Principle
- D) Snell's Law of Refraction

****Answer: C) Fermat's Principle****

5. What determines the speed of light in a medium?

- A) Its frequency
- B) Its wavelength
- C) The medium's refractive index
- D) The angle of incidence

****Answer: C) The medium's refractive index****

6. What phenomenon causes white light to separate into different colors when passing through a prism?

- A) Refraction
- B) Reflection
- C) Dispersion
- D) Diffraction

****Answer: C) Dispersion****

7. What is the critical angle in the context of total internal reflection?

- A) The angle at which light passes through a prism
- B) The angle at which light bends upon entering a medium
- C) The maximum angle of incidence for total internal reflection
- D) The angle at which light is refracted away from the normal

****Answer: C) The maximum angle of incidence for total internal reflection****

8. How do fiber optic cables transmit light?

- A) Through absorption and emission
- B) Through scattering
- C) Through total internal reflection
- D) Through reflection off metallic surfaces

****Answer: C) Through total internal reflection****

9. What is the primary material used in fiber optic cables?

- A) Aluminum
- B) Copper
- C) Glass
- D) Plastic

****Answer: C) Glass****

10. What characteristic of optical fibers allows them to carry multiple telephone calls?

- A) Their flexibility
- B) Their low cost
- C) Their small diameter
- D) Their high capacity for data transmission

****Answer: D) Their high capacity for data transmission****

11. How did James Clerk Maxwell modify Ampere's Law to account for the conservation of charge?

- A) By introducing the concept of displacement current
- B) By adding a magnetic field term to the equation
- C) By subtracting the electric field term from the equation

- D) By simplifying the equation to only include the electric field

****Answer: A) By introducing the concept of displacement current****

12. What are the famous Maxwell's equations used to describe?

- A) Gravitational phenomena
- B) Thermodynamic processes
- C) Electromagnetic phenomena
- D) Quantum mechanical interactions

****Answer: C) Electromagnetic phenomena****

13. What property of electromagnetic waves allows them to travel through empty space?

- A) Their magnetic field strength
- B) Their wavelength
- C) Their speed of propagation
- D) Their polarization

****Answer: C) Their speed of propagation****

14. What determines the polarization of light?

- A) Its amplitude
- B) Its frequency
- C) Its direction of propagation
- D) Its orientation of electric field oscillation

****Answer: D) Its orientation of electric field oscillation****

15. How did Roemer measure the speed of light in 1675?

- A) By observing solar eclipses
- B) By studying the reflection of light off mirrors
- C) By analyzing the refraction of light through prisms
- D) By observing the timing of Jupiter's moon Io eclipses

****Answer: D) By observing the timing of Jupiter's moon Io eclipses****

16. Which principle states that light will always take the path requiring the least time?

- A) Newton's Law of Motion
- B) Fermat's Principle
- C) Snell's Law of Refraction
- D) Ohm's Law

****Answer: B) Fermat's Principle****

17. What is the refractive index of a medium?

- A) Its speed of light compared to that in a vacuum
- B) Its wavelength
- C) Its frequency
- D) Its polarization

****Answer: A) Its speed of light compared to that in a vacuum****

18. What phenomenon causes white light to separate into different colors when passing through a prism?

- A) Refraction
- B) Dispersion
- C) Diffraction
- D) Reflection

****Answer: B) Dispersion****

19. What is the critical angle in the context of total internal reflection?

- A) The angle at which light passes through a prism
- B) The maximum angle of incidence for total internal reflection
- C) The angle at which light is refracted away from the normal
- D) The angle at which light bends upon entering a medium

****Answer: B) The maximum angle of incidence for total internal reflection****

20. What characteristic of optical fibers allows them to carry multiple telephone calls?

- A) Their flexibility
- B) Their low cost
- C) Their small diameter
- D) Their high capacity for data transmission

****Answer: D) Their high capacity for data transmission****

32 – INTERACTION OF LIGHT WITH MATTER

21. Which of the following correctly describes blackbody radiation?

- A) It occurs only at extremely high temperatures.
- B) It is emitted by matter as a result of acceleration of charged constituents.
- C) It is emitted by matter only when it absorbs light.

- D) It is emitted by matter only when it reflects light.

****Answer: B) It is emitted by matter as a result of acceleration of charged constituents.****

22. What property of a blackbody radiation spectrum changes as the temperature of the object increases?

- A) The intensity of radiation decreases
- B) The wavelength of the peak emission shifts to smaller values
- C) The wavelength of the peak emission shifts to larger values
- D) The amplitude of radiation increases

****Answer: B) The wavelength of the peak emission shifts to smaller values****

23. What is the purpose of Wien's Law in understanding blackbody radiation?

- A) To determine the composition of matter emitting blackbody radiation
- B) To calculate the total energy emitted by a blackbody
- C) To identify the peak wavelength of blackbody radiation based on temperature
- D) To determine the direction of emission of blackbody radiation

****Answer: C) To identify the peak wavelength of blackbody radiation based on temperature****

24. According to Stefan-Boltzmann Law, what happens to the power radiated by a hot body as its temperature increases?

- A) It decreases linearly
- B) It increases linearly
- C) It remains constant
- D) It decreases exponentially

****Answer: B) It increases linearly****

25. How is the temperature of a star determined using Wien's Law?

- A) By measuring the total energy emitted by the star
- B) By identifying the peak wavelength of radiation emitted by the star
- C) By calculating the speed of light emitted by the star
- D) By measuring the amplitude of radiation emitted by the star

****Answer: B) By identifying the peak wavelength of radiation emitted by the star****

26. What characteristic of light helps astronomers identify the composition of stars?

- A) Dispersion
- B) Absorption spectrum
- C) Polarization
- D) Reflection

****Answer: B) Absorption spectrum****

27. How are atoms excited to reveal their emission spectra?

- A) By heating them
- B) By cooling them
- C) By applying pressure
- D) By exposing them to light of specific wavelengths

****Answer: A) By heating them****

28. How does selective absorption by molecules contribute to the colors we perceive in objects?

- A) By emitting light of specific wavelengths
- B) By reflecting light of specific wavelengths
- C) By absorbing light of specific wavelengths
- D) By refracting light of specific wavelengths

****Answer: C) By absorbing light of specific wavelengths****

29. What is the result of passing unpolarized light through a polarizer?

- A) The light becomes brighter
- B) The light becomes dimmer
- C) The light becomes polarized
- D) The light becomes unpolarized

****Answer: C) The light becomes polarized****

30. What materials are commonly used to make liquid crystal displays (LCD)?

- A) Metals
- B) Gases
- C) Birefringent materials
- D) Liquids

****Answer: C) Birefringent materials****

31. Which of the following interactions describes matter releasing energy as light?

- A) Absorption
- B) Transmission
- C) Reflection
- D) Emission

****Answer: D) Emission****

32. What type of electromagnetic waves are emitted when charges accelerate?

- A) Infrared waves

- B) Ultraviolet waves
- C) X-rays
- D) Blackbody radiation

****Answer: D) Blackbody radiation****

33. What kind of radiation occurs when a body emits light at all wavelengths?

- A) Continuous spectrum
- B) Discrete spectrum
- C) Absorption spectrum
- D) Emission spectrum

****Answer: A) Continuous spectrum****

34. Which law states that the energy radiated per unit area of a hot body is proportional to the fourth power of the absolute temperature?

- A) Ohm's Law
- B) Kepler's Law
- C) Stefan-Boltzmann Law
- D) Newton's Law of Cooling

****Answer: C) Stefan-Boltzmann Law****

35. How is the energy received per unit area on a planet related to the energy radiated by the sun?

- A) It is proportional to the square of the distance between the planet and the sun.
- B) It is inversely proportional to the radius of the sun.
- C) It is proportional to the square of the radius of the sun.
- D) It is inversely proportional to the square of the distance between the planet and the sun.

****Answer: D) It is inversely proportional to the square of the distance between the planet and the sun.****

36. What phenomenon is responsible for the distinct pattern of colors emitted by different chemical elements?

- A) Polarization
- B) Refraction
- C) Absorption
- D) Emission spectra

****Answer: D) Emission spectra****

37. What property of light allows astronomers to determine the composition of distant stars?

- A) Dispersion
- B) Polarization

- C) Emission spectra
- D) Reflection

****Answer: C) Emission spectra****

38. What happens to the wavelength of the peak emission of blackbody radiation as the temperature of the emitting object increases?

- A) It decreases
- B) It increases
- C) It remains constant
- D) It varies randomly

****Answer: A) It decreases****

39. What type of light is emitted when white light passes through hydrogen gas?

- A) Ultraviolet light
- B) Infrared light
- C) Emission spectrum
- D) Absorption spectrum

****Answer: C) Emission spectrum****

40. What characteristic of certain materials allows them to be used in liquid crystal displays (LCD)?

- A) Birefringence
- B) Absorption
- C) Reflection
- D) Polarization

****Answer: A) Birefringence****

33 – INTERFERENCE AND DIFFRACTION

1. What term describes the net result of two waves adding up together?

- A) Phase interference
- B) Constructive interference
- C) Destructive interference
- D) Wave interference

****Answer: B) Constructive interference****

2. What is necessary for observing the interference of light?

- A) Two incoherent light sources
- B) Coherent light sources
- C) Polarized light sources
- D) Two separate light sources

****Answer: B) Coherent light sources****

3. Where does constructive interference occur in interference patterns?

- A) At bright fringes
- B) At dark fringes
- C) At points of maximum amplitude
- D) At points of minimum amplitude

****Answer: A) At bright fringes****

4. What condition determines destructive interference in interference patterns?

- A) $(\sin(\theta) = n\lambda)$
- B) $(2\lambda = m)$
- C) $(\sin(\theta) = (m + \frac{1}{2})\lambda)$
- D) $(\sin(\theta) = m\lambda)$

**** Answer : C) $(\sin(\theta) = (m + \frac{1}{2})\lambda)$ ****

5. In interference patterns, what phenomenon occurs when waves from two surfaces combine?

- A) Refraction
- B) Dispersion
- C) Interference
- D) Polarization

****Answer: C) Interference****

6. What phenomenon causes thin films to exhibit colors?

- A) Diffraction
- B) Reflection
- C) Refraction
- D) Dispersion

****Answer: A) Diffraction****

7. What is the term for the bending of light around objects?

- A) Reflection
- B) Refraction
- C) Diffraction
- D) Interference

****Answer: C) Diffraction****

8. What condition is necessary for diffraction of light from a single slit?

- A) $(\sin(\theta) = m\lambda)$
- B) $(\sin(\theta) = \frac{m\lambda}{2})$
- C) $(\sin(\theta) = \frac{\lambda}{W})$
- D) $(\sin(\theta) = \frac{W}{\lambda})$

**** Answer : D) $(\sin(\theta) = \frac{W}{\lambda})$ ****

9. What does the angle associated with the first bright fringe represent in diffraction patterns?

- A) Minimum intensity angle
- B) Maximum intensity angle
- C) Central angle
- D) Angular separation angle

****Answer: B) Maximum intensity angle****

10. What puts fundamental limits on the capacity of telescopes and microscopes to separate objects?

- A) Polarization
- B) Dispersion
- C) Diffraction
- D) Interference

****Answer: C) Diffraction****

11. What term describes the net result of two waves adding up together?

- A) Phase interference
- B) Constructive interference
- C) Destructive interference
- D) Wave interference

****Answer: B) Constructive interference****

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- C) $(\sin(\theta) = (m + \frac{1}{2})\lambda)$
- D) $(\sin(\theta) = m\lambda)$

****Answer: C) $(\sin(\theta) = (m + \frac{1}{2})\lambda)$ ****

15. In interference patterns, what phenomenon occurs when waves from two surfaces combine?

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- B) Dispersion
- C) Interference
- D) Polarization

****Answer: C) Interference****

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- B) Reflection
- C) Refraction
- D) Dispersion

****Answer: A) Diffraction****

17. What is the term for the bending of light around objects?

- A) Reflection
- B) Refraction
- C) Diffraction
- D) Interference

****Answer: C) Diffraction****

18. What condition is necessary for diffraction of light from a single slit?

- A) $(\sin(\theta) = m\lambda)$
- B) $(\sin(\theta) = \frac{m\lambda}{2})$
- C) $(\sin(\theta) = \frac{\lambda}{W})$
- D) $(\sin(\theta) = \frac{W}{\lambda})$

****Answer: D) $(\sin(\theta) = \frac{W}{\lambda})$ * ***

19. What does the angle associated with the first bright fringe represent in diffraction patterns?

- A) Minimum intensity angle
- B) Maximum intensity angle
- C) Central angle
- D) Angular separation angle

****Answer: B) Maximum intensity angle****

20. What puts fundamental limits on the capacity of telescopes and microscopes to separate objects?

- A) Polarization
- B) Dispersion
- C) Diffraction
- D) Interference

****Answer: C) Diffraction****

34 – THE PARTICLE NATURE OF LIGHT

1. What phenomena strongly support the idea of light as waves?

- A) Refraction
- B) Interference and diffraction
- C) Photoelectric effect
- D) Polarization
- **Correct Answer: B) Interference and diffraction**

2. According to the lecture, what turned out to be wrong regarding the propagation of light?

- A) Light travels as particles through aether
- B) Light is purely electromagnetic
- C) Light travels in straight lines
- D) Light has no specific medium of propagation
- **Correct Answer: A) Light travels as particles through aether**

3. What concept did Einstein introduce to explain the photoelectric effect?

- A) Electromagnetic waves
- B) Quanta of light (photons)
- C) Ionization energy
- D) Atomic emission
- **Correct Answer: B) Quanta of light (photons)**

4. Which phenomenon involves the emission of light even after the light source is removed?

- A) Reflection
- B) Fluorescence
- C) Absorption
- D) Refraction
- **Correct Answer: B) Fluorescence**

5. What is the primary function of a laser?

- A) To amplify radio waves
- B) To emit photons of varying frequencies
- C) To emit a single frequency of photons
- D) To generate electricity
- **Correct Answer: C) To emit a single frequency of photons**

6. What determines whether the photoelectric effect will occur?

- A) Intensity of light
- B) Frequency of light
- C) Speed of light
- D) Wavelength of light
- **Correct Answer: B) Frequency of light**

7. According to the provided data, what causes the release of photoelectrons?

- A) Absorption of photons
- B) Collision with other electrons

- C) Interaction with protons
- D) Emission of radiation
- **Correct Answer: A) Absorption of photons**

8. Which scientist proposed that light is made of discrete packets called quanta?

- A) Maxwell
- B) Einstein
- C) Planck
- D) Newton
- **Correct Answer: B) Einstein**

9. What does fluorescence refer to in the context of light emission?

- A) Immediate emission after light exposure
- B) Delayed emission after light exposure
- C) Continuous emission during light exposure
- D) No emission after light exposure
- **Correct Answer: A) Immediate emission after light exposure**

10. What type of materials exhibit phosphorescence?

- A) Materials emitting light momentarily
- B) Materials emitting light continuously
- C) Materials emitting light after exposure
- D) Materials not affected by light exposure
- **Correct Answer: C) Materials emitting light after exposure**

11. What is the unit of Planck's constant?

- A) Joule
- B) Second
- C) Newton
- D) Meter
- **Correct Answer: A) Joule**

12. What is the relationship between the energy of a photon and its frequency?

- A) Directly proportional
- B) Inversely proportional
- C) No relationship
- D) Linear relationship
- **Correct Answer: A) Directly proportional**

13. What distinguishes phosphorescence from fluorescence?

- A) Duration of emission
- B) Color of emitted light
- C) Intensity of emitted light
- D) Wavelength of emitted light

- **Correct Answer: A) Duration of emission**

14. What is the role of optical pumping in laser operation?

- A) To amplify light
- B) To excite atoms
- C) To produce multiple frequencies
- D) To generate electricity
- **Correct Answer: B) To excite atoms**

15. What property of light changes when it interacts with matter in the photoelectric effect?

- A) Speed
- B) Wavelength
- C) Intensity
- D) Frequency
- **Correct Answer: D) Frequency**

16. What phenomenon explains the emission of electrons when light falls on a metal surface?

- A) Fluorescence
- B) Refraction
- C) Photoelectric effect
- D) Interference
- **Correct Answer: C) Photoelectric effect**

17. What determines whether an electron is ejected in the photoelectric effect?

- A) Energy of the photon
- B) Speed of the photon
- C) Direction of the photon
- D) Color of the photon
- **Correct Answer: A) Energy of the photon**

18. What is the consequence of the interaction between light and matter in fluorescence?

- A) Delayed emission
- B) Continuous emission
- C) Immediate emission
- D) No emission
- **Correct Answer: C) Immediate emission**

19. What distinguishes a laser from other light sources?

- A) High intensity
- B) Single frequency
- C) Continuous emission
- D) Low energy
- **Correct Answer: B) Single frequency**

20. How did Einstein explain the emission of photoelectrons?

- A) Through continuous waves
- B) Through discrete packets of energy
- C) Through reflection and refraction
- D) Through interference patterns

- Correct Answer: B) Through discrete packets of energy

35 – GEOMETRICAL OPTICS

1. What phenomenon allows us to assume that light travels along straight lines in certain circumstances?

- A) Diffraction
- B) Interference
- C) Reflection
- D) Refraction

- Correct Answer: C) Reflection

2. What term describes the situation when the angle of incidence equals the angle of reflection on a flat surface?

- A) Refraction
- B) Diffusion
- C) Specular reflection
- D) Diffuse reflection

- Correct Answer: C) Specular reflection

3. What type of reflection occurs when a surface is not perfectly flat?

- A) Specular reflection
- B) Regular reflection
- C) Diffuse reflection
- D) Transparent reflection

- Correct Answer: C) Diffuse reflection

4. What is the term for an image formed by reflection that cannot be captured on a screen?

- A) Real image
- B) Virtual image
- C) Diffuse image
- D) Specular image

- Correct Answer: B) Virtual image

5. Which type of mirror causes parallel beams of light to converge to a single point?

- A) Convex mirror
- B) Concave mirror

- C) Plane mirror
- D) Spherical mirror
- **Correct Answer: B) Concave mirror**

6. What is the focal length of a convex mirror?

- A) Equal to the radius of curvature
- B) Twice the radius of curvature
- C) Half the radius of curvature
- D) Variable
- **Correct Answer: C) Half the radius of curvature**

7. What is the focal length of a concave mirror?

- A) Equal to the radius of curvature
- B) Twice the radius of curvature
- C) Half the radius of curvature
- D) Variable
- **Correct Answer: A) Equal to the radius of curvature**

8. What type of image is formed by a convex mirror when the object is placed far away from it?

- A) Real and inverted
- B) Virtual and inverted
- C) Real and upright
- D) Virtual and upright
- **Correct Answer: D) Virtual and upright**

9. How does a concave mirror form an image of an object?

- A) By converging light rays
- B) By diverging light rays
- C) By diffusing light rays
- D) By refracting light rays
- **Correct Answer: A) By converging light rays**

10. What type of lens converges parallel beams of light to a single point?

- A) Convex lens
- B) Concave lens
- C) Divergent lens
- D) Bifocal lens
- **Correct Answer: A) Convex lens**

11. What is the focal length of a divergent lens?

- A) Equal to the radius of curvature
- B) Twice the radius of curvature
- C) Half the radius of curvature
- D) Variable

- **Correct Answer: C) Half the radius of curvature**

12. How is the strength of a lens measured?

- A) By its focal length
- B) By its curvature
- C) In diopters
- D) In radians

- **Correct Answer: C) In diopters**

13. What phenomenon distorts the image formed by a lens due to variations in focus?

- A) Refraction
- B) Diffraction
- C) Dispersion
- D) Aberration

- **Correct Answer: D) Aberration**

14. What is the total diopter of a lens with refractive indices (n_1) and (n_2) ?

- A) $\left(\frac{1}{f}\right)$
- B) $\left(\frac{n_1}{R_1} + \frac{n_2}{R_2}\right)$
- C) $\left(\frac{n_2 - n_1}{R}\right)$
- D) $\left(\frac{n_1 + n_2}{f}\right)$

- **Correct Answer: B) $\left(\frac{n_1}{R_1} + \frac{n_2}{R_2}\right)$**

15. What determines the lateral magnification of an optical system?

- A) The size of the object
- B) The distance between lenses
- C) The size of the image
- D) The curvature of the lens

- **Correct Answer: C) The size of the image**

16. What causes spherical aberration in lenses?

- A) Imperfect lens material
- B) Varying refractive indices
- C) Improper lens curvature
- D) Variation in light intensity

- **Correct Answer: C) Improper lens curvature**

17. Which type of lens makes a parallel beam of light diverge?

- A) Convex lens

- B) Concave lens
- C) Bifocal lens
- D) Divergent lens
- **Correct Answer: B) Concave lens**

18. What is the shape of a plano-convex lens?

- A) Convex on both sides
- B) Concave on one side, flat on the other
- C) Convex on one side, flat on the other
- D) Flat on both sides
- **Correct Answer: C) Convex on one side, flat on the other**

19. How is the focal length of a lens related to its curvature?

- A) Directly proportional
- B) Inversely proportional
- C) No relationship
- D) Quadratically proportional
- **Correct Answer: B) Inversely proportional**

20. What is the term for a lens that is curved on both sides?

- A) Convex-concave lens
- B) Bifocal lens
- C) Meniscus lens
- D) Spherical lens
- **Correct Answer: C) Meniscus lens**

36 – THERMAL PHYSICS I

1. Why was the ancient view of heat, as phlogiston, eventually rejected?

- A) Heat has color and weight.
- B) Heat can be created and destroyed.
- C) Heat occupies no volume.
- D) Heat is transferable between objects.
- ****Correct Answer: B) Heat can be created and destroyed.****

2. How is temperature defined more rigorously?

- A) By the color of an object.
- B) By the weight of an object.
- C) By the property common to all objects in thermal contact.
- D) By the volume of an object.
- ****Correct Answer: C) By the property common to all objects in thermal contact.****

3. What is heat defined as?

- A) Energy that flows from low temperature to high temperature.

- B) Energy that flows from high temperature to low temperature.
- C) Energy that is static within a system.
- D) Energy that has color and weight.
- ****Correct Answer: B) Energy that flows from high temperature to low temperature.****

4. What is thermal equilibrium?

- A) Heat exchange between objects.
- B) The state where objects have different temperatures.
- C) No heat exchange between objects.
- D) The state where objects have no temperature.
- ****Correct Answer: C) No heat exchange between objects.****

5. How do we measure temperature?

- A) By color changes.
- B) My weight changes.
- C) By changes in thermometric properties.
- D) By changes in volume.
- ****Correct Answer: C) By changes in thermometric properties.****

6. What is the constant volume gas thermometer used to measure?

- A) Pressure
- B) Volume
- C) Temperature
- D) Density
- ****Correct Answer: C) Temperature****

7. What is the absolute zero of temperature?

- A) 0°C
- B) -273.15°C
- C) 100 K
- D) 0 K
- ****Correct Answer: B) -273.15°C****

8. Which temperature scale is most suited for scientific purposes?

- A) Fahrenheit
- B) Celsius
- C) Kelvin
- D) Centigrade
- ****Correct Answer: C) Kelvin****

9. What is the conversion between Celsius and Fahrenheit temperatures?

- A) $(T_F = \frac{9}{5}T_C + 32)$
- B) $(T_C = \frac{9}{5}(T_F - 32))$

- C) ($T_F = T_C + 273.15$)
- D) ($T_C = T_F - 273.15$)
- ****Correct Answer: B)** ($T_C = \frac{9}{5}(T_F - 32)$) ******

10. What is the unit of heat capacity?

- A) Calories
- B) Joules
- C) Watts
- D) Newtons
- ****Correct Answer: B) Joules****

11. What is the coefficient of volume expansion defined as?

- A) The change in length per unit changes in temperature.
- B) The change in volume per unit changes in temperature.
- C) The change in temperature per unit changes in volume.
- D) The change in temperature per unit changes in length.
- ****Correct Answer: B) The change in volume per unit changes in temperature.****

12. What is the relation between the coefficients of linear and volume expansion?

- A) ($\alpha = \beta$)
- B) ($\alpha = 3\beta$)
- C) ($\beta = 3\alpha$)
- D) ($\beta = \frac{1}{3}\alpha$)
- ****Correct Answer: C) ($\beta = 3\alpha$)****

13. Why do we use thermostats?

- A) To measure temperature accurately.
- B) To prevent objects from expanding.
- C) To regulate the flow of heat.
- D) To prevent objects from cooling.
- ****Correct Answer: C) To regulate the flow of heat.****

14. Why does water behave strangely between 0°C and 4°C?

- A) It contracts when heated.
- B) It expands uniformly.
- C) It boils at a lower temperature.
- D) It freezes at a higher temperature.
- ****Correct Answer: A) It contracts when heated.****

15. What is heat capacity defined as?

- A) The amount of heat required to change the temperature of a substance.
- B) The amount of heat transferred between two substances.
- C) The ability of a substance to conduct heat.

- D) The amount of heat absorbed by a substance.
- ****Correct Answer: A) The amount of heat required to change the temperature of a substance.****

16. What is the specific heat of water?

- A) 1 cal/g°C
- B) 4.186 J/kg°C
- C) 1000 cal
- D) 273.15 K
- ****Correct Answer: B) 4.186 J/kg°C****

17. What is the unit of thermal conductivity?

- A) Joules
- B) Watts
- C) Newtons
- D) Watts per meter per degree Celsius (W/m°C)
- ****Correct Answer: D) Watts per meter per degree Celsius (W/m°C)****

18. What is convection?

- A) Heat transfer through physical contact.
- B) Heat transfer through radiation.
- C) Heat transfer through fluid motion.
- D) Heat transfer through waves.
- ****Correct Answer: C) Heat transfer through fluid motion.****

19. How is heat transferred through radiation?

- A) Through physical contact.
- B) Through fluid motion.
- C) Through waves.
- D) Through pressure differences.
- ****Correct Answer: C) Through waves.****

20. What is the mechanical equivalent of heat?

- A) 1 calorie raises the temperature of 1 g of water by 1 °C.
- B) 1 kilocalorie (1 kcal) = 1000 cal.
- C) 1 calorie = 4.186 joules.
- D) 1 joule = 1 newton-meter.
- ****Correct Answer: C) 1 calorie = 4.186 joules.****

37 – THERMAL PHYSICS II

1. What are the variables used to specify the state of a system in thermodynamics?

- A) Mass, temperature, pressure

- B) Pressure, volume, temperature
- C) Volume, energy, temperature
- D) Mass, volume, energy
- ****Correct Answer: B) Pressure, volume, temperature****

2. What does the equation of state in thermodynamics relate?

- A) Pressure and volume
- B) Volume and temperature
- C) Pressure, volume, and temperature
- D) Temperature and energy
- ****Correct Answer: C) Pressure, volume, and temperature****

3. What does the First Law of Thermodynamics state?

- A) Energy is always conserved.
- B) Heat flows from hot to cold objects.
- C) Work is directly proportional to heat.
- D) Pressure is inversely proportional to volume.
- ****Correct Answer: A) Energy is always conserved.****

4. What is the mathematical representation of the First Law of Thermodynamics?

- A) $(E = q + w)$
- B) $(q = E - w)$
- C) $(w = E - q)$
- D) $(E = q - w)$
- ****Correct Answer : A) $(E = q + w)$ ****

5. Which term refers to variables whose values depend on the steps leading from one state to another?

- A) Path variables
- B) State variables
- C) Thermodynamic variables
- D) Phase variables
- ****Correct Answer: A) Path variables****

6. What is the internal energy of a gas proportional to in a free expansion?

- A) Temperature
- B) Pressure
- C) Volume
- D) Number of molecules

- ****Correct Answer: A) Temperature****

7. What is specific heat at constant volume defined as?

- A) The amount of heat required to change the temperature of a substance.
- B) The amount of heat transferred between two substances.
- C) The amount of work done on a system.
- D) The amount of heat required to raise the temperature of a substance with constant volume.

- ****Correct Answer: D) The amount of heat required to raise the temperature of a substance with constant volume.****

8. What is the work done by an expanding gas at constant pressure equal to?

- A) $(P\Delta V)$
- B) $(P\Delta T)$
- C) $(P\Delta E)$
- D) $(P\Delta Q)$
- ****Correct Answer : A) $(P\Delta V)$ ****

9. What is the internal energy of an ideal gas proportional to?

- A) Pressure
- B) Volume
- C) Temperature
- D) Number of molecules

- ****Correct Answer: C) Temperature****

10. What is the concept of a thermal reservoir?

- A) A system with a constant temperature
- B) A system with a changing temperature
- C) A system with high pressure
- D) A system with low pressure

- ****Correct Answer: A) A system with a constant temperature****

11. What is the efficiency of a heat engine defined as?

- A) $(1 - \frac{\text{heat put in}}{\text{heat transferred out}})$
- B) $(\frac{\text{heat put in}}{\text{heat transferred out}})$
- C) $(\frac{\text{heat transferred out}}{\text{heat put in}})$
- D) $(1 + \frac{\text{heat put in}}{\text{heat transferred out}})$

– ****Correct Answer : A)** $(1 - \frac{\text{heat put in}}{\text{heat transferred out}})$ ******

12. What is the efficiency of a refrigerator always less than?

- A) 1
- B) 0
- C) 0.5
- D) 2

- ****Correct Answer: A) 1****

38 – THERMAL PHYSICS III

1. What is heat considered as, according to modern understanding?

- A) Random kinetic energy of atoms
- B) Energy flow from hot to cold bodies
- C) Potential energy of molecules
- D) Vibrational energy of particles

- ****Correct Answer: A) Random kinetic energy of atoms****

2. Which area of physics is concerned with the study of heat as arising from the random motion of the basic constituents of matter?

- A) Quantum mechanics
- B) Classical mechanics
- C) Statistical mechanics
- D) Thermodynamics

- ****Correct Answer: C) Statistical mechanics****

3. Why is pressure directly proportional to temperature for a gas confined to a box?

- A) Because of the attraction between gas molecules
- B) Because of the increase in volume
- C) Because increasing temperature increases the speed of gas molecules
- D) Because of the decrease in density

- ****Correct Answer: C) Because increasing temperature increases the speed of gas molecules****

4. What is the relationship between volume and temperature for an ideal gas at constant pressure?

- A) Volume is inversely proportional to temperature
- B) Volume is directly proportional to temperature
- C) Volume remains constant with temperature

- D) Volume is inversely proportional to pressure
- ****Correct Answer: B) Volume is directly proportional to temperature****

5. What is the equation followed by an ideal gas (dilute, no collisions)?

- A) $(PV = kNT)$
- B) $(PV = NkT)$
- C) $(PV = nkT)$
- D) $(PV = mRT)$
- *** *Correct Answer : B) $(PV = NkT)$ * ***

6. What causes changes of phase in matter due to heat?

- A) Changes in density
- B) Changes in pressure
- C) Random kinetic energy
- D) Changes in volume
- ****Correct Answer: C) Random kinetic energy****

7. What is the concept of entropy associated with?

- A) Conservation of energy
- B) Disorder in a system
- C) Heat transfer
- D) Change of phase
- ****Correct Answer: B) Disorder in a system****

8. What happens to the temperature during the change of phase of a substance?

- A) It increases continuously
- B) It decreases continuously
- C) It remains constant
- D) It fluctuates rapidly
- ****Correct Answer: C) It remains constant****

9. What does statistical mechanics interpret entropy as?

- A) Temperature
- B) Disorder
- C) Pressure
- D) Volume
- ****Correct Answer: B) Disorder****

10. How is the average speed of particles defined in statistical mechanics?

- A) The speed of the fastest particle
- B) The speed of the slowest particle
- C) The median speed of all particles
- D) The mean speed of all particles
- ****Correct Answer: D) The mean speed of all particles****

12. In statistical mechanics, what does the total average kinetic energy of one atom depend on?

- A) Temperature
- B) Pressure
- C) Volume
- D) Heat capacity
- ****Correct Answer: A) Temperature****

13. What does the term "latent heat of fusion" refer to?

- A) The heat required to raise the temperature of a substance
- B) The heat required to convert a substance from solid to liquid
- C) The heat required to convert a substance from liquid to gas
- D) The heat required to overcome intermolecular forces in a substance
- ****Correct Answer: B) The heat required to convert a substance from solid to liquid****

14. What is the equation for the change in entropy when heat is added to an ideal gas?

- A) $(\Delta S = \int \frac{dQ}{T})$
- B) $(\Delta S = \int C dT)$
- C) $(\Delta S = \int \frac{dQ}{T^2})$
- D) $(\Delta S = \int \frac{dT}{C})$
- ****Correct Answer : A) $(\Delta S = \int \frac{dQ}{T})$ ****

15. What does the increase in volume lead to in terms of entropy change?

- A) Increase in entropy
- B) Decrease in entropy
- C) No change in entropy
- D) Depends on the temperature
- ****Correct Answer: A) Increase in entropy****

16. What is the primary focus of statistical mechanics?

- A) Study of macroscopic phenomena

- B) Understanding atomic structure
- C) Prediction of individual particle behavior
- D) Calculation of macroscopic properties from molecular properties
- ****Correct Answer: D) Calculation of macroscopic properties from molecular properties****

17. What does the Kelvin scale measure?

- A) Absolute temperature
- B) Relative temperature
- C) Pressure
- D) Volume
- ****Correct Answer: A) Absolute temperature****

18. What concept does the Second Law of Thermodynamics address?

- A) Conservation of energy
- B) Conservation of momentum
- C) Heat transfer
- D) Increase of disorder in the universe
- ****Correct Answer: D) Increase of disorder in the universe****

19. What is the modern understanding of heat?

- A) Transfer of energy between two bodies
- B) Random kinetic energy of atoms
- C) Flow of electrons
- D) Vibrational energy of molecules
- ****Correct Answer: B) Random kinetic energy of atoms****

20. How is the specific heat defined?

- A) Heat required to raise the temperature of a substance by 1 Kelvin
- B) Heat required to melt a substance
- C) Heat required to convert a substance from liquid to gas
- D) Heat required to raise the temperature of a substance by 1 Celsius
- ****Correct Answer: A) Heat required to raise the temperature of a substance by 1 Kelvin****

39 – SPECIAL RELATIVITY I

1. Who created the Special Theory of Relativity?

- A) Isaac Newton
- B) Albert Einstein
- C) Max Planck
- D) Niels Bohr
- ****Correct Answer: B) Albert Einstein****

2. How do we measure time according to the text?

- A) By observing celestial bodies

- B) By using a pendulum
- C) By measuring the heartbeat
- D) All of the above
- ****Correct Answer: D) All of the above****

3. What did Newton believe about time and space?

- A) They are relative quantities
- B) They are absolute quantities
- C) They depend on the speed of reference frame
- D) They are not relevant to physics
- ****Correct Answer: B) They are absolute quantities****

4. What are Galilean coordinate transformations?

- A) Transformations involving time dilation
- B) Transformations involving space contraction
- C) Transformations between inertial frames
- D) Transformations due to gravity
- ****Correct Answer: C) Transformations between inertial frames****

5. What is the consequence of using Galilean transformations for the length of a rod?

- A) It remains the same in all frames
- B) It changes based on the speed of the frame
- C) It contracts in the moving frame
- D) It expands in the moving frame
- ****Correct Answer: A) It remains the same in all frames****

6. What does the Galilean transformation of velocities imply?

- A) Velocity remains the same in all frames
- B) Acceleration remains the same in all frames
- C) Velocity and acceleration change in all frames
- D) Velocity and acceleration are relative
- ****Correct Answer: B) Acceleration remains the same in all frames****

7. What is the speed of light in vacuum?

- A) $(3 \times 10^8) m/s$
- B) $(2.907925 \times 10^8) m/s$
- C) $(2.997925 \times 10^8) m/s$
- D) $(3.997925 \times 10^8) m/s$
- ***Correct Answer : A) $(3 \times 10^8) m/s$ * ***

8. What are the two postulates of Einstein's theory of relativity?

- A) The laws of physics depend on the observer's frame.
- B) The speed of light is constant in all inertial frames.

- C) The laws of physics change with time.
- D) The speed of light depends on the observer's motion.
- ****Correct Answer: B) The speed of light is constant in all inertial frames.****

9. How does one synchronize clocks in different frames?

- A) By using light signals
- B) By using radio signals
- C) By using gravitational forces
- D) By using magnetic fields
- ****Correct Answer: A) By using light signals****

10. How does Einstein's theory of relativity change the concept of time?

- A) Time is absolute and universal
- B) Time is relative and depends on the observer's frame
- C) Time is irrelevant in physics
- D) Time is a fundamental particle
- ****Correct Answer: B) Time is relative and depends on the observer's frame****

40 – SPECIAL RELATIVITY II

1. What is the speed of light in a vacuum?

- A) $299,792,458 m/s$
- B) $30,000 km/s$
- C) $3 \times 10^8 m/s$
- D) $3.14 \times 10^7 m/s$

Answer: C) $3 \times 10^8 m/s$

2. Which scientist developed the theory of special relativity?

- A) Isaac Newton
- B) Albert Einstein
- C) Max Planck
- D) Niels Bohr

Answer: B) Albert Einstein

3. What is the maximum speed any object or information can travel in the universe?

- A) The speed of sound
- B) The speed of light
- C) The speed of gravity
- D) The speed of time

Answer: B) The speed of light

4. According to special relativity, what happens to an object's mass as its speed approaches the speed of light?

- A) It decreases
- B) It increases
- C) It remains constant
- D) It becomes zero

Answer: B) It increases

5. Which of the following is NOT a consequence of special relativity?

- A) Time dilation
- B) Length contraction
- C) Mass increase
- D) Conservation of energy

Answer: D) Conservation of energy

6. What term describes the distortion of time intervals for an object in motion relative to an observer?

- A) Time dilation
- B) Length contraction
- C) Mass increase
- D) Space-time distortion

Answer: A) Time dilation

7. Which equation represents the time dilation effect in special relativity?

- A) $(E = mc^2)$
- B) $(F = ma)$
- C) $(E = hf)$
- D) $(t' = \frac{t}{\sqrt{1 - \frac{v^2}{c^2}}})$

Answer : D) $(t' = \frac{t}{\sqrt{1 - \frac{v^2}{c^2}}})$

8. What is the Lorentz factor denoted by γ in special relativity?

$$-A)\left(\frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}\right)$$

$$-B)\left(\frac{v}{c^2}\right)$$

$$-C)\left(\frac{c^2}{v}\right)$$

$$-D)(v^2 - c^2)$$

$$\text{Answer : A)}\left(\frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}\right)$$

9. According to the theory of special relativity, which of the following is invariant for all observers?

- A) Time
- B) Length
- C) Mass
- D) Speed of light

Answer: D) Speed of light

10. What does the Lorentz transformation equations describe?

- A) The transformation of mass into energy
- B) The transformation of space and time coordinates between two inertial frames
- C) The transformation of energy into mass
- D) The transformation of kinetic energy in a moving frame

Answer: B) The transformation of space and time coordinates between two inertial frames

11. In special relativity, what is the maximum velocity that any object can attain?

- A) The escape velocity
- B) The speed of light
- C) The speed of sound
- D) The speed of gravity

Answer: B) The speed of light

12. Which equation represents the length contraction effect in special relativity?

$$-A)(L' = L)$$

$$-B)\left(L' = \frac{L}{\sqrt{1 - \frac{v^2}{c^2}}}\right)$$

$$-C)(L' = L + v)$$

$$-D)(L' = L - v)$$

$$\text{Answer : B)}(L' = \frac{L}{\sqrt{1 - \frac{v^2}{c^2}}})$$

13. What happens to the time interval between two events for an observer in motion relative to those events?

- A) It remains the same
- B) It decreases
- C) It increases
- D) It becomes zero

Answer: C) It increases

14. According to special relativity, what happens to the mass of an object as its velocity approaches the speed of light?

- A) It decreases
- B) It increases
- C) It remains the same
- D) It becomes zero

Answer: B) It increases

15. What is the significance of the Lorentz factor in special relativity?

- A) It describes the maximum speed attainable by any object
- B) It explains the curvature of spacetime
- C) It accounts for time dilation and length contraction effects
- D) It quantifies the gravitational force between two objects

Answer: C) It accounts for time dilation and length contraction effects

16. Which of the following phenomena is a consequence of special relativity?

- A) The photoelectric effect
- B) The Doppler effect for sound waves
- C) The conservation of momentum
- D) Time dilation

Answer: D) Time dilation

17. What is the speed limit of information transfer in the universe according to special relativity?

- A) The speed of light
- B) The speed of sound
- C) The speed of gravity

- D) The speed of time

Answer: A) The speed of light

18. What happens to the mass of an object as its velocity decreases?

- A) It increases
- B) It decreases
- C) It remains constant
- D) It becomes zero

Answer: C) It remains constant

19. Which equation describes the relationship between energy (E), mass (m), and the speed of light (c) in special relativity?

- A) $(E = mc^2)$
- B) $(E = mv^2)$
- C) $(E = \frac{mc^2}{\sqrt{1 - \frac{v^2}{c^2}}})$
- D) $(E = \frac{1}{2}mv^2)$

Answer : A) $(E = mc^2)$

20. What is the Lorentz factor when an object is at rest?

- A) 0
- B) 1
- C) ∞
- D) Undefined

Answer: B) 1

41 – WAVES AND PARTICLES

1. According to the lecture, what is the phenomenon called when matter exhibits both particle-like and wave-like behavior?

- A) Particle-wave conundrum
- B) Matter duality
- C) Quantum uncertainty
- D) Wave-particle duality

Answer: D) Wave-particle duality

2. What did the actual observation of the photoelectric effect reveal, contrary to classical physics predictions?

- A) The maximum kinetic energy of emitted electrons depended on light intensity
- B) Electrons were emitted for any frequency of light, regardless of intensity
- C) The maximum kinetic energy of emitted electrons was independent of light intensity
- D) No electrons were emitted for frequencies below a cut-off frequency, regardless of intensity

Answer: C) The maximum kinetic energy of emitted electrons was independent of light intensity

3. Who proposed that light comes in packets of energy called photons to explain the photoelectric effect?

- A) Louis de Broglie
- B) Arthur Compton
- C) Max Planck
- D) Albert Einstein

Answer: D) Albert Einstein

4. What experiment conducted by Arthur Compton confirmed that light is made of photons?

- A) Photoelectric effect experiment
- B) Double-slit experiment
- C) Davisson-Germer experiment
- D) Compton scattering experiment

Answer: D) Compton scattering experiment

5. What is the formula for the change in wavelength of a scattered photon according to Compton's explanation?

- A) $(\Delta\lambda = \lambda - \lambda' = \lambda_c - \theta)$
- B) $(\Delta\lambda = \lambda - \lambda' = \lambda_c \cos \theta)$
- C) $(\Delta\lambda = \lambda - \lambda' = \lambda_c - \lambda)$
- D) $(\Delta\lambda = \lambda - \lambda' = \frac{h}{m_e c} (1 - \cos \theta))$

Answer : A) $(\Delta\lambda = \lambda - \lambda' = \lambda_c - \theta)$

6. What experiment demonstrated that electron waves undergo interference, similar to light waves?

- A) Compton scattering experiment
- B) Photoelectric effect experiment
- C) Davisson-Germer experiment

- D) Double-slit experiment

Answer: C) Davisson-Germer experiment

7. What did Louis de Broglie propose about ordinary matter?

- A) It behaves only as particles
- B) It behaves only as waves
- C) It has wave-like properties related to its momentum
- D) It has particle-like properties related to its wavelength

Answer: C) It has wave-like properties related to its momentum

8. What is the De Broglie wavelength of a 0.5 kg cricket ball moving at 2 m/s?

- A) $(6.63 \times 10^{-34})m$
- B) $(1.7 \times 10^{-10})m$
- C) $(1.7 \times 10^{-34})m$
- D) $(6.63 \times 10^{-6})m$

Answer : D) $(6.63 \times 10^{-6})m$

9. What did the Davisson-Germer experiment demonstrate about electron waves?

- A) They have a constant wavelength
- B) They are not affected by interference
- C) They undergo interference similar to light waves
- D) They cannot be diffracted

Answer: C) They undergo interference similar to light waves

10. In the double-slit experiment, what happens if one slit is closed?

- A) Interference disappears
- B) Interference increases
- C) Both particles go through the other slit
- D) The experiment fails

Answer: A) Interference disappears

11. What does the Heisenberg Uncertainty Principle state?

- A) Momentum can be precisely determined if position is accurately known
- B) It's impossible to simultaneously know the position and momentum of a particle
- C) The energy of a particle is fixed at a certain value
- D) The momentum of a particle is always conserved

Answer: B) It's impossible to simultaneously know the position and momentum of a particle

12. What is the consequence of the Energy-Time Uncertainty Principle?

- A) Energy conservation can be violated
- B) Momentum uncertainty increases over time
- C) The lifetime of atomic transitions is shortened
- D) The product of energy and time is fixed

Answer: C) The lifetime of atomic transitions is shortened

13. Why is it impossible to precisely determine the position and momentum of a particle?

- A) Because of limitations in measurement instruments
- B) Because of the act of measurement itself
- C) Because of the uncertainty principle inherent in quantum mechanics
- D) Because particles have dual properties of waves and particles

Answer: C) Because of the uncertainty principle inherent in quantum mechanics

14. What happens to interference fringes if one tries to determine which slit a particle goes through?

- A) They become clearer
- B) They disappear
- C) They become wider
- D) They become brighter

Answer: B) They disappear

15. What is the mathematical relation between position uncertainty and momentum uncertainty?

- A) $(\Delta x \Delta p = \frac{\hbar}{2})$
- B) $(\Delta x \Delta p = \frac{1}{2})$
- C) $(\Delta x \Delta p = \hbar)$
- D) $(\Delta x \Delta p = 2\hbar)$

Answer : A) $(\Delta x \Delta p = \frac{\hbar}{2})$

16. What is the consequence of the Energy-Time Uncertainty Principle?

- A) It allows for violation of energy conservation
- B) It limits the precision of energy measurements over time

- C) It allows for the simultaneous determination of energy and time
- D) It ensures that energy and time are always conserved

Answer: B) It limits the precision of energy measurements over time

17. What is the uncertainty principle for the product of energy and time?

- A) $(\Delta E \Delta t = \hbar)$
- B) $(\Delta E \Delta t = 2)$
- C) $(\Delta E \Delta t = \frac{\hbar}{2})$
- D) $(\Delta E \Delta t = 2\hbar)$

Answer : C) $(\Delta E \Delta t = \frac{\hbar}{2})$

42 – QUANTUM MECHANICS

1. What does the term "quantum" mean?

- A) Continuous variation
- B) Packet or bundle
- C) Wave-particle duality
- D) Quantum state

Answer: B) Packet or bundle

2. What discrepancy in classical theory brought about the Quantum Revolution?

- A) The blackbody radiation law
- B) The photoelectric effect
- C) The stability of the atom
- D) All of the above

Answer: D) All of the above

3. Who proposed the idea of quanta of energy to explain the blackbody radiation law?

- A) Max Planck
- B) Albert Einstein
- C) Niels Bohr
- D) Louis de Broglie

Answer: A) Max Planck

4. Which phenomenon did Einstein's photon theory explain?

- A) Blackbody radiation
- B) Photoelectric effect
- C) Atomic spectra
- D) Neutron decay

Answer: B) Photoelectric effect

5. What hypothesis did Niels Bohr propose to explain the stability of the hydrogen atom?

- A) Orbital eccentricity
- B) Angular momentum quantization
- C) Electron spin alignment
- D) Proton oscillation

Answer: B) Angular momentum quantization

6. What principle explains the stability of the hydrogen atom according to quantum mechanics?

- A) Heisenberg Uncertainty Principle
- B) Schrödinger's Cat Principle
- C) Quantum Tunneling Principle
- D) Pauli Exclusion Principle

Answer: A) Heisenberg Uncertainty Principle

7. What is the consequence of the uncertainty principle for a particle moving between two walls?

- A) Decrease in kinetic energy
- B) Increase in potential energy
- C) Increase in kinetic energy
- D) Decrease in potential energy

Answer: C) Increase in kinetic energy

8. What does quantum mechanics predict regarding particles moving through potential barriers?

- A) Reflection
- B) Refraction
- C) Tunneling
- D) Diffraction

Answer: C) Tunneling

9. What phenomenon allows the sun to sustain fusion reactions?

- A) Quantum interference
- B) Quantum tunneling
- C) Quantum entanglement
- D) Quantum scattering

Answer: B) Quantum tunneling

10. What term describes the likelihood that an event will occur according to quantum mechanics?

- A) Quantum amplitude
- B) Quantum interference
- C) Quantum probability
- D) Quantum state

Answer: C) Quantum probability

11. Who proposed the concept of quanta of energy to explain the blackbody radiation problem?

- A) Albert Einstein
- B) Max Planck
- C) Niels Bohr
- D) Werner Heisenberg

Answer: B) Max Planck

12. What is the significance of the Stern-Gerlach experiment in quantum mechanics?

- A) It demonstrated wave-particle duality.
- B) It provided evidence for quantum superposition.
- C) It confirmed the quantization of angular momentum.
- D) It showed the existence of electron spin.

Answer: C) It confirmed the quantization of angular momentum.

13. What is the role of the wave function in quantum mechanics?

- A) It describes the position of particles.
- B) It determines the energy levels of atoms.
- C) It calculates the probabilities of particle behavior.
- D) It measures the momentum of waves.

Answer: C) It calculates the probabilities of particle behavior.

14. Which equation governs the behavior of wave functions in quantum mechanics?

- A) Maxwell's equations
- B) Schrödinger equation
- C) Einstein's field equations
- D) Heisenberg's uncertainty principle

Answer: B) Schrödinger equation

15. What is the significance of the double-slit experiment in quantum mechanics?

- A) It demonstrates particle-wave duality.
- B) It confirms the existence of electron spin.
- C) It proves the quantization of energy levels.
- D) It measures the momentum of particles.

Answer: A) It demonstrates particle-wave duality.

16. What term describes the phenomenon where electron waves interfere with each other in the double-slit experiment?

- A) Quantum tunneling
- B) Quantum interference
- C) Quantum superposition
- D) Quantum entanglement

Answer: B) Quantum interference

43 – INTRODUCTION TO ATOMIC PHYSICS

1. **Who proposed the atomic theory that states atoms are indivisible?**

- A) Aristotle
- B) Democritus
- C) Dalton
- D) Avogadro

- **Answer: B) Democritus**

2. **Which scientist demonstrated the Law of Conservation of Matter?**

- A) Democritus
- B) Lavoisier
- C) Dalton
- D) Rutherford

- ****Answer: B) Lavoisier****

3. ****According to Dalton's Atomic Theory, atoms of the same element have the same:****

- A) Charge
- B) Mass
- C) Size
- D) Color

- ****Answer: B) Mass****

4. ****Avogadro's hypothesis is related to:****

- A) Equal volumes of gasses
 - B) Equal masses of gasses
 - C) Equal densities of gasses
 - D) Equal pressures of gasses
- ****Answer: A) Equal volumes of gasses****

5. ****Who discovered the atomic nucleus through the gold foil experiment?****

- A) Democritus
 - B) Lavoisier
 - C) Dalton
 - D) Rutherford
- ****Answer: D) Rutherford****

6. ****According to Bohr's model, electrons orbit the nucleus in quantized:****

- A) Paths
 - B) Velocities
 - C) Energies
 - D) Spins
- ****Answer: C) Energies****

7. ****Which principle states that no two electrons in an atom can have the same set of quantum numbers?****

- A) Heisenberg Uncertainty Principle
 - B) Pauli Exclusion Principle
 - C) Bohr's Principle
 - D) Schrodinger Principle
- ****Answer: B) Pauli Exclusion Principle****

8. ****Which equation describes the behavior of wave functions in quantum mechanics?****

- A) Newton's Law

- B) Boyle's Law
- C) Schrodinger Equation
- D) Avogadro's Equation
- ****Answer: C) Schrodinger Equation****

9. ****The principal quantum number (n) determines the:****

- A) Shape of the orbital
- B) Energy level of the electron
- C) Spin of the electron
- D) Angular momentum of the electron
- ****Answer: B) Energy level of the electron****

10. ****Electrons with the same values of (n) and (l) belong to the same:****

- A) Orbital
- B) Shell
- C) Subshell
- D) Spin
- ****Answer: C) Subshell****

11. ****Which scientist introduced the "plum pudding" model of the atom?****

- A) Dalton
- B) Rutherford
- C) Thomson
- D) Bohr
- ****Answer: C) Thomson****

12. ****The energy of the emitted or absorbed photon in the Bohr model is equal to:****

- A) Planck's constant
- B) Rydberg constant
- C) Difference of energy levels
- D) Speed of light
- ****Answer: C) Difference of energy levels****

13. ****Which model of the atom explains the emission and absorption spectra of elements?****

- A) Thomson's model
- B) Rutherford's model
- C) Bohr's model
- D) Schrodinger's model
- ****Answer: C) Bohr's model****

14. ****In the Schrodinger equation, the wave function represents the:****

- A) Position of the electron
- B) Momentum of the electron
- C) Energy of the electron

- D) Probability of finding the electron
- ****Answer: D) Probability of finding the electron****

15. ****Which quantum number determines the orientation of an orbital in space?****

- A) Principal quantum number (n)
- B) Angular momentum quantum number (l)
- C) Magnetic quantum number (m_l)
- D) Spin quantum number (m_s)
- ****Answer: C) Magnetic quantum number (m_l) ****

16. ****Electrons with the same values of n and l but different values of m_l belong to different:****

- A) Orbitals
- B) Shells
- C) Subshells
- D) Spins
- ****Answer: A) Orbitals****

17. ****Identical particles obey the Pauli Exclusion Principle if they are:****

- A) Fermions
- B) Bosons
- C) Nucleons
- D) Electrons
- ****Answer: A) Fermions****

18. ****Which type of states are s, p, d orbitals in an atom?****

- A) Energy states
- B) Angular momentum states
- C) Spin states
- D) Shell states
- ****Answer: B) Angular momentum states****

19. ****What does the principal quantum number (n) represent in the electron configuration?****

- A) Shape of the orbital
- B) Size of the orbital
- C) Energy level of the orbital
- D) Spin of the electron

- ****Answer: C) Energy level of the orbital****

20. ****In the electron configuration notation, how many electrons can be accommodated in the 3p subshell?****

- A) 2
- B) 4
- C) 6
- D) 8

- ****Answer: C) 6****

44 – INTRODUCTION TO NUCLEAR PHYSICS

1. ****What is the approximate diameter of a nucleus compared to the overall diameter of an atom?****

- A) 10 times smaller
- B) 100 times smaller
- C) 10,000 times smaller
- D) 1,000,000 times smaller

- ****Answer: A) 10 times smaller****

2. ****Which particle is responsible for carrying the strong nuclear force?****

- A) Proton
- B) Neutron
- C) Pion
- D) Electron

- ****Answer: C) Pion****

3. ****What is the minimum energy required for an electron to interact with a nucleus?****

- A) Few keV
- B) Few MeV
- C) Few GeV
- D) Few TeV

- ****Answer: B) Few MeV****

4. ****Which of the following particles is not emitted during radioactive decay?****

- A) Alpha particle
- B) Beta particle
- C) Gamma ray

- D) Neutrino
- ****Answer: D) Neutrino****

5. ****What is the most stable element according to binding energy per nucleon?****

- A) Uranium
- B) Iron
- C) Lead
- D) Carbon
- ****Answer: B) Iron****

6. ****Which force is responsible for beta decay?****

- A) Gravitational force
- B) Electromagnetic force
- C) Weak nuclear force
- D) Strong nuclear force
- ****Answer: C) Weak nuclear force****

7. ****What is the approximate half-life of Carbon-14?****

- A) 573 years
- B) 5,730 years
- C) 57,300 years
- D) 573,000 years
- ****Answer: B) 5,730 years****

8. ****What is the primary factor that determines whether a nucleus is stable or unstable?****

- A) Number of protons
- B) Number of neutrons
- C) Total mass
- D) Total energy
- ****Answer: B) Number of neutrons****

9. ****Which particle is the carrier of the electromagnetic force?****

- A) Neutrino
- B) Photon
- C) Pion
- D) Proton
- ****Answer: B) Photon****

10. ****Which type of radiation is composed of heavy positively charged particles?****

- A) Alpha radiation
- B) Beta radiation
- C) Gamma radiation
- D) Neutron radiation
- ****Answer: A) Alpha radiation****

11. ****Which Japanese physicist proposed the existence of the pion particle?****

- A) Hideki Yukawa
- B) Shin'ichirō Tomonaga
- C) Yukawa Hideki
- D) Isamu Akasaki
- ****Answer: A) Hideki Yukawa****

12. ****What is the primary reason behind the stability of nuclei against electrostatic repulsion?****

- A) Weak nuclear force
- B) Gravitational force
- C) Strong nuclear force
- D) Electromagnetic force
- ****Answer: C) Strong nuclear force****

13. ****Which particle has the smallest mass?****

- A) Proton
- B) Neutron
- C) Electron
- D) Pion
- ****Answer: C) Electron****

14. ****What is the approximate diameter of a nucleus in femtometers (fm)?**

- A) 10 fm
- B) 1 fm
- C) 100 fm
- D) 1000 fm
- ****Answer: B) 1 fm****

15. ****Which element is commonly used for radioactive dating of organic materials?**

- A) Uranium
- B) Carbon
- C) Lead
- D) Potassium
- ****Answer: B) Carbon****

16. ****Which particle is not affected by electromagnetic fields during its emission from a nucleus?**

- A) Alpha particle
- B) Beta particle

- C) Gamma ray
- D) Neutrino
- ****Answer: C) Gamma ray****

17. **What is the mass number of an alpha particle?**

- A) 1
- B) 2
- C) 3
- D) 4
- ****Answer: D) 4****

18. **Which force causes the repulsion between two positively charged nuclei?**

- A) Weak nuclear force
- B) Electromagnetic force
- C) Gravitational force
- D) Strong nuclear force
- ****Answer: B) Electromagnetic force****

19. **What happens to the number of nuclei after each half-life in radioactive decay?**

- A) It doubles
- B) It quadruples
- C) It halves
- D) It remains constant
- ****Answer: C) It halves****

20. **What is the primary reason for the stability of iron nuclei?**

- A) High neutron count
- B) High proton count
- C) High binding energy per nucleon
- D) High gamma ray emission
- ****Answer: C) High binding energy per nucleon****

21. **Which type of radiation is neutral and does not bend in a magnetic field?**

- A) Alpha radiation
- B) Beta radiation
- C) Gamma radiation
- D) Neutrino radiation
- ****Answer: C) Gamma radiation****

22. **What is the process called when a heavy nucleus splits into two smaller nuclei?**

- A) Fusion
- B) Fission
- C) Decay
- D) Emission

- ****Answer: B) Fission****

23. **Which particle is not emitted during alpha decay?**

- A) Proton
- B) Neutron
- C) Alpha particle
- D) Helium nucleus

- ****Answer: A) Proton****

24. **Which force is responsible for the stability of a nucleus against electrostatic repulsion?**

- A) Weak nuclear force
- B) Electromagnetic force
- C) Gravitational force
- D) Strong nuclear force

- ****Answer: D) Strong nuclear force****

25. **What is the approximate ratio of the diameter of a nucleus to the diameter of an atom?**

- A) 1:10,000
- B) 1:1,000
- C) 1:10
- D) 1:100

- ****Answer: A) 1:10,000****

45 – PHYSICS OF THE SUN

1. What is the mass of the sun compared to the Earth?

- A) 333,000 times greater
- B) 10 times greater
- C) 333 times greater
- D) 1,392,000 times greater

- ****Answer: A) 333,000 times greater****

2. What is the primary source of energy for the sun?

- A) Chemical fuel
- B) Nuclear fission
- C) Nuclear fusion
- D) Gravitational collapse

- ****Answer: C) Nuclear fusion****

3. How much energy does the sun emit per second?

- A) $3.83 \times 10^3 \text{ joules}$
- B) $3.83 \times 10^{10} \text{ joules}$
- C) $3.83 \times 10^{16} \text{ joules}$
- D) $3.83 \times 10^{24} \text{ joules}$
- ****Answer : C) $3.83 \times 10^{16} \text{ joules}$ ****

4. What is the approximate temperature at the core of the sun?

- A) 5770 K
- B) 8 million K
- C) 15 million K
- D) 600 million K
- ****Answer: C) 15 million K****

5. Which force opposes gravity in maintaining the size of the sun?

- A) Electromagnetic force
- B) Strong nuclear force
- C) Weak nuclear force
- D) Thermal pressure
- ****Answer: D) Thermal pressure****

6. What causes the expansion and contraction of the sun's surface, leading to "sun-quakes"?

- A) Gravitational waves
- B) Solar winds
- C) Nuclear fusion reactions
- D) Vibrations from internal forces
- ****Answer: D) Vibrations from internal forces****

7. How long can the sun sustain core hydrogen fusion before it enters a new phase?

- A) 500 million years
- B) 1 billion years
- C) 5 billion years
- D) 10 billion years
- ****Answer: C) 5 billion years****

8. What happens when the sun's core runs out of hydrogen fuel?

- A) It expands into a Red Giant
- B) It collapses into a White Dwarf
- C) It ignites helium fusion
- D) It forms a black hole
- ****Answer: C) It ignites helium fusion****

9. What is the estimated surface temperature of the Earth due to the greenhouse effect?

- A) 0 K

- B) 290 K
- C) 5770 K
- D) 15 million K
- ****Answer: B) 290 K****

10. Which gasses contribute most to the greenhouse effect?

- A) Nitrogen and oxygen
- B) Carbon dioxide and methane
- C) Helium and hydrogen
- D) Water vapor and oxygen

- ****Answer: B) Carbon dioxide and methane****

1. What is the mass of the sun compared to Earth?

- A) 333,000 times greater

2. How old is the sun?

- B) 4.6 billion years

3. What powers the sun?

- C) Nuclear fusion

4. What is the temperature at the core of the sun?

- A) 15 million K

5. What prevents the sun from collapsing under its own gravity?

- D) Thermal pressure

6. How does heat transfer from the core to the surface of the sun?

- D) Vibrations from internal forces

7. How long is the sun expected to last before major changes occur?

- C) 5 billion years

8. What happens when the core of the sun ignites helium fusion?

- C) It ignites helium fusion

9. What is the average surface temperature of the Earth?

- B) 290 K

10. Which gasses contribute to the greenhouse effect?

- B) Carbon dioxide and methane

11. What theory explains why certain gasses trap the sun's radiation?

- A) Quantum mechanics

12. What will the sun become when it exhausts its hydrogen fuel?

- B) A Red Giant

13. How long can the sun last on core hydrogen fusion?

- A) 5 billion years

14. What is the primary component of the sun's core?

- C) Hydrogen

15. What is the sun's power output in kilowatts?

- B) 3.83×10^{16} kilowatts

16. What causes the pulsating motions of the sun?

- A) Vibrations in the gas due to internal forces

17. How does the sun transfer heat from its core to the surface?

- B) By emitting photons

18. What happens when the sun exhausts its helium fuel?

- A) It becomes a White Dwarf

19. What percentage of the sun's energy is radiated back into space?

- C) About 30%

20. What will the sun's fate be after it exhausts its helium fuel?

- D) It will become a planetary nebula

21. What are the main constituents of the sun's atmosphere?

- B) Hydrogen and helium

22. What causes the surface of the sun to appear bright?

- D) Nuclear fusion reactions

23. How does the sun generate energy?

- A) By converting hydrogen into helium through nuclear fusion

24. What happens to the sun's temperature when it exhausts its hydrogen fuel?

- B) It increases

25. How does the sun maintain its equilibrium?

- C) By balancing thermal pressure with gravitational forces