PHY101
AN INTRODUCTION TO PHYSICS

Important mcqs

Lec 23 - Electrostatics – I

What is the electric field intensity at a distance of 2 meters from a point charge of 5 µC?

a) 9 x 10^9 N/C

b) 1.125 x 10^10 N/C

c) 2.25 x 10^10 N/C

d) 4.5 x 10^10 N/C

Answer: b) 1.125 x 10^10 N/C

Which law of electrostatics relates the electric field to the charge density?

a) Coulomb’s Law

b) Gauss’s Law

c) Ohm’s Law

d) Ampere’s Law

Answer: b) Gauss’s Law

What is the electric potential at a point P, located at a distance of 2 meters from a point charge of 10 µC?

a) 1.125 x 10^10 V

b) 9 x 10^9 V

c) 4.5 x 10^10 V

d) 2.25 x 10^10 V

Answer: d) 2.25 x 10^10 V

What is the potential difference between two points A and B, located at a distance of 5 cm and 10 cm respectively from a point charge of 2 μC?

a) 1.8 x 10^9 V

b) 2.2 x 10^9 V

c) 3.6 x 10^9 V

d) 4.4 x 10^9 V

Answer: c) 3.6 x 10^9 V

What is the work done in moving a charge of 5 μC from a point A to a point B, located at a distance of 10 cm and 20 cm respectively from a point charge of 10 μC?

a) -4.5 x 10^-6 J

b) 4.5 x 10^-6 J

c) 9 x 10^-6 J

d) -9 x 10^-6 J

Answer: a) -4.5 x 10^-6 J

What is the electric field intensity at the center of a circular ring of radius R and charge Q?

a) kQ/R^2

b) 2kQ/R^2

c) 3kQ/R^2

d) 4kQ/R^2

Answer: a) kQ/R^2

What is the electric field intensity at a point on the axis of a uniformly charged disc of radius R and charge Q, at a distance of x from the center of the disc?

a) kQx/2(R^2 + x^2)^(3/2)

b) kQx/(R^2 + x^2)^(3/2)

c) kQ/2(R^2 + x^2)^(3/2)

d) kQ/(R^2 + x^2)^(3/2)

Answer: b) kQx/(R^2 + x^2)^(3/2)

What is the electric potential at the center of a uniformly charged sphere of radius R and charge Q?

a) kQ/R

b) kQ/2R

c) kQ/3R

d) kQ/4R

Answer: d) kQ/4R

What is the work done in moving a charge of 10 μC from a point A to a point B, located at a distance of 5 cm and 10 cm respectively from a uniformly charged sphere

Lec 24 - Electrostatics – II

What is the unit of electric field?

a. Newtons

b. Volts

c. Teslas

d. Newtons per Coulomb

Answer: d. Newtons per Coulomb

Which law relates the electric field to the electric potential?

a. Ohm's Law

b. Coulomb's Law

c. Gauss's Law

d. Ampere's Law

Answer: c. Gauss's Law

Which statement about electric potential is correct?

a. Electric potential is a vector quantity.

b. Electric potential is a scalar quantity.

c. Electric potential is the same as electric field.

d. Electric potential is measured in Amperes.

Answer: b. Electric potential is a scalar quantity.

Which statement about capacitance is correct?

a. Capacitance depends only on the geometry of the system.

b. Capacitance depends only on the charge on the capacitor.

c. Capacitance depends on both the geometry of the system and the dielectric constant of the material between the plates.

d. Capacitance does not depend on the voltage across the capacitor.

Answer: c. Capacitance depends on both the geometry of the system and the dielectric constant of the material between the plates.

Which of the following is true for a conductor in electrostatic equilibrium?
Which of the following is true for a conductor in electrostatic equilibrium?

a. There is no electric field inside the conductor.

b. There is no charge on the surface of the conductor.

c. The electric field is highest at the center of the conductor.

d. The potential inside the conductor is different from the potential outside the conductor.

Answer: a. There is no electric field inside the conductor.

What is the formula for the electric potential due to a point charge?

a. V = kq/r

b. V = kq/r^2

c. V = kQ/r

d. V = kQ/r^2

Answer: a. V = kq/r

What is the relationship between electric potential and electric field?

a. Electric potential is proportional to electric field.

b. Electric potential is the negative gradient of electric field.

c. Electric potential is the curl of electric field.

d. Electric potential is the divergence of electric field.

Answer: b. Electric potential is the negative gradient of electric field.

Which statement about the dielectric material between the plates of a capacitor is correct?

a. The dielectric material increases the capacitance of the capacitor.

b. The dielectric material decreases the voltage of the capacitor.

c. The dielectric material increases the electric field between the plates.

d. The dielectric material decreases the energy stored in the capacitor.

Answer: a. The dielectric material increases the capacitance of the capacitor.

What is the formula for the capacitance of a parallel-plate capacitor?

a. C = ?A/d

b. C = ?d/A

c. C = Ad/?

d. C = ?A^2/d

Answer: a. C = ?A/d

What is the electric potential energy of a system of two point charges q1 and q2 separated by a distance r?

a. U = kq1q2

b. U = kq1q2/r^2

c. U = kq1q2/r

d. U = kq1^2/r + kq2^2/r

Answer: c. U = kq1q2/r

Lec 26 - Electric Potential

What is the unit of electric potential?

a) Coulomb (C)

b) Ampere (A)

c) Volt (V)

d) Tesla (T)

Answer: c) Volt (V)

Which of the following is true for an equipotential surface?

a) The electric field is zero at all points on the surface

b) The electric field is perpendicular to the surface at all points

c) The electric field is parallel to the surface at all points

d) The electric field is maximum at all points on the surface

Answer: a) The electric field is zero at all points on the surface

What is the electric potential due to a point charge at a distance of 2 meters, if the charge is 4 Coulombs?

a) 2 V

b) 4 V

c) 8 V

d) 16 V

Answer: c) 8 V (V = kq/r = (9x10^9 Nm^2/C^2) x (4 C) / (2 m) = 8 V)

What is the electric potential due to a dipole at a distance of 3 meters, if the dipole moment is 5 Cm and the angle between the dipole moment and the line joining the dipole to the point is 60 degrees?

a) 1.8 V

b) 3.6 V

c) 7.2 V

d) 14.4 V

Answer: a) 1.8 V (V = k(p/r^2)cos? = (9x10^9 Nm^2/C^2) x (5x10^-6 Cm) / (3 m)^2 x cos60° = 1.8 V)

The work done in moving a charge on an equipotential surface is:

a) Zero

b) Positive

c) Negative

d) Cannot be determined

Answer: a) Zero

The electric potential energy of a system of two charges is -10 J. What is the work done in moving one of the charges from infinity to a distance of 2 meters from the other charge?

a) 2 J

b) 4 J

c) 8 J

d) 10 J

Answer: d) 10 J (The work done is equal to the change in potential energy, which is -10 J. Therefore, the work done is +10 J)

The electric potential due to a uniformly charged sphere at a distance outside the sphere:

a) Increases as the distance increases

b) Decreases as the distance increases

c) Remains constant as the distance increases

d) Can be zero at some distances

Answer: b) Decreases as the distance increases

What is the electric potential due to a uniform electric field of magnitude 5 N/C?

a) 2 V

b) 5 V

c) 10 V

d) 25 V

Answer: b) 5 V (V = Ed = 5 N/C x 1 m = 5 V)

Which of the following statements is true for a charged conductor in electrostatic equilibrium?

a) The electric potential is zero inside the conductor

b) The electric field is zero inside the conductor

c) The electric potential is maximum at the surface of the conductor

d) The electric field is maximum at the surface of the conductor

Answer: b) The electric field is zero inside the conductor

The electric potential due to a system of charges is the:

a) Vector sum of the electric potentials due to each charge

b) Scalar sum of the electric potentials

Lec 27 - Capacitors and Currents

A capacitor of capacitance 2 microfarads is charged to 100 V. The energy stored in the capacitor is:

a) 1 J

b) 2 J

c) 4 J

d) 10 J

Answer: c) 4 J

Explanation: The energy stored in a capacitor is given by the formula E = 1/2 CV^2, where C is the capacitance and V is the voltage across the capacitor. Substituting the given values, we get E = 1/2 * 2 * 10^-6 * (100)^2 = 4 J.

Which of the following materials would be the best choice for making a capacitor with a high capacitance?

a) Air

b) Glass

c) Paper

d) Aluminum foil

Answer: d) Aluminum foil

Explanation: The capacitance of a capacitor depends on the area of the plates, the distance between them, and the dielectric constant of the material between them. Aluminum foil has a high surface area and can be rolled up to form a capacitor with a large area. It is also a good conductor, which is important for minimizing resistance and maximizing capacitance.

A capacitor is connected in series with a resistor and a battery. What happens to the voltage across the capacitor as time passes?

a) It decreases exponentially.

b) It increases linearly.

c) It remains constant.

d) It oscillates.

Answer: a) It decreases exponentially.

Explanation: In a series circuit, the same current flows through all the components, so the voltage across the capacitor and the resistor must add up to the voltage of the battery. As the capacitor charges up, the voltage across it increases, but the voltage across the resistor decreases. The rate of change of the voltage across the capacitor is proportional to the current flowing through the circuit and the capacitance of the capacitor. This leads to an exponential decrease in the voltage across the capacitor as it charges up.

What is the time constant of a circuit consisting of a 10 microfarad capacitor and a 1 kilohm resistor?

a) 1 microsecond

b) 10 microseconds

c) 100 microseconds

d) 1 millisecond

Answer: b) 10 microseconds

Explanation: The time constant of an RC circuit is equal to the product of the resistance and the capacitance, ? = RC. Substituting the given values, we get ? = 10 * 10^-6 * 10^3 = 10 * 10^-3 = 10 microseconds.

A capacitor is charged up to a voltage of 12 V and then disconnected from the battery. If the capacitance is 2 microfarads, how much charge is stored on the capacitor?

a) 6 microcoulombs

b) 12 microcoulombs

c) 24 microcoulombs

d) 48 microcoulombs

Answer: b) 12 microcoulombs

Explanation: The charge stored on a capacitor is given by the formula Q = CV, where C is the capacitance and V is the voltage across the capacitor. Substituting the given values, we get Q = 2 * 10^-6 * 12 = 24 * 10^-6 = 12 microcoulombs.

Which of the following is true about the current in a capacitor?

a) The current is always zero.

b) The current is always positive.

c) The current can be positive or negative.

d) The current is independent of the voltage across the capacitor.

Answer: a) The current is always zero.

Explanation: In a DC circuit, a capacitor acts as an open circuit, so

Lec 28 - Currents and Circuits

In a simple circuit consisting of a resistor and a battery, what happens to the current if the resistance is doubled?

a) The current doubles

b) The current is halved

c) The current remains the same

d) The current becomes zero

Answer: b) The current is halved

What is the unit of electric current?

a) Joule

b) Coulomb

c) Watt

d) Ampere

Answer: d) Ampere

In a parallel circuit, what happens to the total resistance when additional resistors are added?

a) The total resistance decreases

b) The total resistance increases

c) The total resistance remains the same

d) The total resistance becomes zero

Answer: a) The total resistance decreases

What is the relationship between voltage, current, and resistance in a circuit?

a) V = IR

b) I = VR

c) R = IV

d) V = RI

Answer: a) V = IR

In a circuit with a battery and a single resistor, what happens to the current if the voltage of the battery is increased?

a) The current increases

b) The current decreases

c) The current remains the same

d) The current becomes zero

Answer: a) The current increases

What is the role of a capacitor in a circuit?

a) To store energy in the form of electric charge

b) To increase the resistance of the circuit

c) To reduce the resistance of the circuit

d) To act as a switch

Answer: a) To store energy in the form of electric charge

In a circuit with multiple resistors in series, what happens to the total resistance when the resistors are replaced with ones of lower resistance?

a) The total resistance increases

b) The total resistance decreases

c) The total resistance remains the same

d) The total resistance becomes zero

Answer: b) The total resistance decreases

What is the unit of electric potential difference?

a) Volt

b) Joule

c) Coulomb

d) Watt

Answer: a) Volt

In a series circuit, what happens to the current as it passes through each component?

a) The current increases

b) The current decreases

c) The current remains the same

d) The current becomes zero

Answer: b) The current decreases

What is the relationship between power, voltage, and current in a circuit?

a) P = VI

b) V = PI

c) I = PV

d) P = IV

Answer: a) P = VI

Lec 29 - The Magnetic Field

1. **Which of the following is NOT a magnetic material?**
   a) Iron
   b) Copper
   c) Nickel
   d) Cobalt
   Answer: b) Copper

2. **Which of the following is NOT a unit of magnetic field strength?**
   a) Tesla
   b) Gauss
   c) Weber
   d) Ampere/meter
   Answer: c) Weber

3. **In which direction does a north magnetic pole point?**
   a) North
   b) South
   c) East
   d) West
   Answer: b) South

4. **Which of the following devices is used to measure magnetic field strength?**
   a) Voltmeter
   b) Ammeter
   c) Galvanometer
   d) Magnetometer
   Answer: d) Magnetometer

5. **Which of the following is a property of magnetic fields?**
   a) They are always parallel to electric fields.
   b) They cannot be shielded or blocked.
   c) They can only be produced by permanent magnets.
   d) They do not interact with electric charges.
   Answer: b) They cannot be shielded or blocked.

6. **Which of the following is the formula for calculating magnetic field strength?**
   a) B = ?0I/2?r
   b) B = ?0I/4?r
   c) B = ?0I/?r
   d) B = ?0I/r
   Answer: b) B = ?0I/4?r

7. **What is the direction of the magnetic field around a straight current-carrying wire?**
   a) Toward the wire
   b) Away from the wire
   c) Parallel to the wire
   d) Perpendicular to the wire
   Answer: d) Perpendicular to the wire

8. **Which of the following is a property of a solenoid?**
   a) It has a north and south pole.
   b) It produces a uniform magnetic field inside.
   c) Its magnetic field is strongest at its ends.
   d) It does not produce a magnetic field.
   Answer: b) It produces a uniform magnetic field inside.

9. **Which of the following is the formula for calculating the magnetic force on a charged particle moving in a magnetic field?**
   a) F = qvB
   b) F = qv/E
   c) F = qE/B
   d) F = qB/E
   Answer: a) F = qvB

10. **Which of the following is NOT a type of magnetic domain?**
    a) Ferromagnetic
    b) Paramagnetic
    c) Diamagnetic
    d) Electromagnetic
    Answer: d) Electromagnetic

Lec 30 - Electromagnetic Induction

When a magnet is moved towards a coil of wire, an induced current is produced. What is the direction of the induced current?

A) In the opposite direction to the motion of the magnet

B) In the same direction as the motion of the magnet

C) In a direction perpendicular to the motion of the magnet

D) The direction depends on the strength of the magnet

Answe**r: A) In the opposite direction to the motion of the magnet**

Faraday's law of electromagnetic induction relates which of the following quantities?

A) Electric field and magnetic field

B) Electric field and time-varying magnetic field

C) Magnetic field and time-varying electric field

D) Magnetic field and current

Answer: B) Electric field and time-varying magnetic field

A transformer is a device used to:

A) Store electrical energy

B) Increase or decrease voltage levels in a circuit

C) Convert AC to DC

D) Convert DC to AC

Answer: B) Increase or decrease voltage levels in a circuit

Lenz's law states that:

A) The magnitude of the induced emf is proportional to the rate of change of magnetic field

B) The direction of the induced emf is in the same direction as the change in magnetic field

C) The direction of the induced emf is opposite to the change in magnetic field

D) The direction of the induced emf is perpendicular to the magnetic field

Answer: C) The direction of the induced emf is opposite to the change in magnetic field

Which of the following is not a way to induce an electromotive force in a conductor?

A) Moving a magnet near a conductor

B) Moving a conductor near a magnet

C) Changing the electric field near a conductor

D) Changing the magnetic field near a conductor

Answer: C) Changing the electric field near a conductor

The primary coil of a transformer is connected to a 120 V AC power source. If there are 200 turns in the primary coil and 400 turns in the secondary coil, what is the voltage across the secondary coil?

A) 60 V

B) 120 V

C) 240 V

D) 480 V

Answer: C) 240 V

Which of the following is a measure of the strength of an induced electric field?

A) Resistance

B) Capacitance

C) Magnetic flux

D) Inductance

Answer: D) Inductance

An induced current is produced in a coil of wire when:

A) A magnetic field is applied to the coil

B) The coil is connected to a battery

C) The coil is moved through a magnetic field

D) A static magnetic field is present in the vicinity of the coil

Answer: C) **The coil is moved through a magnetic field**

A metal rod is moved perpendicular to a magnetic field with a velocity of 5 m/s. The rod has a length of 0.2 m and a resistance of 2 ohms. If the magnetic field has a strength of 0.3 T, what is the magnitude of the induced emf?

A) 0.6 V

B) 1.0 V

C) 3.0 V

D) 6.0 V

Answer: A) 0.6 V

What is the purpose of a commutator in a DC motor?

A) To convert AC to DC

B) To increase the speed of the motor

C) To reverse the direction of the current in the motor

D) To increase the efficiency of the motor

Answer: C) To reverse the direction of the current in

Lec 31 - Alternating Current

What is the phase difference between voltage and current in an ideal inductor in an AC circuit?

A. 0 degrees

B. 90 degrees

C. 180 degrees

D. 270 degrees

Answer: B. 90 degrees

What is the unit of frequency in an AC circuit?

A. Hertz

B. Volt

C. Ampere

D. Ohm

Answer: A. Hertz

What is the term for the opposition of an AC circuit to the flow of current?

A. Resistance

B. Reactance

C. Impedance

D. Conductance

Answer: B. Reactance

Which of the following components is commonly used to reduce the reactance of an AC circuit?

A. Resistor

B. Capacitor

C. Inductor

D. Transformer

Answer: B. Capacitor

What is the effect of increasing the frequency of an AC circuit?

A. Increases the reactance of inductors

B. Decreases the reactance of inductors

C. Increases the reactance of capacitors

D. Decreases the reactance of capacitors

Answer: B. Decreases the reactance of inductors

What is the term for the measure of the amount of AC power being used in a circuit?

A. Amplitude

B. Frequency

C. Power factor

D. RMS voltage

A**nswer: C. Power factor**

What is the relationship between the voltage and current in a purely resistive AC circuit?

A. They are in phase

B. Voltage leads current by 90 degrees

C. Voltage lags current by 90 degrees

D. Voltage and current are 180 degrees out of phase

Answer: A. They are in phase

Which of the following is true for a parallel AC circuit?

A. Voltage is the same across all components

B. Current is the same across all components

C. Resistance increases as more components are added

D. Capacitance decreases as more components are added

Answer: A. Voltage is the same across all components

What is the unit of power in an AC circuit?

A. Watt

B. Volt-ampere

C. Ohm

D. Joule

Answer: B. Volt-ampere

What is the term for the time delay between the peak voltage and peak current in an AC circuit?

A. Phase angle

B. Power factor

C. Impedance

D. Reactance

Answer: A. Phase angle

Lec 33 - Electromagnetic Waves

What is the speed of an electromagnetic wave in a vacuum?

A) 3 × 10^8 m/s

B) 1 × 10^8 m/s

C) 5 × 10^8 m/s

D) 2 × 10^8 m/s

Answer: A) 3 × 10^8 m/s

Which of the following electromagnetic waves has the highest frequency?

A) Microwaves

B) X-rays

C) Radio waves

D) Infrared waves

Answer: B) X-rays

What is the relationship between the wavelength and frequency of an electromagnetic wave?

A) Inversely proportional

B) Directly proportional

C) No relationship

D) Random relationship

Answer: A) Inversely proportional

What type of electromagnetic waves are used in communication systems such as cell phones and radios?

A) Microwaves

B) X-rays

C) Radio waves

D) Infrared waves

Answer: C) Radio waves

What is the range of frequencies for visible light?

A) 400 nm to 700 nm

B) 100 nm to 400 nm

C) 700 nm to 1000 nm

D) 1 nm to 100 nm

Answer: A) 400 nm to 700 nm

What is the relationship between the electric and magnetic fields in an electromagnetic wave?

A) They are perpendicular to each other

B) They are parallel to each other

C) They are randomly oriented

D) They do not exist in electromagnetic waves

Answer: A) They are perpendicular to each other

What is the electromagnetic spectrum?

A) The range of all possible frequencies of electromagnetic waves

B) The range of all possible wavelengths of electromagnetic waves

C) The range of all possible amplitudes of electromagnetic waves

D) The range of all possible speeds of electromagnetic waves

Answer: A) The range of all possible frequencies of electromagnetic waves

Which of the following is not an electromagnetic wave?

A) Sound waves

B) X-rays

C) Gamma rays

D) Ultraviolet rays

Answer: A) Sound waves

What is the energy of an electromagnetic wave proportional to?

A) Its frequency

B) Its wavelength

C) Its amplitude

D) Its speed

Answer: A) Its frequency

What is the relationship between the energy of an electromagnetic wave and its frequency?

A) Directly proportional

B) Inversely proportional

C) No relationship

D) Random relationship

Answer: A) Directly proportional

Lec 34 - Physics of Light

What is the speed of light in a vacuum?

a. 3 x 10^5 m/s

b. 3 x 10^7 m/s

c. 3 x 10^8 m/s

d. 3 x 10^10 m/s

Answer: c. 3 x 10^8 m/s

Which of the following is NOT part of the visible spectrum?

a. Infrared

b. Ultraviolet

c. Red

d. Blue

A**nswer: a. Infrared**

Which phenomenon of light explains the double-slit experiment?

a. Reflection

b. Refraction

c. Interference

d. Diffraction

Answer: c. Interference

What is the wave-particle duality of light?

a. Light behaves only as a wave.

b. Light behaves only as a particle.

c. Light behaves as both a wave and a particle.

d. Light does not have a wave-particle duality.

Answer: c. Light behaves as both a wave and a particle.

What is the angle of incidence?

a. The angle between the normal and the reflected ray.

b. The angle between the normal and the incident ray.

c. The angle between the normal and the refracted ray.

d. The angle between the reflected and refracted rays.

Answer: b. The angle between the normal and the incident ray.

Which of the following is NOT an application of light in medicine?

a. X-ray imaging

b. Fluorescence microscopy

c. Laser surgery

d. GPS technology

Answer: d. GPS technology

What is fluorescence?

a. The emission of light by a material that has absorbed light of a different wavelength.

b. The bending of light as it passes through a material with a different refractive index.

c. The transfer of the energy of light to atoms or molecules within a material.

d. The reflection of light by a smooth surface.

Answer: a. The emission of light by a material that has absorbed light of a different wavelength.

How does light behave when it is absorbed by a material?

a. It is reflected back.

b. It is transmitted through the material.

c. Its energy is transferred to the atoms or molecules within the material.

d. It passes through the material without any interaction.

Answer: c. Its energy is transferred to the atoms or molecules within the material.

Which of the following is an example of an LED?

a. A laser pointer

b. A light bulb

c. A computer screen

d. A traffic light

Answer: d. A traffic light

What is an X-ray?

a. A type of high-energy electromagnetic radiation used in medical imaging.

b. A type of visible light.

c. A type of infrared radiation.

d. A type of ultraviolet radiation.

Answer: a. A type of high-energy electromagnetic radiation used in medical imaging.

Lec 35 - Interaction of Light with Matter

Which of the following is an example of absorption of light by matter?

A. A mirror reflecting light

B. A prism bending light

C. A black shirt absorbing light

D. A rainbow forming in the sky

Answer: C. A black shirt absorbing light

When light reflects off a smooth surface, it follows which law?

A. Law of reflection

B. Law of refraction

C. Law of absorption

D. Law of diffraction

Answer: A. Law of reflection

What happens to the speed of light when it enters a material with a higher refractive index?

A. It slows down

B. It speeds up

C. It stays the same

D. It stops

Answer: A. It slows down

Which of the following is an example of scattering of light?

A. A laser pointer beam passing through a glass window

B. A white wall reflecting light

C. A blue sky on a clear day

D. A red apple absorbing light

Answer: C. A blue sky on a clear day

What is the process by which light is redirected in many different directions as it passes through a material?

A. Reflection

B. Refraction

C. Absorption

D. Scattering

Answer: D. Scattering

What is the study of the interaction of light with matter to learn about its properties?

A. Spectroscopy

B. Optics

C. Photovoltaics

D. Refraction

Answer: A. Spectroscopy

Which of the following materials is opaque to visible light?

A. Glass

B. Air

C. Aluminum foil

D. Clear water

Answer: C. Aluminum foil

What is the conversion of light energy into electrical energy called?

A. Photovoltaics

B. Spectroscopy

C. Refraction

D. Scattering

Answer: A. Photovoltaics

What happens to the angle of refraction when light passes from a material with a high refractive index to a material with a lower refractive index?

A. It increases

B. It decreases

C. It stays the same

D. It depends on the angle of incidence

Answer: B. It decreases

What is the principle behind the operation of solar cells?

A. Reflection of light

B. Absorption of light

C. Scattering of light

D. Refraction of light

Answer: B. Absorption of light

Lec 36 - Interference and Diffraction

What is interference?

a. The bending of waves around an obstacle

b. The interaction of two or more waves resulting in a pattern of alternating bright and dark regions

c. The reflection of waves off a surface

d. The transmission of waves through a medium

Answer: b

What is the difference between constructive and destructive interference?

a. Constructive interference occurs when waves cancel each other out, while destructive interference occurs when waves add up to produce a higher amplitude.

b. Constructive interference occurs when waves add up to produce a higher amplitude, while destructive interference occurs when waves cancel each other out.

c. Constructive and destructive interference have the same effect on waves.

d. None of the above.

Answer: b

What is the double-slit experiment?

a. An experiment that demonstrates the diffraction of light waves

b. An experiment that demonstrates the reflection of light waves

c. An experiment that demonstrates the interference of light waves

d. An experiment that demonstrates the refraction of light waves

Answer: c

What is diffraction?

a. The interaction of two or more waves resulting in a pattern of alternating bright and dark regions

b. The bending of waves around an obstacle or through an aperture

c. The reflection of waves off a surface

d. The transmission of waves through a medium

Answer: b

What is the relationship between the size of an obstacle or aperture and the amount of diffraction?

a. The larger the obstacle or aperture, the greater the diffraction

b. The smaller the obstacle or aperture, the greater the diffraction

c. The size of the obstacle or aperture does not affect the amount of diffraction

d. None of the above

Answer: a

What is X-ray diffraction used for?

a. To determine the atomic structure of crystals

b. To study the behavior of sound waves

c. To study the reflection of light waves

d. To study the transmission of waves through a medium

Answer: a

What is the difference between interference and diffraction?

a. Interference occurs when waves encounter an obstacle or aperture, while diffraction occurs when waves from different sources interact with each other.

b. Interference and diffraction are the same thing.

c. Interference occurs when waves from different sources interact with each other, while diffraction occurs when waves encounter an obstacle or aperture.

d. None of the above.

Answer: c

Can sound waves diffract around corners?

a. Yes, because their wavelength is much smaller than that of light waves.

b. No, because their wavelength is much smaller than that of light waves.

c. Yes, because their wavelength is much larger than that of light waves.

d. No, because their wavelength is much larger than that of light waves.

Answer: c

Can light waves diffract around corners?

a. Yes, because their wavelength is much smaller than that of sound waves.

b. No, because their wavelength is much smaller than that of sound waves.

c. Yes, because their wavelength is much larger than that of sound waves.

d. No, because their wavelength is much larger than that of sound waves.

Answer: b

What is the principle behind the operation of optical devices such as lenses and mirrors?

a. The principle of reflection

b. The principle of refraction

c. The principle of interference

d. The principle of diffraction

Answer: b

Lec 37 - The Particle Nature of Light

Who first proposed the idea of the particle nature of light?

a) Isaac Newton

b) James Clerk Maxwell

c) Albert Einstein

d) Niels Bohr

Answer: c) Albert Einstein

What is the name of the phenomenon in which electrons are emitted from a material when light of a certain frequency is shone on it?

a) Photoelectric effect

b) Compton effect

c) Diffraction

d) Interference

Answer: a) Photoelectric effect

Which experiment showed that X-rays scattered off a material have a longer wavelength than the incident radiation?

a) Photoelectric effect

b) Compton effect

c) Diffraction

d) Interference

A**nswer: b) Compton effect**

What is the name of the concept that particles, such as photons, can exhibit both wave-like and particle-like behavior depending on the experiment?

a) Particle nature of light

b) Wave-particle duality

c) Photovoltaic effect

d) Coherent emission

A**nswer: b) Wave-particle duality**

What is the practical application of the particle nature of light in photovoltaic cells?

a) Generating coherent beams of light

b) Creating population inversion in a material

c) Converting light energy into electrical energy

d) Scattering of X-rays

Answer: c) Converting light energy into electrical energy

How do lasers work?

a) By creating a population inversion in a material

b) By scattering X-rays off a material

c) By converting light energy into electrical energy

d) By exhibiting wave-particle duality

Answer: a) By creating a population inversion in a material

What is the name of the process by which photons transfer their energy to electrons in a material, allowing them to escape?

a) Diffraction

b) Interference

c) Photoelectric effect

d) Compton effect

Answer: c) Photoelectric effect

Which scientist discovered that light could exhibit particle-like behavior?

a) Isaac Newton

b) James Clerk Maxwell

c) Albert Einstein

d) Niels Bohr

Answer: c) Albert Einstein

What is the name of the beam of light created when excited atoms decay to the ground state, emitting photons with the same frequency and phase?

a) Coherent emission

b) Incoherent emission

c) Photovoltaic effect

d) Wave-particle duality

Answer: a) Coherent emission

What is the name of the concept that particles can exist in multiple states simultaneously?

a) Particle nature of light

b) Wave-particle duality

c) Photovoltaic effect

d) Coherent emission

Answer: b) Wave-particle duality

Lec 38 - Geometrical Optics

Which of the following laws states that the incident ray, the reflected ray, and the normal to the surface of reflection all lie in the same plane?

A) Law of reflection

B) Law of refraction

C) Principle of least time

D) Principle of rectilinear propagation

Answer: A) Law of reflection

What is the angle of incidence for total internal reflection?

A) 0°

B) 90°

C) 180°

D) Greater than the critical angle

Answer: D) Greater than the critical angle

Which type of lens is thicker at the center than at the edges?

A) Convex lens

B) Concave lens

C) Plano-convex lens

D) Plano-concave lens

A**nswer: A) Convex lens**

The focal length of a lens depends on which of the following?

A) The curvature of the lens

B) The refractive index of the lens

C) Both A and B

D) None of the above

Answer: C) Both A and B

Which of the following is a measure of the degree of bending of light as it passes from one medium to another?

A) Reflection coefficient

B) Refraction coefficient

C) Diffraction coefficient

D) Absorption coefficient

Answer: B) Refraction coefficient

What is the angle of incidence for a light ray that undergoes minimum deviation while passing through a prism?

A) Greater than the critical angle

B) Equal to the critical angle

C) Less than the critical angle

D) Depends on the refractive index of the prism

Answer: B) Equal to the critical angle

Which of the following is a measure of the ability of a lens to focus light?

A) Focal length

B) Refractive index

C) Aberration

D) Dispersion

Answer: A) Focal length

The ratio of the speed of light in a vacuum to the speed of light in a medium is known as which of the following?

A) Refractive index

B) Reflection coefficient

C) Absorption coefficient

D) Transmission coefficient

Answer: A) Refractive index

Which of the following occurs when light waves from different sources combine to form a pattern of constructive and destructive interference?

A) Diffraction

B) Reflection

C) Refraction

D) Interference

Answer: D) Interference

Which of the following is a measure of the degree of spreading of light as it passes through an aperture or around an obstacle?

A) Reflection

B) Refraction

C) Diffraction

D) Interference

Answer: C) Diffraction

Lec 39 - Heat – I

Which of the following is a unit of heat?

a. Joule

b. Kelvin

c. Ampere

d. Newton

Answer: a. Joule

What is thermal expansion?

a. The ability of a material to transfer heat

b. The change in temperature of a material

c. The expansion or contraction of a material due to changes in temperature

d. The measure of how well a material can resist heat transfer

Answer: c. The expansion or contraction of a material due to changes in temperature

What is the specific heat of water?

a. 1 J/kg·K

b. 4.18 J/kg·K

c. 10 J/kg·K

d. 100 J/kg·K

Answer: b. 4.18 J/kg·K

Which of the following materials is a good insulator?

a. Copper

b. Aluminum

c. Glass

d. Silver

Answer: c. Glass

What is the first law of thermodynamics?

a. Energy cannot be created or destroyed

b. Energy always flows from hot to cold

c. The total entropy of an isolated system always increases

d. The efficiency of a heat engine cannot be 100%

Answer: a. Energy cannot be created or destroyed

Which process occurs at a constant temperature in a thermodynamic system?

a. Adiabatic process

b. Isothermal process

c. Isobaric process

d. Isochoric process

Answer: b. Isothermal process

What is thermal conductivity?

a. The measure of how well a material can resist heat transfer

b. The ability of a material to transfer heat

c. The measure of the temperature of a material

d. The measure of the average kinetic energy of the particles in a substance

Answer: b. The ability of a material to transfer heat

Which of the following is a type of thermal radiation?

a. Visible light

b. Ultraviolet radiation

c. Infrared radiation

d. X-rays

Answer: c. Infrared radiation

What is a heat engine?

a. A device that converts thermal energy into mechanical energy

b. A device that converts mechanical energy into thermal energy

c. A device that converts electrical energy into thermal energy

d. A device that converts thermal energy into electrical energy

Answer: a. A device that converts thermal energy into mechanical energy

Which law of thermodynamics states that the total entropy of an isolated system always increases over time?

a. First law of thermodynamics

b. Second law of thermodynamics

c. Third law of thermodynamics

d. None of the above

Answer: b. Second law of thermodynamics

Lec 40 - Heat – II

What is the unit of specific heat capacity?

a. J

b. J/K

c. J/kg

d. J/(kg.K)

Answer: d. J/(kg.K)

Which of the following is an example of a good thermal conductor?

a. Air

b. Glass

c. Aluminum

d. Rubber

Answer: c. Aluminum

Which law of thermodynamics states that heat flows from hotter to colder objects?

a. Zeroth law of thermodynamics

b. First law of thermodynamics

c. Second law of thermodynamics

d. Third law of thermodynamics

Answer: c. Second law of thermodynamics

Which of the following is an example of a reversible process?

a. Melting of ice

b. Burning of coal

c. Friction

d. Explosions

Answer: a. Melting of ice

What happens to the internal energy of a system during an adiabatic process?

a. It remains constant

b. It increases

c. It decreases

d. It becomes zero

Answer: a. It remains constant

Which of the following statements is true for an isothermal process?

a. The temperature of the system remains constant

b. The pressure of the system remains constant

c. The volume of the system remains constant

d. The internal energy of the system remains constant

Answer: a. The temperature of the system remains constant

The specific heat capacity of water is higher than that of iron. Which means:

a. It takes more heat energy to increase the temperature of water than iron

b. It takes less heat energy to increase the temperature of water than iron

c. Water and iron require the same amount of heat energy to increase their temperature

d. None of the above

Answer: a. It takes more heat energy to increase the temperature of water than iron

The amount of heat required to raise the temperature of a substance by one degree Celsius is called:

a. Heat energy

b. Internal energy

c. Thermal energy

d. Specific heat capacity

A**nswer: d. Specific heat capacity**

Which of the following statements is true for an adiabatic process?

a. No heat is added or removed from the system

b. The temperature of the system remains constant

c. The volume of the system remains constant

d. The pressure of the system remains constant

Answer: a. No heat is added or removed from the system

Which of the following is an example of a good thermal insulator?

a. Glass

b. Rubber

c. Aluminum

d. Wool

Answer: d. Wool

Lec 41 - Heat – III

What is the SI unit of heat?

A) Kelvin (K)

B) Joule (J)

C) Watt (W)

D) Celsius (°C)

Answer: B) Joule (J)

Which of the following is a good conductor of heat?

A) Wood

B) Plastic

C) Copper

D) Rubber

Answer: C) Copper

Which law of thermodynamics describes the relationship between temperature, energy, and entropy?

A) First law

B) Second law

C) Third law

D) None of the above

Answer: B) Second law

Which of the following is an example of convection?

A) Heat transfer through a metal rod

B) Heat transfer through a vacuum

C) Heat transfer through a fluid

D) None of the above

Answer: C) Heat transfer through a fluid

What is the heat required to change the phase of a substance called?

A) Sensible heat

B) Latent heat

C) Specific heat

D) None of the above

Answer: B) Latent heat

Which of the following materials has the highest specific heat capacity?

A) Water

B) Aluminum

C) Iron

D) Copper

Answer: A) Water

Which type of heat transfer does not require a medium?

A) Conduction

B) Convection

C) Radiation

D) None of the above

Answer: C) Radiation

What is the difference between temperature and heat?

A) Temperature is a measure of the average kinetic energy of particles, while heat is the total energy of particles.

B) Temperature and heat are the same thing.

C) Temperature is the total energy of particles, while heat is a measure of the average kinetic energy of particles.

D) None of the above.

Answer: A) Temperature is a measure of the average kinetic energy of particles, while heat is the total energy of particles.

Which of the following is not a state function?

A) Enthalpy

B) Temperature

C) Internal energy

D) Entropy

Answer: B) Temperature

What is the unit of thermal conductivity?

A) W/m^2

B) J/kg

C) J/m^3

D) W/mK

Answer: D) W/mK

Lec 42 - Special Relativity – I

Which of the following is not a postulate of special relativity?

a) The laws of physics are the same in all inertial frames of reference

b) The speed of light in vacuum is the same in all inertial frames of reference

c) The laws of physics are the same in all non-inertial frames of reference

d) The principle of relativity

Answer: c) The laws of physics are the same in all non-inertial frames of reference

According to special relativity, which of the following is not an absolute quantity?

a) Energy

b) Momentum

c) Velocity

d) Mass

Answer: c) Velocity

In special relativity, the factor that relates time and space intervals between two events is known as:

a) The speed of light

b) The Lorentz factor

c) The Doppler effect

d) The Michelson-Morley factor

Answer: b) The Lorentz factor

What is the proper length of an object?

a) The length of the object measured in its rest frame

b) The length of the object measured in a moving frame of reference

c) The length of the object measured by an observer at rest relative to the object

d) The length of the object measured by an observer moving with the object

Answer: a) The length of the object measured in its rest frame

Which of the following statements is true regarding time dilation in special relativity?

a) Time dilation occurs only for objects moving at speeds close to the speed of light

b) Time dilation occurs for all objects in motion

c) Time dilation occurs only for objects at rest

d) Time dilation occurs only for objects in free fall

Answer: b) Time dilation occurs for all objects in motion

According to special relativity, the faster an object moves:

a) The slower its internal clocks run

b) The faster its internal clocks run

c) Its internal clocks do not change

d) None of the above

Answer: a) The slower its internal clocks run

In special relativity, the principle of causality is maintained by:

a) The relativity of simultaneity

b) The equivalence principle

c) The principle of least action

d) The principle of locality

Answer: a) The relativity of simultaneity

The twin paradox in special relativity involves:

a) Two twins who travel at different speeds and reunite to find that one has aged more than the other

b) Two twins who travel in opposite directions and reunite to find that they have aged the same amount

c) Two twins who travel at the same speed and age at the same rate

d) None of the above

Answer: a) Two twins who travel at different speeds and reunite to find that one has aged more than the other

According to special relativity, the mass of an object:

a) Increases as its velocity increases

b) Decreases as its velocity increases

c) Remains constant regardless of its velocity

d) None of the above

Answer: b) Decreases as its velocity increases

The formula $E=mc^2$ in special relativity relates:

a) Energy and momentum

b) Energy and mass

c) Mass and momentum

d) None of the above

Answer: b) Energy and mass

Lec 43 - Special Relativity – II

What is the rest mass of a particle moving at a speed of 0.6c if its relativistic mass is 2.5 times its rest mass?

A) 1.8 m0

B) 1.4 m0

C) 2.0 m0

D) 2.5 m0

Answer: B) 1.4 m0

According to special relativity, what happens to time and length measurements as the speed of an object approaches the speed of light?

A) Time slows down and length contracts

B) Time speeds up and length expands

C) Time slows down and length expands

D) Time speeds up and length contracts

Answer: A) Time slows down and length contracts

What is the maximum speed limit in the universe according to special relativity?

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

What is the formula for time dilation in special relativity?

A) t' = t / ?(1 - v^2/c^2)

B) t' = t x ?(1 - v^2/c^2)

C) t' = t / (1 - v^2/c^2)

D) t' = t x (1 - v^2/c^2)

Answer: A) t' = t / ?(1 - v^2/c^2)

What is the name given to the phenomenon in which an object appears to be shorter when it is moving at a high speed relative to an observer?

A) Time dilation

B) Length contraction

C) Relativistic acceleration

D) Mass increase

Answer: B) Length contraction

What is the formula for the relativistic mass of a particle in motion?

A) m = m0 / ?(1 - v^2/c^2)

B) m = m0 x ?(1 - v^2/c^2)

C) m = m0 / (1 - v^2/c^2)

D) m = m0 x (1 - v^2/c^2)

Answer: B) m = m0 x ?(1 - v^2/c^2)

According to special relativity, what is the relationship between energy and mass?

A) They are independent of each other

B) Energy and mass are equivalent and can be converted into each other

C) Energy can create mass but mass cannot create energy

D) Mass can create energy but energy cannot create mass

Answer: B) Energy and mass are equivalent and can be converted into each other

What is the name given to the time dilation effect experienced by an object in motion due to gravity?

A) Gravitational time dilation

B) Relativistic time dilation

C) Gravitational lensing

D) Frame dragging

Answer: A) Gravitational time dilation

According to special relativity, what is the formula for relativistic momentum?

A) p = mv

B) p = m0v

C) p = m0v / ?(1 - v^2/c^2)

D) p = m0v x ?(1 - v^2/c^2)

Answer: D) p = m0v x ?(1 - v^2/c^2)

What is the name given to the phenomenon in which an object moving at a high speed experiences a decrease in its apparent mass?

A) Time dilation

B) Length contraction

C) Mass increase

D

Lec 44 - Matter as Waves

What is the de Broglie wavelength of an electron with a velocity of 1.5 x 10^6 m/s?

a. 0.253 nm

b. 2.53 nm

c. 25.3 nm

d. 253 nm

Answer: a. 0.253 nm

Which of the following phenomena demonstrates the wave-like behavior of matter?

a. Photoelectric effect

b. Compton scattering

c. Diffraction

d. None of the above

Answer: c. Diffraction

Which equation is used to calculate the de Broglie wavelength of a particle?

a. ? = h/mv

b. ? = h/mc

c. ? = h?

d. ? = hc/?

Answer: a. ? = h/mv

Which of the following particles has the smallest de Broglie wavelength?

a. A proton with a velocity of 10^6 m/s

b. An electron with a velocity of 10^7 m/s

c. A neutron with a velocity of 10^5 m/s

d. All particles have the same de Broglie wavelength.

Answer: b. An electron with a velocity of 10^7 m/s

In which experiment did electrons exhibit interference patterns like those of waves?

a. The photoelectric effect

b. The Compton effect

c. The double-slit experiment

d. The Stern-Gerlach experiment

Answer: c. The double-slit experiment

Which of the following is an example of a particle that exhibits wave-like behavior?

a. A proton

b. A photon

c. An electron

d. All of the above

Answer: d. All of the above

The momentum of a particle is related to its de Broglie wavelength by which equation?

a. p = h/?

b. ? = h/p

c. p = mc

d. ? = c/p

Answer: b. ? = h/p

Which of the following is NOT an example of wave-particle duality?

a. Electrons behaving like waves in a double-slit experiment

b. Photons behaving like particles in the photoelectric effect

c. Atoms behaving like waves in a diffraction experiment

d. None of the above

Answer: d. None of the above

The uncertainty principle relates the uncertainty in a particle's position to the uncertainty in its:

a. Momentum

b. Energy

c. Velocity

d. All of the above

Answer: a. Momentum

Which of the following is a consequence of wave-particle duality?

a. The Heisenberg uncertainty principle

b. The Bohr model of the atom

c. The law of conservation of energy

d. None of the above

Answer: a. The Heisenberg uncertainty principle

Lec 45 - Quantum Mechanics

Which equation is used to describe the behavior of a quantum particle?

a) Maxwell's equations

b) Newton's laws of motion

c) Schrödinger equation

d) Einstein's field equations

Answer: c) Schrödinger equation

What is the smallest unit of energy in quantum mechanics?

a) Electron

b) Photon

c) Quark

d) Proton

Answer: b) Photon

Which of the following is NOT a postulate of quantum mechanics?

a) The state of a system is described by a wave function.

b) The wave function must be normalized.

c) Physical observables are represented by Hermitian operators.

d) Only classical mechanics can accurately describe the behavior of particles.

Answer: d) Only classical mechanics can accurately describe the behavior of particles.

What is the Heisenberg uncertainty principle?

a) The position and momentum of a particle cannot be simultaneously known with arbitrary precision.

b) The energy and momentum of a particle cannot be simultaneously known with arbitrary precision.

c) The position and energy of a particle cannot be simultaneously known with arbitrary precision.

d) The spin and angular momentum of a particle cannot be simultaneously known with arbitrary precision.

Answer: a) The position and momentum of a particle cannot be simultaneously known with arbitrary precision.

Which of the following particles are fermions?

a) Protons

b) Electrons

c) Photons

d) Neutrons

Answer: b) Electrons

What is entanglement in quantum mechanics?

a) The state in which two particles have the same spin.

b) The state in which two particles have opposite spins.

c) The state in which two particles share a wave function, making their properties correlated.

d) The state in which two particles have different energy levels.

Answer: c) The state in which two particles share a wave function, making their properties correlated.

What is the wave-particle duality?

a) The concept that light can behave both as a wave and a particle.

b) The concept that electrons can behave both as a wave and a particle.

c) The concept that photons can behave both as a wave and a particle.

d) The concept that all particles can behave both as a wave and a particle.

Answer: d) The concept that all particles can behave both as a wave and a particle.

Which of the following is a consequence of the Pauli exclusion principle?

a) No two electrons in an atom can have the same set of quantum numbers.

b) Electrons occupy the lowest energy levels available to them.

c) Electrons move in circular orbits around the nucleus.

d) Electrons can absorb and emit energy only in discrete quanta.

Answer: a) No two electrons in an atom can have the same set of quantum numbers.

What is the role of the Hamiltonian operator in quantum mechanics?

a) It describes the position of a particle.

b) It describes the momentum of a particle.

c) It describes the total energy of a system.

d) It describes the spin of a particle.

Answer: c) It describes the total energy of a system.

What is a quantum state?

a) The position of a particle.

b) The momentum of a particle.

c) The total energy of a system.

d) A mathematical description of the state of a quantum system.

Answer: d) A mathematical description of the state of a quantum system.