CUET 2022 Physics Solutions

Question ID: 909402

Q. Two point charges (—q) and (+4q) are placed at separation 'r'. Where should a third charge be placed so that the entire system of charges becomes in equilibrium ?

(1) at separation 'r' from (— q) on the extreme side of — q.
(2) at separation 'r' from (4q) on the extreme side of 4q.
(3) r at separation —2 from (— q) in between the two charges.
(4) at separation 4 from (4q) in between the two charges.

Solutions:

To achieve equilibrium in the system of charges, the net electrostatic force acting on the third charge should be zero. This means that the third charge should experience equal and opposite forces from the two existing charges.

Considering the charges (-q) and (+4q), the force between them follows the inverse square law:

F = k * (q1 * q2) / r^2

where F is the electrostatic force, k is the electrostatic constant, q1 and q2 are the magnitudes of the charges, and r is the separation between them.

To achieve equilibrium, the third charge should be placed in a position such that the magnitudes of the forces it experiences from (-q) and (+4q) are equal.

From the given options:
(3) at a separation of r from (-q) in between the two charges, and
(4) at a separation of 4r from (+4q) in between the two charges.

The correct option is (3) because placing the third charge at a separation of r from (-q) in between the two charges would result in equal and opposite forces acting on it, achieving equilibrium.

Question ID: 909401

Q. An infinitely long wire is charged uniformly with charge density A and placed in air, the electric field at distance r from wire will be :

(1) $\lambda/4\pi\varepsilon_0 r$

(2) $\lambda/4\pi\varepsilon_0 r^2$

(3) $\lambda/2\varepsilon_0$

(4) $\lambda/(2\pi r\varepsilon_0)$

Solution:

The electric field created by an infinitely long uniformly charged wire can be determined using Gauss's law. Gauss's law states that the electric field through a closed surface is directly proportional to the total charge enclosed by that surface.

For an infinitely long wire, the electric field at a distance r from the wire can be found by considering a cylindrical Gaussian surface with radius r and length L (perpendicular to the wire). The Gaussian surface should be symmetric with respect to the wire.

The charge enclosed by the Gaussian surface will be the charge density (A) multiplied by the length L of the Gaussian surface. Therefore, the charge enclosed is Q = A * L.

The electric field at distance r from the wire will be given by the equation:

$E * 2\pi rL = A * L / \varepsilon_0$

Here, ε_0 is the permittivity of free space.

Simplifying the equation, we find:

$E = A / (2\pi r\varepsilon_0)$

Therefore, the electric field at a distance r from the wire is given by $E = A / (2\pi r\varepsilon_0)$.

Question ID: 909405

Q. A parallel plate capacitor having cross - sectional area 'A' and separated by distance 'd' is filled by copper plate of thickness b. It's capacitance is :

(1) $\varepsilon_0 * (A / 2d)$
(2) $\varepsilon_0 * (A / (d - b))$
(3) $2\varepsilon_0 * (A/(d + b/2))$
(4) $\varepsilon_0 * (A/(d + b/2))$

Solution:
To find the capacitance of the parallel plate capacitor filled with a copper plate, we can use the formula for the capacitance of a parallel plate capacitor:

$C = \varepsilon_0 * (A / d)$

where:
C is the capacitance,
ε_0 is the permittivity of free space ($\varepsilon_0 \approx 8.854 \times 10^{-12}$ F/m),
A is the cross-sectional area of the plates,
and d is the separation distance between the plates.

In this case, we have a copper plate of thickness b inserted between the plates. The presence of the copper plate will affect the capacitance of the capacitor.

The capacitance of the parallel plate capacitor with the copper plate can be calculated by considering the effective separation distance, which takes into account the thickness of the copper plate.

The effective separation distance (d') is given by:

$d' = d - b$

Substituting d' into the capacitance formula, we get:

$C = \varepsilon_0 * (A / (d - b))$

Therefore, the capacitance of the parallel plate capacitor filled with a copper plate of thickness b is given by $C = \varepsilon_0 * (A / (d - b))$.

Question ID: 909410
Q. Drift velocity of electrons is directly proportional to the :

(1) Temperature
(2) Voltage applied
(3) Length of the conductor
(4) Area of cross section of conductor

Solution:
“The drift velocity of electrons in a conductor is primarily influenced by the voltage applied across the conductor. Therefore, **the correct answer is option (2) - Voltage applied.**

When a voltage is applied across a conductor, an electric field is established within the conductor, which exerts a force on the free electrons, causing them to move in the opposite direction of the electric field. This movement of electrons is known as drift velocity.

While temperature can affect the conductivity of the conductor, it does not directly determine the drift velocity of electrons. Similarly, the length of the conductor and the area of cross-section do not directly impact the drift velocity. However, they can indirectly influence the drift velocity by affecting the resistance and current in the conductor, which in turn affects the voltage and electric field, thus indirectly impacting the drift velocity.”

Question ID: 909412
Q. A proton and an alpha particle moving with same kinetic energy enter in the region of uniform magnetic field perpendicular to it. The ratio of radii of their trajectories will be :

(1) 1:1
(2) √2:1
(3) 4:1
(4) 1:√2

Solution:
The radius of the trajectory of a charged particle moving in a magnetic field is given by the formula:

r = (m * v) / (q * B)

Where:
r is the radius of the trajectory,
m is the mass of the particle,
v is the velocity of the particle,
q is the charge of the particle,
and B is the magnetic field strength.

Since both the proton and the alpha particle have the same kinetic energy, we can assume that their velocities are the same. Therefore, the ratio of their radii of trajectory will depend solely on the mass-to-charge ratio (m/q) of the particles.

For a proton, the mass-to-charge ratio (m/q) is equal to the mass of the proton (m_p) divided by the charge of the proton (q_p).

For an alpha particle, the mass-to-charge ratio (m/q) is equal to the mass of the alpha particle (m_alpha) divided by the charge of the alpha particle (q_alpha).

The mass of the alpha particle (m_alpha) is approximately four times the mass of the proton (m_p), and the charge of the alpha particle (q_alpha) is twice the charge of the proton (q_p).

Therefore, the mass-to-charge ratio (m/q) for the alpha particle is (4 * m_p) / (2 * q_p), which simplifies to 2 * (m_p / q_p).

Comparing the mass-to-charge ratios for the proton and the alpha particle, we find:

(m/q)_alpha = 2 * (m_p / q_p)

(m/q)_proton = m_p / q_p

The ratio of the radii of their trajectories (r_alpha / r_proton) can be calculated by taking the ratio of their mass-to-charge ratios:

(r_alpha / r_proton) = ((m/q)_alpha) / ((m/q)_proton)
= (2 * (m_p / q_p)) / (m_p / q_p)
= 2

Therefore, the ratio of the radii of their trajectories will be 2:1.

So, the correct option is (3) 4:1.

Question ID: 909413

Q. An electron is projected in a uniform magnetic field along the direction of field, the electron will experience :

(1) a force opposite to the magnetic field
(2) a force in the direction of magnetic field
(3) no force in magnetic field
(4) a force perpendicular to the magnetic field

Solution:
When an electron is projected in a uniform magnetic field along the direction of the field, it will experience a force perpendicular to the magnetic field. Therefore, the correct option is (4) a force perpendicular to the magnetic field.

The force experienced by a charged particle moving in a magnetic field is given by the formula:

F = q * v * B * sin(theta)

Where:
F is the force on the electron,
q is the charge of the electron,

v is the velocity of the electron,
B is the magnetic field strength,
and theta is the angle between the velocity vector and the magnetic field vector.

In this case, the electron is projected along the direction of the magnetic field, which means the angle theta is 0 degrees. In the formula, sin(0) is equal to 0, so the force becomes:

$F = q * v * B * 0 = 0$

Since the force is zero, it implies that the electron will not experience any force in the direction of the magnetic field itself. However, it will experience a force perpendicular to the magnetic field, causing it to move in a circular or helical path depending on the initial conditions.

Question ID: 909415

Q. An electron is shot into the uniform magnetic field, normal to the direction of field. Then the frequency of revolution of the electron in its circular orbit :

(1) is independent of its speed
(2) decreases with its speed
(3) increases with its speed
(4) increase with radius of revolution

Solution:
The frequency of revolution of an electron in a circular orbit in a uniform magnetic field can be determined using the formula:

$f = (qB) / (2\pi m)$

Where:
f is the frequency of revolution,
q is the charge of the electron,
B is the magnetic field strength,
and m is the mass of the electron.

Let's analyze the options:

(1) The frequency of revolution being independent of the speed of the electron is incorrect. The formula clearly shows that the frequency depends on the charge-to-mass ratio of the electron, which includes the velocity (speed) of the electron.

(2) The frequency of revolution decreasing with the speed of the electron is incorrect. There is no direct relationship between the speed of the electron and the frequency of revolution. The speed affects the radius of the circular orbit, but it does not affect the frequency of revolution itself.

(3) The frequency of revolution increasing with the speed of the electron is also incorrect. Again, there is no direct relationship between the speed of the electron and the frequency of revolution. The speed affects the radius of the circular orbit, but it does not affect the frequency.

(4) The frequency of revolution increasing with the radius of revolution is correct. According to the formula, the frequency is directly proportional to the magnetic field strength (B) and the charge-to-mass ratio of the electron (q/m). The radius of revolution (r) is related to the charge-to-mass ratio (q/m) and the speed (v) of the electron. As the radius increases, the frequency of revolution also increases.

Therefore, the correct option is (4) the frequency of revolution increases with the radius of revolution.

Question ID: 909416

Q. To convert a galvanometer into an ammeter, one should connect :

(1) high resistance in series with galvanometer
(2) low resistance in series with galvanometer
(3) low resistance in parallel with galvanometer
(4) high resistance in parallel with galvanometer

Solution:

To convert a galvanometer into an ammeter, one should connect a low resistance in parallel with the galvanometer. Therefore, the correct option is (3) low resistance in parallel with the galvanometer.

A galvanometer is a sensitive device used to measure small currents. It has a high internal resistance and is designed to deflect a needle or pointer in response to the current flowing through it.

To convert the galvanometer into an ammeter, which is used to measure larger currents, a low resistance (known as a shunt resistor) is connected in parallel with the galvanometer. The shunt resistor provides an alternate path for the current, allowing a portion of the current to bypass the galvanometer.

By selecting an appropriate low resistance value for the shunt resistor, the majority of the current will flow through the shunt resistor, while only a small fraction of the current will flow through the galvanometer. This allows the galvanometer to be used as an ammeter to measure the larger current accurately.

Connecting a high resistance in series or parallel with the galvanometer would not convert it into an ammeter because it would either restrict the current flow too much or not provide a proper current division for measurement.

Hence, the correct method to convert a galvanometer into an ammeter is **to connect a low resistance in parallel with the galvanometer.**

Question ID: 909417

Q. Given below are two statements :

Statement I : The electric field produced by a scalar source is known as electric charge.

Statement II : The magnetic field produced by a vector source is known as current element (I dl).

In the light of the above statements, choose the correct answer from the options given below :

(1) Both Statement I and Statement II are true

(2) Both Statement I and Statement II are false

(3) Statement I is correct but Statement II is false

(4) Statement **I** is incorrect but Statement **II** is true

Solution:
The correct answer is:

(3) Statement I is correct but Statement II is false.

Statement I: The electric field produced by a scalar source is known as electric charge. This statement is incorrect. Electric charge is not the electric field itself, but rather the property that gives rise to the electric field. Electric charge is a scalar quantity, but the electric field is a vector quantity.

Statement II: The magnetic field produced by a vector source is known as current element (I dl).
This statement is also incorrect. The magnetic field produced by a current element (I dl) is not called a vector source. A current element (I dl) is a small segment of a current-carrying wire, and it generates a magnetic field around it. The magnetic field is a vector quantity, but the current element is not a source of the magnetic field itself.

Therefore, both statements are false.

Question ID: 909418
Q. Which of the following rays are used in doing LASIK (Laser Assisted in Situ peratomileusis) eye surgery ?

(1) Ultraviolet rays
(2) Infrared rays
(3) Gamma rays
(4) Micro waves

Solution:
The correct answer is:

(2) Infrared rays

LASIK (Laser Assisted in Situ Keratomileusis) eye surgery utilizes laser technology to reshape the cornea of the eye and correct refractive errors such as nearsightedness, farsightedness, and astigmatism. The laser used in LASIK surgery typically operates in the infrared range of the electromagnetic spectrum.

Infrared rays have a longer wavelength than visible light, making them suitable for precise and controlled tissue ablation during the surgery. The laser used in LASIK surgery emits infrared light, which is absorbed by the corneal tissue, allowing for precise reshaping without damaging surrounding structures.

Ultraviolet rays, gamma rays, and microwaves are not used in LASIK eye surgery. Ultraviolet rays are harmful to the eyes and are generally not used in any form of eye surgery. Gamma rays are high-energy electromagnetic radiation used in radiation therapy for cancer treatment, but they are not used in LASIK surgery. Microwaves, on the other hand, are not suitable for the precise and controlled tissue ablation required in LASIK surgery.

Therefore, the correct option is (2) Infrared rays.

Question ID: 909419

Q. The magnetic field of a plane electromagnetic wave is given by Bx =2 x 10- 7 sin (0.6 x 103y + 2 x 1011 t) T. An expression for its electric field is :

(1) Ex=2 x 10-7sin(0.6x 103y+2x 1011 t)V/M
(2) Ey = 60 sin (0.6 x 103y +2 x 1011 t) V/M
(3) Ex = 2 x 10 -7 sin (0.6 x 103y +2 x 1011 t)V/M
(4) Ez = 60 sin (0.6 x 103y +2 x 1011 t) V/ M

Solution:

To determine the expression for the electric field from the given magnetic field of a plane electromagnetic wave, we can use the relationship between the electric field (E) and the magnetic field (B) in an electromagnetic wave:

E = cB

Where:
E is the electric field,
B is the magnetic field,
c is the speed of light in vacuum (approximately 3 x 10^8 m/s).

Comparing the given magnetic field Bx = 2 x 10^-7 sin(0.6 x 10^3y + 2 x 10^11t) T, we can see that the electric field Ex will be:

Ex = cBx
= (3 x 10^8 m/s) (2 x 10^-7 sin(0.6 x 10^3y + 2 x 10^11t)) T
= 6 x 10^1 sin(0.6 x 10^3y + 2 x 10^11t) V/m

Therefore, the correct option is (2) Ey = 60 sin(0.6 x 10^3y + 2 x 10^11t) V/m.

Question ID: 909420
Q. Number of photoelectrons emitted per second is proportional to

(1) Intensity of incident radiation
(2) Frequency of incident radiation
(3) Stopping potential
(4) Wavelength of incident radiation

Solution:

The number of photoelectrons emitted per second in the photoelectric effect is directly proportional to the intensity of the incident radiation. Therefore, the correct option is (1) Intensity of incident radiation.

The photoelectric effect is the phenomenon where electrons are emitted from a material when it is illuminated with electromagnetic radiation. The number of photoelectrons emitted depends on the intensity of the incident radiation, which refers to the amount of energy carried by the radiation per unit area per unit time. The higher the intensity of the incident radiation, the greater the number of photons interacting with the material, resulting in a higher number of emitted photoelectrons per second.

The other options do not directly affect the number of photoelectrons emitted:

(2) The frequency of the incident radiation affects the kinetic energy of the emitted electrons, but not the number of emitted photoelectrons per second.

(3) The stopping potential refers to the minimum potential difference required to stop the emitted photoelectrons from reaching a detector. It does not affect the number of photoelectrons emitted per second.

(4) The wavelength of the incident radiation affects the energy of the individual photons but does not directly affect the number of photoelectrons emitted per second.

Hence, the correct option is (1) Intensity of incident radiation.

Question ID: 909421

Q. Emission of electron from the surface of metal when radiation of appropriate frequency is allowed to incident on it is called :

(1) Nuclear fission
(2) Compton effect
(3) Photoelectric effect
(4) Thermonic radiations

Solution:

The emission of electrons from the surface of a metal when radiation of appropriate frequency is incident on it is called the photoelectric effect. Therefore, the correct option is (3) Photoelectric effect.

The photoelectric effect is a phenomenon in which electrons are ejected from the surface of a material (usually a metal) when it absorbs photons of sufficient energy. The key aspect is that the incident radiation must have a frequency above a certain threshold, known as the threshold frequency. Only photons with energies above this threshold frequency can cause the emission of electrons.

Nuclear fission (option 1) refers to the splitting of atomic nuclei into smaller fragments, typically in the context of nuclear reactions.

Compton effect (option 2) refers to the scattering of photons by free charged particles, such as electrons. It involves a change in the wavelength of the scattered photons.

Thermionic emissions (option 4) refer to the emission of electrons from a heated material, typically from a cathode in a vacuum tube, due to the thermal energy provided. This is different from the photoelectric effect, which involves the absorption of photons to release electrons.

Therefore, the correct term for the described phenomenon is the photoelectric effect.

Question ID: 909422

Q. An electron, an a particle, a proton and a deutron have the same kinetic energy. Which of these particles has the shortest De Broglie wavelength.

(1) Electron
(2) Proton
(3) **α** Particle
(4) Deutron

Solution:

The De Broglie wavelength (λ) of a particle is given by the equation:

$\lambda = h / p$

Where:
λ is the De Broglie wavelength,

h is the Planck's constant (approximately 6.626 x 10^-34 J*s),
p is the momentum of the particle.

Since all the particles (electron, alpha particle, proton, and deuteron) have the same kinetic energy, we can compare their momenta to determine which particle has the shortest De Broglie wavelength.

The momentum (p) of a particle can be calculated using the equation:

$p = \sqrt{(2mK)}$

Where:
m is the mass of the particle,
K is the kinetic energy of the particle.

Comparing the masses of the given particles, we find that the electron has the smallest mass, followed by the proton, the deuteron, and the alpha particle. Therefore, the electron will have the highest momentum and the shortest De Broglie wavelength among the given particles.

Hence, the correct option is (1) Electron.

Question ID: 909423
Q.The ratio of radii of two nuclei having atomic mass numbers 27 and 8 respectively, will be :

(1) R1/R2 = 3/2
(2) R1/R2 = 4/2
(3) R1/R2 = 6/4
(4) R1/R2 = $\sqrt{3}/2$

Solution:

The ratio of the radii of two nuclei can be approximated by the cube root of the ratio of their mass numbers.

Given:
Atomic mass number of nucleus 1 (A1) = 27
Atomic mass number of nucleus 2 (A2) = 8

The ratio of their radii (R1/R2) can be approximated as:

(R1/R2) ≈ ∛(A1/A2)

Plugging in the values:

(R1/R2) ≈ ∛(27/8)

Simplifying:

(R1/R2) ≈ ∛(27) / ∛(8)
(R1/R2) ≈ 3 / 2

Therefore, the correct option is (1) R1/R2 = 3/2.

Question ID: 909424
Q.If No is the original mass of the substance of half life t1/2 =4 years, then the amount of substance left after 12 years is :

(1) N0/16
(2) No/ 4
(3) No/ 8
(4) No/2

Solution:

The half-life of a substance is the time it takes for half of the initial quantity of the substance to decay or transform.

Given:
Original mass of the substance = N0

Half-life (t1/2) = 4 years

After 12 years, which is 3 times the half-life, we need to determine the amount of substance left.

Since the half-life is 4 years, after 4 years, half of the substance will remain. After another 4 years (total 8 years), half of the remaining substance will remain. After another 4 years (total 12 years), half of the remaining substance will remain.

So, after 12 years, the amount of substance left will be:

Amount left = N0 * (1/2) * (1/2) * (1/2)
= N0 * (1/8)

= No/8

Therefore, the correct option is (3) No/8.

Question ID: 909425

Q.Match List - I with List - II.

List - I (Components of Reactor) (Function)
(A) Uranium (B) Moderator (C) Control rod (HI) Used for fission reaction (D) Coolent

List - II (Function)
(I) Reaction rate can be controlled by it
(II) Slows down the fast moving neutrons
(III) Used for fission reaction
(IV) (IV) Transfers heat from core to turbine

Choose the correct answer from the options given below :

(1) (A) - (III), (B) - (IV), (C) - (I), (D) - (II)
(2) (A) - (III), (B) - (II), (C) - (IV), (D) - (I)
(3) (A) - (III), (B) - (II), (C) - (I), (D) - (IV)

(4) (A) - (II), (B) - (HI), (C) - (IV), (D) - (I)

Solution:

Matching the components of the reactor (List - I) with their functions (List - II), we have:

(A) Uranium - (III) Used for fission reaction
(B) Moderator - (II) Slows down the fast-moving neutrons
(C) Control rod - (I) Reaction rate can be controlled by it
(D) Coolant - (IV) Transfers heat from the core to the turbine

Therefore, the correct answer is:

(3) (A) - (III), (B) - (II), (C) - (I), (D) - (IV)

Question ID: 909426
Q. The difference in mass of a nucleus and its constituent nucleons is called the

(1) Packing fraction
(2) Mass defect
(3) Binding energy
(4) Binding energy per nucleon

Solution:

The difference in mass of a nucleus and its constituent nucleons is called the mass defect.

The mass defect is the mass difference between the sum of the individual masses of the nucleons and the actual measured mass of the nucleus. It arises due to the conversion of a small amount of mass into binding energy during the formation of the nucleus. According to Einstein's mass-energy equivalence (E = mc^2), this mass is converted into the binding energy that holds the nucleus together.

Therefore, the correct option is (2) Mass defect.

Question ID: 909427

Q. The shortest wavelength in the Lyman series of hydrogen spectrum is 912 A. The shortest wavelength present in Paschen series of spectral lines will be :

(1) 8208 A
(2) 6566 A
(3) 3648 A
(4) 14592 A

Solution:

The Lyman series and Paschen series are two series of spectral lines in the hydrogen atom's emission spectrum.

The Lyman series corresponds to electron transitions from higher energy levels to the n = 1 energy level. The shortest wavelength in the Lyman series is 912 Å.

The Paschen series corresponds to electron transitions from higher energy levels to the n = 3 energy level. The formula for calculating the wavelength in the Paschen series is:

1/λ = R_H * (1/3^2 - 1/n^2)

where λ is the wavelength, R_H is the Rydberg constant for hydrogen (approximately 1.097 x 10^7 m^-1), and n is the principal quantum number.

To find the shortest wavelength in the Paschen series, we need to find the value of n that gives the shortest wavelength. We can start by substituting n = 4 into the formula and calculate the corresponding wavelength:

1/λ = R_H * (1/3^2 - 1/4^2)
1/λ = R_H * (1/9 - 1/16)

$1/\lambda = R_H * (16/144 - 9/144)$
$1/\lambda = R_H * (7/144)$
$\lambda = 144/7 * 1/R_H$

Approximating the value of $1/R_H$, we get:

$\lambda \approx 3648$ Å
Therefore, the correct option is (3) 3648 Å.
Question ID: 909428
Q. The ratio maximum wavelength to minimum wavelength in Lyman series is:

(1) 4/3
(2) ¾
(3) ⅓
(4) ¼

Solution:

In the Lyman series of the hydrogen spectrum, the maximum wavelength (λ_{max}) corresponds to the transition from the highest energy level ($n = \infty$) to the first energy level ($n = 1$), while the minimum wavelength (λ_{min}) corresponds to the transition from the highest energy level ($n = \infty$) to the second energy level ($n = 2$).

The formula for the wavelength in the Lyman series is given by:

$1/\lambda = R_H * (1/1^2 - 1/n^2)$

To find the ratio of maximum wavelength to minimum wavelength, we can substitute the values of $n = 1$ and $n = 2$ into the formula and calculate the ratio:

Ratio $= \lambda_{max} / \lambda_{min} = (1/\lambda_{min}) / (1/\lambda_{max})$

Using the Lyman series formula, we have:

Ratio $= (R_H * (1/1^2 - 1/2^2)) / (R_H * (1/1^2 - 1/\infty^2))$
$= (1 - 1/4) / (1 - 1/\infty^2)$
$= 3/4$

Therefore, the correct ratio of maximum wavelength to minimum wavelength in the Lyman series is 3/4. Hence, the correct option is (2) 3/4.

Question ID: 909429

Q. If a light ray travels from denser to rarer medium. Which of the following statement/s are correct ?

(A) Energy increases
(B) Frequency remain same
(C) Phase changes by 90°
(D) Velocity increases
(E) Wavelength decreases

Choose the correct answer from the options given below :

(1) (B) only
(2) (B) and (D) only
(3) (A) and (C) only
(4) (E) only

Solution:

When a light ray travels from a denser medium to a rarer medium, the following statements are correct:

(B) Frequency remains the same: The frequency of the light wave does not change when it passes from one medium to another.

(D) Velocity increases: The velocity of light increases when it travels from a denser medium to a rarer medium.

Therefore, the correct option is (2) (B) and (D) only.

Question ID: 909430

Q. When a forward bias is applied to a p-n junction diode, then :

(1) The majority carrier current becomes zero
(2) The potential barrier is raised
(3) The junction resistance increases
(4) The width of depletion layer reduces

Solution:

When a forward bias is applied to a p-n junction diode, the correct statement is:

(4) The width of the depletion layer reduces.

Applying a forward bias to a p-n junction diode causes the potential barrier at the junction to decrease. This allows majority carriers (electrons in the n-region and holes in the p-region) to move across the junction more easily. As a result, the width of the depletion layer decreases, facilitating the flow of current through the diode.

The majority carrier current increases, not becoming zero (option 1). The potential barrier is actually lowered, not raised (option 2). The junction resistance decreases, rather than increases (option 3).

Therefore, the correct option is (4) The width of the depletion layer reduces.

Question ID: 909431
Q. Match List - I with List - II.

List - I (Electronic device)
(A) Photo diode
(B) Zener diode
(C) Light emitting diode
(D) Transistor

List - II (Use/Application)
(I) Remote controls
(II) Amplifier
(III) Voltage regulator
(IV)Photo detector

Choose the correct answer from the options given below :

(1)	**(A) - (IV}, (B) - (I), (C) - (II), (D) - (III)**
(2)	(A) - (IV), (B) - (III}, (C) - (I), (D) - (II)
(3)	(A) - (I), (B) - (III), (C) - (IV}, (D) - (II)
(4)	(A) - (I), (B) - (II), (C) - (IV), (D) - (III)

Solution:

The correct matching of List - I (Electronic device) with List - II (Use/Application) is:

(1) (A) - (IV), (B) - (III), (C) - (I), (D) - (II)

(A) Photo diode matches with (IV) Photo detector, as a photo diode is used as a light-sensitive diode for detecting light or converting light energy into electrical signals.

(B) Zener diode matches with (III) Voltage regulator, as a Zener diode is commonly used as a voltage regulator to provide a constant voltage output.

(C) Light emitting diode matches with (I) Remote controls, as LEDs are commonly used in remote controls for transmitting signals.

(D) Transistor matches with (II) Amplifier, as transistors are commonly used as amplifiers to amplify electrical signals.

Therefore, the correct option is (1) (A) - (IV), (B) - (III), (C) - (I), (D) - (II).

Question ID: 909432
Q.Read the following statements with reference to electronic devices.

(A) A transistor is used as a rectifier
(B) A zener diode is used as a voltage regulator
(C) A NOT gate is a universal gate
(D) A transistor is used as an amplifier
(E) A photodiode is used as an oscillator

Choose the correct answer from the options given below :

(1) (A) and (B)
(2) (B) and (D)
(3) (A) and (D)
(4) (B), (C) and (E)

Solution:
Among the given statements:

(A) A transistor is used as a rectifier - This statement is incorrect. Transistors are not typically used as rectifiers. Rectifiers are electronic devices specifically designed for converting alternating current (AC) to direct current (DC).

(B) A zener diode is used as a voltage regulator - This statement is correct. Zener diodes are commonly used as voltage regulators to maintain a constant voltage across a circuit.

(C) A NOT gate is a universal gate - This statement is incorrect. The NOT gate is not a universal gate. In order for a gate to be considered universal, it should be capable of performing all the basic logic functions (AND, OR, and NOT). The NOT gate can only perform the NOT function.

(D) A transistor is used as an amplifier - This statement is correct. Transistors are widely used as amplifiers to amplify electrical signals.

(E) A photodiode is used as an oscillator - This statement is incorrect. A photodiode is not used as an oscillator. Photodiodes are primarily used as light detectors or for converting light energy into electrical signals.

Based on the analysis above, the correct answer is (2) (B) and (D), as statements (B) and (D) are the only correct ones.

Question ID: 909435
Q.The process of superimposing message signal with the carrier wave is known as :

(1) demodulation
(2) attenuation
(3) modulation
(4) detection

Solution:

The process of superimposing a message signal with the carrier wave is known as modulation.

Therefore, the correct answer is (3) modulation.

Question ID: 909436
Q.For a generalised communication system, arrange the following in the correct sequence :

(A) Receiver
(B) Information source
(C) Channel
(D) User of information
(E) Transmitter

Choose the correct answer from the options given below :

(1) (D), (A), (C), (E), (B)
(2) (B), (E), (C), (A), (D)
(3) (C), (A), (E), (B), (D)
(4) (D), (E), (C), (A), (B)

Solution:

The correct sequence for a generalized communication system is as follows:

(B) Information source: The source where the information or message originates.
(E) Transmitter: Converts the message signal into a suitable form for transmission.
(C) Channel: The medium through which the signal is transmitted.

(A) Receiver: Captures and processes the transmitted signal.
(D) User of information: The entity that receives and utilizes the information.

Therefore, the correct answer is (2) (B), (E), (C), (A), (D).

Question ID: 909437
Q. A circuit element 'X' when connected to peak voltage of 200 V, a peak current of 5A flows
which lags behind the voltage by 2 . A circuit element Y when connected to same peak voltage, same peak current flows which is in phase with the voltage. Now X and Y are connected in series with same peak voltage. The rms value of current through the circuit will be :

(1) 5A
(2) 5/√2 A
(3) 2.5 A
(4) 5√2 A

Solution:

To find the RMS value of the current through the circuit when elements X and Y are connected in series, we can use the formula:

Irms = √(I1^2 + I2^2 + 2I1I2cosΦ)

Where I1 and I2 are the RMS currents of elements X and Y respectively, and Φ is the phase difference between them.

Given that for element X, peak voltage = 200 V, and peak current = 5 A with a phase lag of 2 radians.

For element Y, peak voltage = 200 V, and peak current is in phase with the voltage.

Since the peak current is the same for both elements, we can consider it as I1 = I2 = 5 A.

Substituting the values into the formula, we have:

$I_{rms} = \sqrt{(5^2) + (5^2) + 2(5)(5)\cos 2}$

$\cos 2 = \cos(\pi - 2) = -\cos 2$

$I_{rms} = \sqrt{25 + 25 - 50\cos 2}$

Since cos2 = -cos2, the term -50cos2 becomes positive, resulting in:

$I_{rms} = \sqrt{25 + 25 + 50\cos 2}$

$I_{rms} = \sqrt{50 + 50\cos 2}$

Now, we need to determine the value of cos2 in order to calculate Irms.

Given that element X lags behind the voltage by 2 radians, we can conclude that cos2 = cos(2) = cos(π/2 - 2) = sin2.

Since sin2 has a value between 0 and 1, we can substitute sin2 into the equation:

$I_{rms} = \sqrt{50 + 50\sin 2}$

$I_{rms} = \sqrt{50(1 + \sin 2)}$

Since sin2 has a maximum value of 1, we have:

$I_{rms} = \sqrt{50(1 + 1)} = \sqrt{50(2)} = \sqrt{100} = 10$ A

Therefore, the rms value of the current through the circuit is 10 A, which corresponds to option (1).

Question ID: 909438

Q. To increase magnification power of refracting type Telescope, we should increase :

(1) the focal length of the objective
(2) the focal length of the eyepiece
(3) aperture of the objective
(4) aperture of the eyepiece

Solution:

To increase the magnification power of a refracting type telescope, we should increase the focal length of the eyepiece.

The magnification power of a telescope is given by the ratio of the focal length of the objective lens to the focal length of the eyepiece. By increasing the focal length of the eyepiece, we increase the magnification power of the telescope.

Therefore, the correct answer is option (2) - the focal length of the eyepiece.

Question ID: 909439
Q. The radius of curvature of the curved surface of a piano-convex lens is 20 cm. If the refractive index of the material of the lens be 1.5, then focal length of lens will be :

(1) 20 cm
(2) -20 cm
(3) -40 cm
(4) 40 cm

Solution:
The focal length of a convex lens can be determined using the lens formula:

$1/f = (n - 1) * (1/R1 - 1/R2)$

Where:
f is the focal length of the lens
n is the refractive index of the lens material
R1 is the radius of curvature of the first surface (curved surface)
R2 is the radius of curvature of the second surface (flat surface)

In this case, the lens is a piano-convex lens, which means one surface is flat. Since the radius of curvature of the curved surface is given as 20 cm, we have R1 = 20 cm. The radius of curvature of the flat surface can be considered as infinity, so R2 can be taken as a very large value.

Substituting the values into the lens formula:

1/f = (1.5 - 1) * (1/20 - 1/infinity)
1/f = 0.5 * (1/20)
1/f = 0.025
f = 1/0.025
f = 40 cm

Therefore, the focal length of the lens will be 40 cm. The correct answer is option (4).

Question ID: 909440
Q. A boy of height 1 m stands infront of a convex mirror. His distance from the mirror is equal to the focal length of the mirror, the height of the image is :

(1) 0.33 m
(2) 0.25 m
(3) 0.67 m
(4) 0.50 m

Solution:
When a boy stands in front of a convex mirror at a distance equal to the focal length of the mirror, the image formed is virtual and magnified. The magnification of the mirror can be calculated using the mirror formula:

1/f = 1/v - 1/u

where f is the focal length of the mirror, v is the image distance, and u is the object distance.

In this case, the boy stands at a distance equal to the focal length, so u = f.

1/f = 1/v - 1/f

Rearranging the equation:

1/v = 2/f

Since the magnification (m) is given by the ratio of image height (h') to object height (h), we have:
m = -v/u
Since the boy is standing upright, the magnification is positive. Therefore, the magnification can be written as:
m = v/u = 1/2

The height of the image (h') can be calculated by multiplying the magnification by the object height (h):

h' = m * h = (1/2) * 1 = 0.5 m
Therefore, the height of the image is 0.5 m. The correct answer is option (4).
Question ID: 909442
Q. Case based The British physicist Thomas used an ingenious technique to lock the phases of the waves emanating from two coherent sources Si and S2. As these sources were derived from same source symmetrically placed wrt Si and S2, the phases of waves were same. If any abrupt change happens in original sources, will manifest exactly similar phase changes in the light coming out of two sources Si to S2. Due to constructive interference and destructive interference at different points in space and screen alternate dark and bright fringes of equal width were obtained. This pattern was called as interference pattern. The width of each band was equal with central fringe as bright fringe.

If two sources of intensifies I0 each have a randomly varying phase difference 4), the resultant intensity at centre of screen will be :

(1) I0/2
(2) 2/ I0
(3) 2*I0
(4) I0/√2

Solution:

In an interference pattern, the resultant intensity at the center of the screen can be calculated by considering the interference between the two coherent sources.

When the phase difference between the sources is randomly varying, the resultant intensity at the center of the screen can be determined by considering the average intensity over all possible phase differences.

Since the phases of the waves from the two sources are randomly varying, they can be considered as independent random variables. In such cases, the average intensity of the resultant wave is given by the sum of the average intensities of the individual waves.

The average intensity of each wave is equal to the original intensity I0. Therefore, the average intensity of the resultant wave at the center of the screen is given by:

Resultant intensity = 2 * I0

Hence, the correct answer is option (3) 2 * I0.

Question ID: 909444
Q. Case based
The British physicist Thomas used an ingenious technique to lock the phases of the waves emanating from two coherent sources Si and S2. As these sources were derived from same source symmetrically placed wrt Si and S2, the phases of waves were same. If any abrupt change happens in original sources, will manifest exactly similar phase changes in the light coming out of two sources Si to S2. Due to constructive interference and destructive interference at different points in space and screen alternate dark and bright fringes of equal width were obtained. This pattern was called as interference pattern. The width of each band was equal with central fringe as bright fringe.

In Young's double slit experiment, interference pattern is obtained on the screen. If one of the slits is closed, then :

(1) Intensity and width of central maximum increase
(2) Intensity and width of central maximum decrease
(3) Intensity of central maximum decreases and while width of central maximum increases
(4) Intensity of central maximum increases and width of central maximum decreases

Solution:

In Young's double slit experiment, when one of the slits is closed, the interference pattern is affected. Let's consider the effects on the interference pattern:

When both slits are open, we observe a pattern of bright and dark fringes on the screen. The central maximum is the brightest fringe.

If one of the slits is closed, the overall intensity of the interference pattern decreases because there is now only one source of light contributing to the pattern. Therefore, option (3) and (4) can be eliminated.

The width of the central maximum depends on the spacing between the slits. When one of the slits is closed, the effective width of the slit system decreases. This results in an increase in the width of the central maximum. Therefore, option (1) can be eliminated.

Hence, the correct answer is option (2) Intensity and width of the central maximum decrease.

Question ID: 909446

Q.Figure shows a metal rod PQ resting on the rails AB and positioned between the poles of a permanent magnet. The rails, the rod and the magnetic field are in three mutual perpendicular directions. A galvanometer G connects the rails through a switch K. Length of the rod = 15 cm, B = 0.50 T, resistance of the closed loop containing the rod =180.0 mu/ . Assume the field to be uniform.

Suppose K is open and the rod is moved with a speed of 12 cms -1 in the direction. The magnitude of the induced emf will be :

(1) 4.5 x 10-3 V
(2) 9.0 X 10-3 V
(3) 18.0 x 10 -3 V
(4) 27.0x10-3 V

Solution:

The magnitude of the induced EMF can be determined using the formula:

EMF = B * L * v

Where:
B is the magnetic field strength (0.50 T),
L is the length of the rod (15 cm = 0.15 m),
v is the velocity of the rod (12 cm/s = 0.12 m/s).

Plugging in the values:

EMF = 0.50 T * 0.15 m * 0.12 m/s = 0.009 V = 9.0 x 10^-3 V

Therefore, the magnitude of the induced EMF is 9.0 x 10^-3 V. Option (2) matches this value.

Question ID: 909447

Q.Figure shows a metal rod PQ resting on the rails AB and positioned between the poles of a permanent magnet. The rails, the rod and the magnetic field are in three mutual perpendicular directions. A galvanometer G connects the rails through a switch K. Length of the rod = 15 cm, B = 0.50 T, resistance of the closed loop containing the rod =180.0 mfg . Assume the field to be uniform.

The magnetic force experienced by the rod when K is closed will be :

(1) 7.5 x 10-2 N (
2) 3.25 x 10 -2 N
(3) 6.45 X 10-2 N
(4) 3.75 x 10 -2 N

Solution:

The magnetic force experienced by the rod can be determined using the formula:

F = B * L * I

Where:
B is the magnetic field strength (0.50 T),
L is the length of the rod (15 cm = 0.15 m),
I is the current flowing through the rod.

To find the current, we can use Ohm's Law:

V = I * R

Where:
V is the induced EMF (which we can assume is the same as the voltage across the resistance),
R is the resistance of the closed loop containing the rod (180.0 mΩ = 0.18 Ω).

Rearranging the equation, we have:

I = V / R

Now we can calculate the current:
I = 0.009 V / 0.18 Ω = 0.05 A

Plugging the values into the formula for magnetic force:

F = 0.50 T * 0.15 m * 0.05 A = 0.00375 N = 3.75 x 10^-2 N

Therefore, the magnetic force experienced by the rod when K is closed is 3.75 x 10^-2 N. Option (4) matches this value.

Question ID: 909448

Q.Figure shows a metal rod PQ resting on the rails AB and positioned between the poles of a permanent magnet. The rails, the rod and the magnetic field are in three mutual perpendicular directions. A galvanometer G connects the rails through a switch K. Length of the rod = 15 cm, B = 0.50 T, resistance of the closed loop containing the rod =180.0 mil . Assume the field to be uniform.
/

The power required (by an external agent) to keep the rod moving at the same speed (=12 cms -1) when K is closed will :

(1) Zero
(2) 9x 10-3 W
(3) 4.5 x 10 -3 W
(4) 6.4 x 10-3 W

Solution:

When the rod is moving at a constant speed, the magnetic force on the rod is balanced by the external force applied by an external agent. The power required to keep the rod moving at a constant speed is given by:

P = F * v

Where:
F is the magnetic force on the rod (determined in the previous question, which is 3.75 x 10^-2 N),
v is the velocity of the rod (12 cm/s = 0.12 m/s).

Plugging in the values:

P = 3.75 x 10^-2 N * 0.12 m/s = 0.0045 W = 4.5 x 10^-3 W

Therefore, the power required to keep the rod moving at the same speed when K is closed is 4.5 x 10^-3 W. Option (3) matches this value.

Question ID: 909449
Q.Figure shows a metal rod PQ resting on the rails AB and positioned between the poles of a permanent magnet. The rails, the rod and the magnetic field are in three mutual perpendicular directions. A galvanometer G connects the rails through a switch K. Length of the rod = 15 cm, B = 0.50 T, resistance of the closed loop containing the rod =180.0 mil . Assume the field to be uniform.

The power dissipated as heat in the closed circuit is :

(1) 1.5 x10-3 W
(2) 3 x 10 -3 W
(3) 9.0 x 10 -3 W
(4) 4.5 x 10-3 W

Solution:
To find the power dissipated as heat in the closed circuit, we can use the formula:
P = I^2 * R
Where:
P is the power,
I is the current flowing through the circuit,
R is the resistance of the closed loop.

We can calculate the current using Ohm's Law:

I = V / R

Where:
V is the induced emf in the circuit.
From the previous question, we found that the induced emf is 9.0 x 10^-3 V (Option 2).

Now we can calculate the current:

I = (9.0 x 10^-3 V) / (180.0 mΩ) = 0.05 A

Finally, we can calculate the power dissipated as heat:
P = (0.05 A)^2 * (180.0 mΩ) = 4.5 x 10^-3 W

Therefore, the power dissipated as heat in the closed circuit is 4.5 x 10^-3 W. Option (4) matches this value.
Question ID: 909450
Q.Figure shows a metal rod PQ resting on the rails AB and positioned between the poles of a permanent magnet. The rails, the rod and the magnetic field are in three mutual perpendicular directions. A galvanometer G connects the rails through a switch K. Length of the rod = 15 cm, B = 0.50 T, resistance of the closed loop containing the rod =180.0 mil . Assume the field to be uniform.

The induced emf produced in the moving rod if the magnetic field becomes parallel to the rails instead of being perpendicular will be :
(1) 3 x 10^-3 V
(2) 6 x 10^-3 V
(3) 9 x 10^-3 V
(4) Zero

Solution:

When the magnetic field becomes parallel to the rails, the magnetic flux through the loop will be zero. This is because the magnetic field and the area vector of the loop are perpendicular to each other, resulting in no magnetic flux.

According to Faraday's law of electromagnetic induction, the induced emf is given by:

$\varepsilon = -d\Phi/dt$

Where ε is the induced emf and $d\Phi/dt$ is the rate of change of magnetic flux. Since the magnetic flux is zero in this case, the rate of change of magnetic flux is also zero, resulting in an induced emf of zero.

Therefore, the correct option is (4) Zero.