

NEET-UG Physics Sample Paper-20

Duration: 1 Hour

Maximum Marks: 180

Instructions

- This paper contains a total of 45 Multiple Choice Questions.
- Each correct answer carries **+4 marks**.
- Each incorrect answer carries **-1 mark**.
- No negative marking for unattempted questions.

Q1. The SI unit of pressure is:

- (A) Pascal
- (B) Joule
- (C) Watt
- (D) Newton

Q2. A car accelerates uniformly from 10 m/s to 30 m/s in 5 s. Acceleration is:

- (A) 2 m/s^2
- (B) 4 m/s^2
- (C) 5 m/s^2
- (D) 10 m/s^2

Q3. Displacement of a particle is zero when:

- (A) Distance is zero
- (B) Initial and final positions are same
- (C) Velocity is zero
- (D) Acceleration is zero

Q4. Newton's first law is also called:

- (A) Law of inertia



- (B) Law of force
- (C) Law of motion
- (D) Law of energy

Q5. Momentum is given by:

- (A) mv
- (B) m/v
- (C) v/m
- (D) mv^2

Q6. Work done is maximum when angle between force and displacement is:

- (A) 0°
- (B) 90°
- (C) 180°
- (D) 45°

Q7. Mechanical energy is sum of:

- (A) KE and PE
- (B) KE only
- (C) PE only
- (D) Work and power

Q8. Unit of angular momentum is:

- (A) $\text{kg m}^2/\text{s}$
- (B) kg m/s
- (C) N m
- (D) J



Q9. For a satellite, centripetal force is provided by:

- (A) Gravity
- (B) Tension
- (C) Friction
- (D) Pressure

Q10. Acceleration due to gravity on Moon is approximately:

- (A) 9.8 m/s^2
- (B) 4.9 m/s^2
- (C) 1.6 m/s^2
- (D) 0

Q11. Density is defined as:

- (A) Mass/volume
- (B) Volume/mass
- (C) Force/area
- (D) Energy/time

Q12. Bernoulli's principle is based on:

- (A) Conservation of energy
- (B) Conservation of mass
- (C) Newton's law
- (D) Ohm's law

Q13. Coefficient of viscosity depends on:

- (A) Nature of fluid
- (B) Shape
- (C) Area



(D) Force

Q14. Absolute zero temperature is:

(A) 0°C

(B) 273 K

(C) 0 K

(D) -100°C

Q15. Heat capacity is:

(A) Heat per unit temperature

(B) Temperature per heat

(C) Work per heat

(D) Energy per mass

Q16. Ideal gas equation is:

(A) $PV = nRT$

(B) $P = VRT$

(C) $V = nRT$

(D) $PV = RT$

Q17. Wavelength is measured in:

(A) meter

(B) second

(C) Hz

(D) Newton

Q18. Pitch of sound depends on:

(A) Frequency

(B) Amplitude



- (C) Speed
- (D) Intensity

Q19. Electric field lines originate from:

- (A) Positive charge
- (B) Negative charge
- (C) Neutral body
- (D) Ground

Q20. Potential at infinity is taken as:

- (A) Zero
- (B) One
- (C) Infinite
- (D) Negative

Q21. Energy stored in capacitor is:

- (A) $\frac{1}{2}CV^2$
- (B) CV^2
- (C) $\frac{1}{2}QV$
- (D) Both A and C

Q22. Resistance of wire increases with:

- (A) Length
- (B) Area
- (C) Temperature
- (D) Both A and C

Q23. Ohmic conductor obeys:

- (A) Linear V-I relation



- (B) Nonlinear
- (C) Random
- (D) Constant current

Q24. Magnetic field due to circular loop is maximum at:

- (A) Center
- (B) Edge
- (C) Outside
- (D) Infinite

Q25. Lorentz force acts on:

- (A) Moving charge
- (B) Stationary charge
- (C) Neutral body
- (D) Mass

Q26. Transformer works on principle of:

- (A) Mutual induction
- (B) Self induction
- (C) Resistance
- (D) Capacitance

Q27. Reactance is opposition to:

- (A) AC
- (B) DC
- (C) Voltage
- (D) Current



Q28. Microwaves are used in:

- (A) Cooking
- (B) Lighting
- (C) Cooling
- (D) Heating water only

Q29. Power of lens is measured in:

- (A) Diopter
- (B) Meter
- (C) Watt
- (D) Joule

Q30. Myopia is corrected using:

- (A) Concave lens
- (B) Convex lens
- (C) Plane mirror
- (D) Prism

Q31. Interference requires:

- (A) Coherent sources
- (B) Incoherent sources
- (C) Single source
- (D) No source

Q32. Energy of photon is:

- (A) hf
- (B) h/f
- (C) f/h



(D) hf^2

Q33. Work function is minimum energy to:

- (A) Remove electron
- (B) Add electron
- (C) Move electron
- (D) Stop electron

Q34. Atomic number represents:

- (A) Protons
- (B) Neutrons
- (C) Electrons
- (D) Nucleons

Q35. Binding energy is related to:

- (A) Stability
- (B) Instability
- (C) Mass
- (D) Volume

Q36. LED emits light due to:

- (A) Recombination
- (B) Ionization
- (C) Reflection
- (D) Refraction

Q37. NAND gate is combination of:

- (A) AND + NOT
- (B) OR + NOT



- (C) AND + OR
- (D) NOT + NOT

Q38. Systematic error can be reduced by:

- (A) Calibration
- (B) Repetition
- (C) Randomization
- (D) None

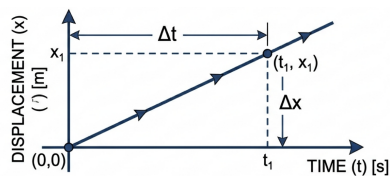
Q39. Parallax error occurs due to:

- (A) Wrong angle
- (B) Wrong scale
- (C) Wrong unit
- (D) Wrong value

Q40. A body in uniform motion has:

- (A) Zero acceleration
- (B) Constant acceleration
- (C) Increasing velocity
- (D) Decreasing velocity

Q41. The motion of the particle is:

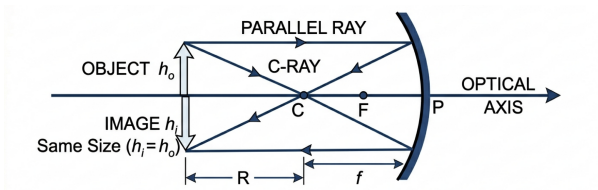


- (A) Uniform velocity
- (B) Uniform acceleration
- (C) At rest



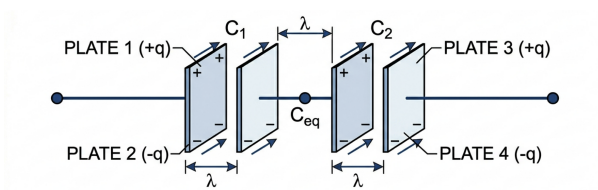
(D) Variable velocity

Q42. Object is placed at:



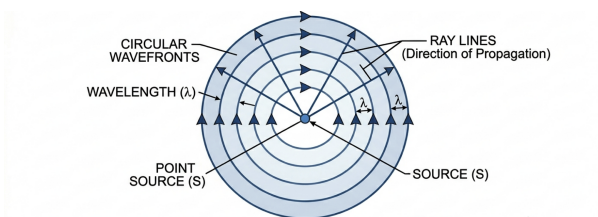
- (A) At C
- (B) At F
- (C) Between F and C
- (D) Beyond C

Q43. The equivalent capacitance is:



- (A) Less than both
- (B) Greater than both
- (C) Equal to sum
- (D) Infinite

Q44. This represents:

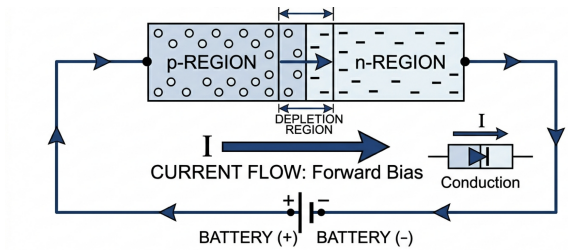


(A) Spherical wave



- (B) Plane wave
- (C) Standing wave
- (D) Longitudinal wave

Q45. Current flows:



- (A) Easily
- (B) Not at all
- (C) Randomly
- (D) Only at high voltage



Detailed Solutions**Q1.****Solution**

Concept: Definition and SI unit of pressure.

Solution: Pressure is defined as the force applied perpendicular to the surface of an object per unit area over which that force is distributed. The formula is $P = F/A$. In the International System of Units (SI), the unit of force (F) is the Newton (N) and the unit of area (A) is the square meter (m^2). Therefore, the SI unit of pressure is N/m^2 . This derived unit is given the special name Pascal (Pa), in honor of Blaise Pascal. The other options are units for different physical quantities: Joule is for energy, Watt is for power, and Newton is for force.

Final Answer : Pascal

Answer: (A)

Q2.**Solution**

Concept: Uniform acceleration from the equations of kinematics.

Solution: Acceleration is the rate of change of velocity. For uniform acceleration, it is calculated by the formula:

$$a = (\text{Final Velocity} - \text{Initial Velocity}) / \text{Time}$$

$$a = (v - u) / t$$

Given values are:

$$\text{Initial velocity (u)} = 10 \text{ m/s}$$

$$\text{Final velocity (v)} = 30 \text{ m/s}$$

$$\text{Time (t)} = 5 \text{ s}$$

Substituting the values into the formula:

$$a = (30 \text{ m/s} - 10 \text{ m/s}) / 5 \text{ s}$$

$$a = 20 \text{ m/s} / 5 \text{ s}$$

$$a = 4 \text{ m/s}^2$$

Thus, the acceleration of the car is 4 m/s^2 .

Final Answer : 4 m/s^2

Answer: (B)



Q3.

Solution

Concept: The distinction between distance and displacement in kinematics.

Solution: Displacement is a vector quantity that refers to the change in an object's position. It is the shortest straight-line distance from the initial to the final point and has a direction. Distance, on the other hand, is a scalar quantity that refers to the total path length covered by an object. Displacement is zero when the object's final position is the same as its initial position. For example, if a particle moves in a circle and completes one full revolution, it returns to its starting point. In this case, the displacement is zero, even though the distance covered is the circumference of the circle ($2\pi r$).

Final Answer : Initial and final positions are same

Answer: (B)

Q4.

Solution

Concept: Newton's First Law of Motion and the concept of inertia.

Solution: Newton's First Law of Motion states: "An object at rest will stay at rest, and an object in motion will stay in motion with the same speed and in the same direction unless acted upon by an unbalanced external force." This property of an object to resist changes in its state of motion is called inertia. Because the first law is a formal statement of this principle, it is also known as the Law of Inertia.

Final Answer : Law of inertia

Answer: (A)



Q5.

Solution

Concept: Definition and formula for linear momentum.

Solution: Linear momentum is a fundamental quantity in physics, defined as the "quantity of motion" of an object. It is a vector quantity, possessing both magnitude and direction. The momentum (p) of an object is calculated as the product of its mass (m) and its velocity (v).

The formula is:

$$p = m \times v$$

Therefore, momentum is given by mv .

Final Answer : mv

Answer: (A)

Q6.

Solution

Concept: Work done by a constant force and its dependence on the angle between force and displacement.

Solution: The work done (W) by a constant force (F) on an object is defined as the product of the magnitude of the force and the magnitude of the displacement (d) in the direction of the force. The formula is:

$$W = Fd \cos(\theta)$$

where θ is the angle between the force vector and the displacement vector.

To maximize the work done, the value of $\cos(\theta)$ must be at its maximum. The cosine function has a maximum value of +1, which occurs when the angle θ is 0° . This means the force and the displacement are in the same direction. When $\theta = 0^\circ$, $W = Fd(1) = Fd$, which is the maximum possible work.

Final Answer : 0°

Answer: (A)



Q7.

Solution

Concept: Definition of mechanical energy in a physical system.

Solution: Mechanical energy is the energy associated with the motion and position of an object. In a conservative system (where energy is conserved), it is the sum of the kinetic energy and the potential energy.

- Kinetic Energy (KE) is the energy an object possesses due to its motion ($KE = \frac{1}{2}mv^2$).

- Potential Energy (PE) is the energy stored in an object due to its position or configuration (e.g., gravitational potential energy $PE = mgh$).

Total Mechanical Energy (ME) = KE + PE.

Final Answer : KE and PE

Answer: (A)

Q8.

Solution

Concept: The definition and SI unit of angular momentum.

Solution: Angular momentum (L) is the rotational equivalent of linear momentum. For a point particle of mass m moving with velocity v at a radius r , its magnitude can be expressed as $L = mvr$.

To find the SI unit, we combine the units of each component:

Unit of mass (m) = kg

Unit of velocity (v) = m/s

Unit of radius (r) = m

Unit of $L = (kg) \times (m/s) \times (m) = kgm^2/s$.

Therefore, the SI unit of angular momentum is kilogram-meter squared per second.

Final Answer : $kg\ m^2/s$

Answer: (A)



Q9.

Solution

Concept: Centripetal force required for circular orbital motion.

Solution: For any object to move in a circular path, it must be subjected to a net force directed towards the center of the circle. This force is called the centripetal force. In the case of a satellite orbiting a planet (like Earth), the satellite is continuously "falling" towards the planet, but its tangential velocity is high enough that it misses the surface and continues in an orbit. The force that constantly pulls the satellite towards the center of the planet is the gravitational force of attraction between the planet and the satellite. Thus, gravity provides the necessary centripetal force to keep the satellite in its orbit.

Final Answer : Gravity

Answer: (A)

Q10.

Solution

Concept: Acceleration due to gravity on celestial bodies, specifically the Moon.

Solution: The acceleration due to gravity (g) on the surface of a celestial body is determined by its mass (M) and radius (R) according to Newton's Law of Universal Gravitation: $g = GM/R^2$. The Moon has significantly less mass and a smaller radius than Earth. The result of these combined factors is that the Moon's surface gravity is about 1/6th of Earth's gravity.

Given that Earth's gravity is approximately 9.8 m/s^2 , the Moon's gravity is:

$$g_{\text{moon}} \approx (1/6) * g_{\text{earth}} \approx (1/6) * 9.8 \text{ m/s}^2 \approx 1.63 \text{ m/s}^2.$$

The closest answer is 1.6 m/s^2 .

Final Answer : 1.6 m/s^2

Answer: (C)



Q11.

Solution**Concept:** Definition of density.**Solution:** Density is an intrinsic property of a substance that describes the amount of mass contained in a given volume. It is a measure of how tightly packed the matter is within an object.The formula for density (ρ) is the ratio of mass (m) to volume (V):

$$\rho = \text{Mass} / \text{Volume.}$$

Its SI unit is kilograms per cubic meter (kg/m^3).**Final Answer : Mass/volume****Answer: (A)**

Q12.

Solution**Concept:** The fundamental principle underlying Bernoulli's equation in fluid dynamics.**Solution:** Bernoulli's principle is a direct consequence of the principle of conservation of energy as applied to a moving fluid. It is derived from the work-energy theorem, which states that the total work done on a system by all forces is equal to the change in the system's kinetic energy.

For an ideal fluid (incompressible, non-viscous, and in steady flow), the principle states that the sum of its pressure energy, kinetic energy per unit volume, and potential energy per unit volume remains constant along a streamline. The equation is expressed as:

$$P + \frac{1}{2}\rho v^2 + \rho gh = \text{constant}$$

Where:

- P is the static pressure of the fluid.
- $\frac{1}{2}\rho v^2$ is the dynamic pressure, representing the kinetic energy per unit volume.
- ρgh is the hydrostatic pressure, representing the potential energy per unit volume.

This equation shows that if the speed (v) of the fluid increases, its pressure (P) or its potential energy must decrease to keep the total sum constant. This relationship is a powerful tool for analyzing fluid flow and is the basis for understanding phenomena like the lift generated by an airplane wing.

Final Answer : Conservation of energy**Answer: (A)**

Q13.

Solution

Concept: The factors determining the coefficient of viscosity of a fluid.

Solution: The coefficient of viscosity (η), often simply called viscosity, is a measure of a fluid's internal resistance to flow, essentially its "thickness" or internal friction. It is an intrinsic property of the fluid, meaning it depends on the substance itself, not on the external conditions of the flow.

The primary factors that determine a fluid's viscosity are:

1. Intermolecular Forces: Stronger cohesive forces between the molecules of a fluid lead to greater resistance to flow, resulting in higher viscosity (e.g., honey has strong intermolecular forces and is highly viscous).
2. Temperature: For liquids, viscosity decreases as temperature increases because the molecules gain kinetic energy and can more easily overcome the intermolecular forces. For gases, viscosity increases with temperature because more frequent molecular collisions impede the overall flow.

Since these factors are characteristic of the fluid's composition and state, the coefficient of viscosity depends on the nature of the fluid. External factors like the shape of the container, the area of contact, or the applied force are involved in calculations of viscous drag, but they do not alter the value of the coefficient of viscosity itself.

Final Answer : Nature of fluid

Answer: (A)



Q14.

Solution

Concept: The definition of absolute zero in thermodynamics.

Solution: Absolute zero is the theoretical lower limit of the thermodynamic temperature scale. It is the point at which the fundamental particles of a substance have the minimum possible thermal energy. In classical thermodynamics, this would correspond to the cessation of all particle motion. In quantum mechanics, particles still possess a minimum, non-zero amount of energy called zero-point energy, but absolute zero represents the lowest possible energy state of the system.

The Kelvin (K) scale is an absolute temperature scale, where its zero point (0 K) is defined as absolute zero. On the more common Celsius scale, absolute zero corresponds to -273.15°C . The relationship is $T(\text{K}) = T(^{\circ}\text{C}) + 273.15$. 0°C is the freezing point of water, equivalent to 273.15 K. -273 K is approximately the freezing point of water.

0 K is, by definition, absolute zero.

According to the third law of thermodynamics, it is impossible to reach absolute zero in a finite number of steps

Final Answer : 0 K

Answer: (C)

Q15.

Solution

Concept: The definition of heat capacity.

Solution: Heat capacity (symbol C) is an extensive physical property of matter, meaning it is proportional to the size of the system. It is defined as the amount of heat energy (Q) required to raise the temperature of a given object or system by one degree Celsius or one Kelvin.

The defining formula is:

$$C = Q / \delta T$$

where Q is the heat added and δT is the resulting change in temperature.

From this formula, we can see that heat capacity is the ratio of heat to temperature change, or "heat per unit temperature". Its SI unit is joules per kelvin (J/K).

It is important to distinguish heat capacity from specific heat capacity (c), which is an intensive property (a characteristic of the substance itself) defined as the heat capacity per unit mass: $c = C/m = Q/(m \delta T)$.

Final Answer : Heat per unit temperature

Answer: (A)



Q16.

Solution

Concept: The equation of state for an ideal gas, known as the Ideal Gas Law.

Solution: The Ideal Gas Law is a fundamental equation in chemistry and physics that describes the behavior of a hypothetical ideal gas. An ideal gas is a theoretical gas composed of randomly moving point particles that do not interact with each other except through perfectly elastic collisions. This law provides a good approximation of the behavior of many real gases under conditions of moderate pressure and temperature.

The law mathematically relates the four macroscopic properties of a gas: pressure (P), volume (V), number of moles (n), and absolute temperature (T). The equation is universally written as:

$$PV = nRT$$

Where:

- P is the absolute pressure of the gas.
- V is the volume occupied by the gas.
- n is the amount of substance of the gas, measured in moles.
- R is the universal gas constant (approximately $8.314 \text{ J}\cdot\text{mol}^{-1}\cdot\text{K}^{-1}$).
- T is the absolute temperature of the gas, measured in Kelvin.

Final Answer : $PV=nRT$

Answer: (A)



Q17.

Solution

Concept: The physical nature of wavelength and its corresponding units of measurement.

Solution: Wavelength, denoted by the Greek letter lambda (λ), is a fundamental characteristic of a periodic wave. It is defined as the spatial period of the wave, which is the distance over which the wave's shape repeats. It can be measured as the distance between two consecutive points in the same phase, such as two adjacent crests, troughs, or zero crossings.

Since wavelength is a measure of distance or length, its standard unit in the International System of Units (SI) is the meter (m). For different types of waves, other units of length are commonly used for convenience, such as nanometers (nm) for visible light or kilometers (km) for long-wave radio, but they are all units of length.

The other options represent different physical quantities:

- 'second' is the unit of time.
- 'Hz' (Hertz) is the unit of frequency (cycles per second).
- 'Newton' is the unit of force.

Final Answer : meter

Answer: (A)

Q18. **Concept:**

The relationship between the physical properties of sound waves and their perceived characteristics.

Solution: Sound is a mechanical wave that propagates through a medium like air. Its physical properties include frequency, amplitude, and waveform. Our perception of these properties corresponds to pitch, loudness, and timbre.

Pitch is the subjective perception of how "high" or "low" a sound is. This perception is primarily determined by the frequency of the sound wave.

- **High frequency (many vibrations per second) corresponds to a high pitch (e.g., a flute's high note).**
 - **Low frequency (fewer vibrations per second) corresponds to a low pitch (e.g., a tuba's low note).**
- Frequency is measured in Hertz (Hz).**

The other physical properties relate to different perceptions:

- **Amplitude corresponds to the perceived loudness or intensity of the sound.**
- **The waveform (or harmonic content) corresponds to the timbre or quality of the sound, which allows us to distinguish between different instruments playing the same note.**

Final Answer : Frequency

Answer: (A)



Q19.

Solution

Concept: The conventions for representing electric fields using electric field lines.

Solution: Electric field lines are a visual representation used to map out the electric field in a region of space. They follow a set of conventions to show both the direction and strength of the field. The most fundamental convention concerns their direction:

The direction of the electric field line at any point is defined as the direction of the electrostatic force that a small, positive test charge would experience if placed at that point.

Following this convention:

- If a positive test charge is placed near a positive source charge, it will be repelled. Therefore, the electric field lines must point away from the positive source charge. This means that electric field lines are drawn to originate from positive charges.
- If a positive test charge is placed near a negative source charge, it will be attracted. Therefore, the electric field lines must point towards the negative source charge. This means they terminate on negative charges.

Final Answer : Positive charge

Answer: (A)



Q20.

Solution

Concept: The reference point for defining electric potential in electrostatics.

Solution: Electric potential (V) is defined as the electric potential energy per unit charge. Crucially, only differences in potential (voltage) are physically meaningful, as they determine the work done on a charge moving between two points.

To assign an absolute value of potential to a single point, a reference point must be chosen where the potential is defined to be a specific value.

For calculations involving a finite distribution of charges (charges that are contained within a specific region of space), it is standard and most convenient to choose the reference point at an infinite distance from the charge distribution. At infinity, the influence of the charges (both the electric field and the force) diminishes to zero.

Therefore, the potential at this infinitely distant reference point is universally defined to be zero.

This convention simplifies the formula for the potential of a point charge Q at a distance r to $V = kQ/r$, which represents the work done per unit charge to bring a charge from infinity to that point.

Final Answer : Zero

Answer: (A)



Q21.

Solution

Concept: Factors affecting the electrical resistance of a conductor. The resistance of a material depends on its intrinsic properties, its physical dimensions, and external conditions like temperature.

Solution: The resistance (R) of a conducting wire is given by the formula $R = \rho L/A$, where ρ (rho) is the electrical resistivity of the material, L is the length of the wire, and A is its cross-sectional area.

- **Length (L):** The formula shows that resistance is directly proportional to length ($R \propto L$). A longer wire provides a longer path for electrons to travel, leading to more collisions with the atoms of the material, thus increasing the overall resistance.
- **Temperature:** For most metallic conductors, the resistivity (ρ) increases as temperature rises. Higher temperatures cause the atoms in the conductor to vibrate more vigorously. This increased vibration makes it more difficult for free electrons to pass through, increasing the frequency of collisions and therefore increasing the resistance.

Based on these two points, resistance increases with both an increase in length and an increase in temperature. Therefore, option D correctly identifies both factors.

Final Answer : “Both A and C”

Answer: (D)

Q22.

Solution

Concept: Ohm’s Law, which describes the relationship between voltage, current, and resistance for certain materials known as ohmic conductors.

Solution: Ohm’s Law states that the current (I) flowing through a conductor is directly proportional to the voltage (V) applied across its ends, provided that the temperature and other physical conditions remain unchanged. Mathematically, this is expressed as $V \propto I$, or $V = IR$, where R is the constant of proportionality called resistance.

An ohmic conductor is any material that follows this law. For such a conductor, the resistance R is constant. If we plot a graph of Voltage (V) on the y-axis against Current (I) on the x-axis, the equation $V = RI$ takes the form of $y = mx$, which is the equation of a straight line passing through the origin with a slope equal to the resistance R . This straight-line graph is referred to as a linear V-I relation.

Final Answer : “Linear V-I relation”

Answer: (A)



Q23.

Solution

Concept: The magnetic field generated by a current-carrying circular loop of wire, as described by the Biot-Savart Law.

Solution: The magnetic field (B) at a point on the axis of a circular loop of radius R carrying a current I, at a distance x from its center, is given by the formula:

$$B = (\mu_0 I R^2) / (2(x^2 + R^2)^{3/2})$$

Here, μ_0 is the permeability of free space. To find where the magnetic field is maximum, we need to find the value of x that makes the denominator $(x^2 + R^2)^{3/2}$ minimum. The term x^2 is always non-negative ($x \geq 0$). The denominator will be at its absolute minimum when $x = 0$. This position, $x = 0$, corresponds to the center of the circular loop. At the center, the magnetic field has its maximum value $B = \mu_0 I / (2R)$.

Final Answer : “Center”

Answer: (A)

Q24.

Solution

Concept: The Lorentz force, which is the combined force exerted on a charged particle by electric and magnetic fields.

Solution: The Lorentz force describes the total force F on a point charge q moving with velocity v in the presence of an electric field E and a magnetic field B. The full equation is:

$$F = qE + q(v \times B)$$

The force has two components:

1. Electric Force ($F_e = qE$): This force acts on any charge q, whether it is moving or stationary.
2. Magnetic Force ($F_m = q(v \times B)$): This force is proportional to the charge q, its velocity v, and the magnetic field B.

Crucially, it depends on the cross product of the velocity and the magnetic field. If the charge is stationary, its velocity v is zero. When $v = 0$, the term $q(v \times B)$ becomes zero, meaning the magnetic force is zero. Therefore, a magnetic field exerts a force only on a charge that is in motion.

Final Answer : “Moving charge”

Answer: (A)



Q25.

Solution

Concept: The fundamental operating principle of an electrical transformer.

Solution: A transformer is a device used to increase or decrease AC voltages. It works based on the principle of mutual induction. Mutual induction is the phenomenon where a changing current in one coil induces an electromotive force (EMF) in a nearby coil.

A transformer consists of a primary coil and a secondary coil wound on a common laminated iron core. When an alternating voltage is applied to the primary coil, it drives an alternating current through it. This alternating current produces a continuously changing magnetic flux in the iron core. The iron core guides this changing flux through the secondary coil. According to Faraday's Law of Induction, this changing magnetic flux induces an alternating EMF (voltage) in the secondary coil. This transfer of energy from the primary coil to the secondary coil via a changing magnetic field is the essence of mutual induction.

Final Answer : "Mutual induction"

Answer: (A)



Q26.

Solution

Concept: Reactance is the opposition offered by inductors and capacitors to the flow of alternating current due to energy storage in magnetic and electric fields.

Solution: Reactance is a property of inductors and capacitors in an AC circuit. It differs from resistance because it does not dissipate energy but temporarily stores and releases it.

- **Inductive Reactance (X_L):** An inductor opposes changes in current. In an AC circuit, the continuously varying current leads to a continuous opposition. It is given by:
- **Inductive Reactance (X_L):** An inductor opposes changes in current. In an AC circuit, the continuously varying current leads to continuous opposition. It is given by:

$$X_L = 2\pi fL$$

For DC ($f = 0$), $X_L = 0$, meaning an ideal inductor offers no opposition in steady state.

- **Capacitive Reactance (X_C):** A capacitor opposes changes in voltage. In AC circuits, this results in opposition to current flow. It is given by:

$$X_C = \frac{1}{2\pi fC}$$

For DC ($f = 0$), $X_C \rightarrow \infty$, meaning an ideal capacitor blocks steady current.

Since both X_L and X_C depend on frequency and become significant only when $f \neq 0$, reactance is specifically associated with alternating current (AC).

Final Answer : “AC”

Answer: (A)



Q27.

Solution

Concept: The practical applications of microwaves, a part of the electromagnetic spectrum.

Solution: Microwaves are electromagnetic waves with frequencies between 300 MHz and 300 GHz. One of their most common household applications is in microwave ovens for cooking. The working principle is based on dielectric heating. Food contains a significant amount of water, and water molecules (HO) are polar (they have a positive and a negative end).

The microwaves generate a rapidly oscillating electric field. This field exerts a torque on the water molecules, causing them to continuously rotate to align with the field. This rapid rotation and resulting friction between molecules generate thermal energy, which heats and cooks the food efficiently.

Final Answer : “Cooking”

Answer: (A)

Q28.

Solution

Concept: The definition and standard unit for the power of an optical lens.

Solution: The power (P) of a lens is a measure of its ability to converge or diverge light. It is defined as the reciprocal of its focal length (f). A lens with a short focal length bends light rays more sharply and is considered more powerful.

The mathematical relationship is:

$$P = 1/f$$

For this formula to be used correctly, the focal length f must be expressed in meters. The corresponding SI unit for lens power is the diopter (D). One diopter is the power of a lens with a focal length of one meter ($1 \text{ D} = 1 \text{ m}^{-1}$). Convex lenses have positive power, while concave lenses have negative power.

Final Answer : “Diopter”

Answer: (A)



Q29.

Solution

Concept: The use of corrective lenses for vision defects, specifically myopia.

Solution: Myopia, commonly known as nearsightedness, is a refractive error of the eye where parallel light rays from a distant object are focused in front of the retina, instead of directly on it. This causes distant objects to appear blurry.

This condition occurs if the eyeball is too long or the eye's lens system is too powerful (converges light too strongly).

To correct myopia, a lens is needed that can diverge the incoming light rays before they enter the eye. By diverging the rays, the effective focal point is moved backward to fall precisely on the retina. A concave lens is a diverging lens. It spreads out the light, compensating for the eye's excessive convergence and allowing for a clear image of distant objects to be formed on the retina.

Final Answer : "Concave lens"

Answer: (A)

Q30.

Solution

Concept: The necessary conditions for producing a stable and observable interference pattern from waves.

Solution: Interference is a phenomenon where two or more waves superpose to form a resultant wave of greater, lower, or the same amplitude. To observe a sustained interference pattern (e.g., stable bright and dark fringes in a light experiment), the interacting waves must be coherent.

Coherence means that the wave sources must satisfy two conditions:

1. Same Frequency: The waves must have the same frequency and wavelength.
2. Constant Phase Difference: The phase difference between the waves at any point in space must remain constant over time.

If the sources are incoherent (e.g., two independent light bulbs), their phase relationship changes randomly and rapidly.

As a result, the conditions for constructive and destructive interference shift constantly, and the pattern is washed out, leading to uniform illumination. Therefore, coherent sources are essential for interference.

Final Answer : "Coherent sources"

Answer: (A)



Q31.

Solution

Concept: Interference is a wave phenomenon that occurs due to the principle of superposition, where two or more light waves combine to produce a resultant intensity distribution. For a stable and sustained interference pattern, the interfering waves must maintain a definite phase relationship.

Solution: When two light waves overlap in space, they interfere with each other. Depending on their phase difference, they produce:

- **Constructive interference** (bright fringes) when the phase difference is an integral multiple of 2π
- **Destructive interference** (dark fringes) when the phase difference is an odd multiple of π

For these bright and dark fringes to remain fixed and clearly visible, the phase difference between the waves must remain constant with time. This condition is satisfied only when the sources are **coherent**.

- **Coherent sources:** These are sources that emit light waves of the same frequency (or wavelength) and maintain a constant phase difference. Such sources produce a stable and well-defined interference pattern. In practice, coherent sources are obtained by splitting a single light source (as in Young's double-slit experiment).
- **Incoherent sources:** These sources emit waves with random and rapidly changing phase differences. As a result, the interference pattern keeps shifting and averages out, making it impossible to observe any stable fringes.
- **Single source:** A single source by itself cannot produce interference because at least two waves are required. However, a single source can be divided into two coherent sources using devices like slits or beam splitters.
- **No source:** In the absence of a source, no light waves are present, and hence interference cannot occur.

Thus, the essential requirement for observing sustained interference is the presence of **coherent sources**.

Final Answer : "Coherent sources"

Answer: (A)



Q32.

Solution

Concept: The quantum nature of light and the energy of a photon, as described by the Planck-Einstein relation. This concept is a fundamental pillar of modern physics, explaining phenomena that classical wave theory could not.

Solution: In the early 20th century, to resolve issues like the photoelectric effect, Albert Einstein proposed that light is not just a continuous wave but is also composed of discrete packets of energy called photons. The energy (E) of a single photon is directly proportional to the frequency (f) of its associated electromagnetic wave. This groundbreaking relationship is given by the equation:

$$E = hf$$

Here, 'h' is Planck's constant, a fundamental constant of nature with an approximate value of 6.626×10^{-34} joule-seconds (J·s). This equation beautifully illustrates the dual nature of light. It connects a particle property (energy of a photon, E) with a wave property (frequency, f). It implies that higher-frequency light (like blue or ultraviolet) consists of more energetic individual photons compared to lower-frequency light (like red or infrared).

Final Answer : “ hf ”

Answer: (A)

Q33.

Solution

Concept: The photoelectric effect and the definition of work function (Φ), a key parameter in understanding electron emission from materials.

Solution: The work function is a property intrinsic to a given material, representing the minimum thermodynamic work (i.e., energy) required to remove an electron from the surface of that material to a point just outside the surface with zero kinetic energy.

Electrons in a metal are held within it by electrostatic attractive forces. To be liberated from the surface, an electron must acquire enough energy to overcome this binding. In the photoelectric effect, this energy is supplied by an incident photon. According to Einstein's photoelectric equation, $K_{\text{max}} = hf - \Phi$, the maximum kinetic energy (K_{max}) of an emitted electron is the energy of the incident photon (hf) minus the work function (Φ). If the photon's energy is less than the work function ($hf < \Phi$), no electrons will be emitted, no matter how intense the light is. Thus, the work function represents the energy threshold for electron emission.

Final Answer : “Remove electron”

Answer: (A)



Q34.

Solution

Concept: The fundamental structure of an atom and the definition of atomic number (Z) which identifies a chemical element.

Solution: The atomic number, universally denoted by the symbol Z, is defined as the number of protons found in the nucleus of an atom. The number of protons is the single most important characteristic of an atom because it uniquely determines the element. For instance, any atom containing exactly 6 protons in its nucleus is an atom of carbon, any atom with 1 proton is hydrogen, and any atom with 92 protons is uranium. While the number of neutrons determines the isotope of the element and the number of electrons determines its ionic state (whether it is neutral or charged), the atomic number (proton count) is what defines the element's identity and its place in the periodic table.

Final Answer : "Protons"

Answer: (A)

Q35.

Solution

Concept: Nuclear binding energy and its direct correlation to the stability of an atomic nucleus.

Solution: The binding energy of a nucleus is the energy that would be required to completely disassemble it into its constituent protons and neutrons, collectively known as nucleons.

Conversely, it is the energy that is released when nucleons bind together to form a nucleus. This energy release is a consequence of the mass defect (the nucleus's mass is slightly less than the sum of the masses of its individual nucleons), as described by Einstein's mass-energy equivalence, $E=mc^2$. A higher binding energy per nucleon indicates that more energy is needed to pull the nucleus apart. This implies that the nucleons are held together more tightly by the strong nuclear force, making the nucleus more stable. Therefore, binding energy is the primary measure of nuclear stability.

Final Answer : "Stability"

Answer: (A)



Q36.

Solution

Concept: The operational principle of a Light Emitting Diode (LED), a semiconductor device that converts electrical energy into light energy.

Solution: An LED is fundamentally a p-n junction diode made from specific semiconductor materials. When the diode is forward-biased, an external voltage pushes majority charge carriers across the junction: electrons from the n-side move towards the p-side, and holes from the p-side move towards the n-side. When these electrons and holes meet in the depletion region near the junction, they "recombine". During this recombination event, an electron from the higher energy level (the conduction band) falls into a hole at a lower energy level (the valence band).

This transition releases energy. In certain semiconductor materials (like gallium arsenide phosphide, GaAsP), this energy is released in the form of a photon of light. The color (and hence energy) of the emitted light depends on the energy gap between the conduction and valence bands of the material. This process is called electroluminescence.

Final Answer : "Recombination"

Answer: (A)

Q37.

Solution

Concept: The construction of basic logic gates in digital electronics, specifically the NAND gate.

Solution: In digital logic, complex operations are built from simple logic gates. The NAND gate is a universal gate, meaning any other logical function can be constructed using only NAND gates. The name "NAND" is a contraction of "NOT AND", which precisely describes its function. It performs the logical AND operation followed by a logical NOT (inversion) operation.

- The AND part of the gate takes two or more inputs and produces a high output (1) only if all inputs are high.
- The NOT part (an inverter) then takes this result and flips it.

Therefore, the output of a NAND gate is low (0) only when all of its inputs are high (1); otherwise, its output is high (1). This is functionally equivalent to connecting the output of an AND gate directly to the input of a NOT gate.

Final Answer : "AND + NOT"

Answer: (A)



Q38.

Solution

Concept: The classification and mitigation of experimental errors, distinguishing between systematic and random errors.

Solution: Systematic errors are predictable, consistent errors that shift all measurements in the same direction away from the true value. They are not reduced by averaging repeated measurements. Sources include instrumental errors (like a zero error where a scale reads 0.1 kg when nothing is on it), environmental errors (like a change in room temperature affecting a material's resistance), and observational errors (like consistent parallax error). Since these errors have a definite cause, they cannot be reduced by repetition. The best way to reduce or eliminate them is to identify the source and correct it. This process is called calibration, where the measuring instrument is compared against a known, highly accurate standard, and then adjusted or its readings are corrected to match the standard.

Final Answer : “Calibration”

Answer: (A)

Q39.

Solution

Concept: Sources of observational error in measurements, specifically parallax error.

Solution: Parallax error is an observational error that occurs when the apparent position of an object changes due to a change in the line of sight of the observer. In measurements, this happens when reading a scale with a needle or indicator that is separated from the scale itself by some distance. If the observer's eye is not positioned directly perpendicular to the marking on the scale, their line of sight will be at an angle. This "wrong angle" causes the needle to appear to line up with a different mark than it actually is, leading to an inaccurate reading. To avoid this, one should always position their eye directly above the measurement mark, ensuring the line of sight is perpendicular to the scale.

Final Answer : “Wrong angle”

Answer: (A)



Q40.

Solution

Concept: The definitions of uniform motion and acceleration in kinematics.

Solution: Uniform motion describes a body moving with a constant velocity. Velocity is a vector quantity, meaning it has both magnitude (speed) and direction. For velocity to be constant, both the speed of the body and its direction of motion must remain unchanged. This implies motion in a straight line at a constant speed. Acceleration is defined as the rate of change of velocity over time ($a = \delta v / \delta t$). If the velocity is constant, then the change in velocity (δv) over any time interval is zero. Therefore, a body in uniform motion has zero acceleration. This is a direct consequence of Newton's First Law of Motion.

Final Answer : “Zero acceleration”

Answer: (A)

Q41.

Solution

Concept: Graphical analysis of motion using displacement-time (x-t) graphs.

Solution: A displacement-time graph plots the position (or displacement) of an object on the y-axis against time on the x-axis. The physical meaning of the slope of this graph is crucial. The slope is calculated as the change in the vertical axis divided by the change in the horizontal axis (slope = $\delta x / \delta t$). By definition, the average velocity of an object is the change in its displacement divided by the change in time. Therefore, the slope of the displacement-time graph represents the velocity of the object. The problem states that the graph is a straight line. A straight line has a constant slope everywhere along it. Since the slope represents velocity, a constant slope means the object has a constant velocity. This type of motion is called uniform velocity.

Final Answer : “Uniform velocity”

Answer: (A)



Q42.

Solution

Concept: Image formation by a concave spherical mirror for different object positions.

Solution: For a concave mirror, the center of curvature (C) is the center of the sphere of which the mirror is a part. A key principle of reflection from spherical mirrors is that any ray of light passing through the center of curvature will strike the mirror along a normal (i.e., perpendicular to the surface at the point of incidence). Consequently, this ray reflects back upon itself along the same path. When an object is placed at the center of curvature (C), all rays from a point on the object (e.g., its tip) will reflect from the mirror and reconverge at a corresponding point also located at C. This results in the formation of an image that is located at the same position as the object (at C). This image is real, inverted, and has the same size as the object (magnification is -1).

Final Answer : “At C”

Answer: (A)

Q43.

Solution

Concept: The calculation of equivalent capacitance for capacitors connected in a series circuit.

Solution: When capacitors are connected in series, they are connected end-to-end, forming a single path for the charge. The total charge (Q) stored on each capacitor in the series is the same. The total voltage across the combination is the sum of the individual voltages. The equivalent capacitance (C_{eq}) is given by the reciprocal formula:

$$1/C_{eq} = 1/C_1 + 1/C_2 + \dots$$

For two capacitors, C_1 and C_2 , solving for C_{eq} gives: $C_{eq} = (C_1 * C_2)/(C_1 + C_2)$.

This mathematical structure ensures that the equivalent capacitance is always smaller than the smallest individual capacitance in the series.

For example, if $C_1 = 2 \mu\text{F}$ and $C_2 = 10 \mu\text{F}$, $C_{eq} = (2 * 10) / (2 + 10) = 20 / 12 \approx 1.67 \mu\text{F}$.

This value is smaller than the smallest capacitor ($2 \mu\text{F}$). Therefore, connecting capacitors in series always decreases the total capacitance.

Final Answer : “Less than both”

Answer: (A)



Q44.

Solution

Concept: The concept of wavefronts and their shapes based on the type of wave source.

Solution: A wavefront is an imaginary surface that connects all adjacent points of a wave that are vibrating in the same phase. The shape of the wavefront is determined by the source of the wave. A point source is an idealized source that emits waves uniformly in all directions in an isotropic (uniform) three-dimensional medium. Since the waves travel outward from the source with the same speed in every direction, the locus of all points at an equal distance from the source will have the same phase. The geometric shape that satisfies this condition is a sphere.

Therefore, a point source generates spherical wavefronts that expand outwards. The figure showing concentric circles is a two-dimensional representation of these expanding spherical waves.

Final Answer : “Spherical wave”

Answer: (A)

Q45.

Solution

Concept: The behavior of a p-n junction diode under forward bias conditions.

Solution: A p-n junction has a natural depletion region with a built-in potential barrier that opposes the flow of majority charge carriers. Forward biasing involves applying an external voltage source that counteracts this barrier; the positive terminal is connected to the p-type region and the negative terminal to the n-type region. This applied external field pushes the majority carriers (holes in the p-side and electrons in the n-side) towards the junction. This reduces the width of the depletion region and lowers the potential barrier. Once the applied forward voltage becomes greater than the barrier potential (approximately 0.7 V for silicon diodes), the barrier is overcome. The diode's resistance becomes very low, allowing a large current to flow across the junction. Therefore, in forward bias, the diode acts like a closed switch, and current flows easily.

Final Answer : “Easily”

Answer: (A)



Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	A	2	B	3	B	4	A	5	A
6	A	7	A	8	A	9	A	10	C
11	A	12	A	13	A	14	C	15	A
16	A	17	A	18	A	19	A	20	A
21	D	22	A	23	A	24	A	25	A
26	A	27	A	28	A	29	A	30	A
31	A	32	A	33	A	34	A	35	A
36	A	37	A	38	A	39	A	40	A
41	A	42	A	43	A	44	A	45	A

