CUET Physics Solution 2023 June 20 Shift 3

Ques 136. Choose the correct statement: Three charges 2q, q, q are located at the vertices of an equilateral triangle. At the centroid:
1. the field is zero but the potential is non-zero
2. potential is zero but the field is non-zero
3. both field and potential are zero
4. both field and potential are non-zero

Solu. At the centroid of an equilateral triangle formed by charges of equal magnitude, the resultant electric field due to the charges will be zero because the electric fields produced by each charge will cancel out due to symmetry.

However, the potential at the centroid will not necessarily be zero. The potential due to each charge will contribute to the total potential at the centroid, and since potential is a scalar quantity, it does not cancel out as electric fields do.

Therefore, the correct statement is:

1. the field is zero but the potential is non-zero

Ques 137. The electric charges are distributed in a small volume. The flux of the electric field through a sphere of radius 10 cm surrounding the total charge is 20 Vm. The flux over a concentric sphere of radius 20 cm will be:
1. 20 Vm
2. 25 Vm
3. 40 Vm
4. 200 Vm

Solu. Here's the explanation for Gauss's Law without the extra formatting characters:

Gauss's Law states that the total electric flux passing through a closed surface is proportional to the total charge enclosed by that surface. Mathematically, it's expressed as:
Phi_E = Q_enc / epsilon_0
where:

- Phi_E is the electric flux
- Q_enc is the total charge enclosed by the surface
- epsilon_0 is the permittivity of free space

Imagine a sphere with a radius of 10 cm enclosing a total charge. If the electric flux through this sphere is 20 Vm, we can find the total enclosed charge using:
Q_enc = Phi_E * epsilon_0
Since both Phi_E (20 Vm) and epsilon_0 are constants, the total enclosed charge (Q_enc) will also be constant.
Now, consider a concentric sphere with a radius of 20 cm. Because the enclosed charge remains the same, the electric flux passing through this larger sphere will also be the same, 20 Vm.
Therefore, the correct answer is:

1. 20 Vm

Ques 140. Which of the following statements are correct?
A. Electric field lines are always perpendicular to equipotential lines.
B. A zero electric field inside a conducting sphere does not mean that the potential gradient is also zero
C. The resultant of two electric fields is determined by vector addition of the two field strengths
D. If the field lines get closer together at any place, it means that the field strength is decreasing
E. The resultant potential at a point is just the sum of the individual potentials.
Choose the correct answer from the options given below:
1. A, C and E only
2. A, B and D only
3. B, C and E only
4. A, C and D only

Solu. The correct answer is: 1. A, C and E only
Here's why each statement is true or false:

- A. Electric field lines are always perpendicular to equipotential lines. - This statement is True. Electric field lines point in the direction of the force a positive charge would experience at that point. Since no work is done moving a charge along an equipotential line (by definition, potential is constant), the electric field lines must be perpendicular to them.
- B. A zero electric field inside a conducting sphere does not mean that the potential gradient is also zero. - This statement is True. Inside a conductor, charges redistribute themselves so that the electric field cancels out. However, there can still be a potential difference between points within the conductor, meaning the potential gradient isn't necessarily zero.
- C. The resultant of two electric fields is determined by vector addition of the two field strengths. - This statement is True. Electric fields obey vector addition, meaning their combined effect is found by adding the individual vectors representing their strengths and directions.
- D. If the field lines get closer together at any place, it means that the field strength is increasing. - This statement is False. Actually, the opposite is true. When electric field lines get closer together, it indicates a stronger electric field because more lines are needed to represent the same amount of force per unit charge.
- E. The resultant potential at a point is just the sum of the individual potentials. - This statement is True. Potential is a scalar quantity, so the total potential at a point due to multiple sources is simply the sum of the individual potentials from each source.

Therefore, only statements A, C, and E are correct.

Ques 142. Two wires of copper have lengths L and 2L and cross sectional area 2A and A, respectively. The ratio of their specific resistance would be-
1.1:2
2. 1:8

3. 1:1
4. 1:4

Solu. Given:
Length of first wire (L_1) = L
Length of second wire (L_2) = 2L
Cross-sectional area of first wire (A_1) = 2A
Cross-sectional area of second wire (A_2) = A
We know that the resistance (R) of a wire is given by:
$R = (\rho * L) / A$
Therefore, the ratio of their specific resistances (R_1 and R_2) is:
$R_1 / R_2 = (L_1 / L_2) * (A_2 / A_1)$
Substituting the given values:
$R_1 / R_2 = (L / 2L) * (A / 2A) = 1/2 * 2/1 = 1$
Hence, the ratio of their specific resistances is 1:1.

Ques 143. The drift speed of electrons in a conductor is estimated to be only a few mm s^1, But on closing a circuit, how current is established almost instantly in an electric circuit?
1. Electrons are accelerated towards the positive end of the conductor while their velocity increases towards the other end
2. Drift velocity of electrons increases
3. Electric field is established throughout the circuit with the speed of an electromagnetic wave, causing at every point local electron drift causing current.
4. The electrons drift towards the negative end

Solu. The correct option is:
3. Electric field is established throughout the circuit with the speed of an electromagnetic wave, causing at every point local electron drift causing current.
When a circuit is closed, an electric field is established almost instantaneously throughout the circuit. This electric field exerts a force on the free electrons in the conductor, causing them to start moving. Although individual electrons have a slow drift velocity, the electric field propagates

through the conductor at nearly the speed of light, enabling the establishment of current almost instantly.

Ques 145. A galvanometer having a resistance of 8 Ω is shunted by a wire of resistance 2 Ω. If the current is 1 A, the part of it passing through the shunt will be:
1. 0.25 A
2.0.78 A
3.0.2 A
4.0.8 A

Solu. Given:
Resistance of galvanometer (R_g) = 8 Ω
Resistance of shunt (R_s) = 2 Ω
Total current (I) = 1 A

1. Calculate the total resistance in the circuit with the shunt:
   R_total = (R_g * R_s) / (R_g + R_s) = (8 * 2) / (8 + 2) = 1.6 Ω

2. Calculate the voltage across the shunt:
   V = I * R_total = 1 * 1.6 = 1.6 V

3. Calculate the current passing through the shunt using Ohm's law:
   I_s = V / R_s = 1.6 / 2 = 0.8 A

Therefore, the part of the current passing through the shunt is 0.8 A.

Ques 147. Ferromagnetic material core used for transformer must have
1. low permeability and low hysteresis loss
2. low permeability and high hysteresis loss
3. high permeability and low hysteresis loss
4. high permeability and high hysteresis loss

Solu. The correct option is:
3. high permeability and low hysteresis loss
In transformers, ferromagnetic materials are used as cores to enhance the magnetic coupling between the primary and secondary windings. The core material should have high permeability to allow efficient magnetic flux linkage, which helps in achieving high efficiency and reducing energy losses. Additionally, low hysteresis loss is desirable to minimize the energy dissipated as heat during each cycle of magnetization and demagnetization, ensuring the transformer operates efficiently.

Ques 148. A bar magnet when suspended horizontally and perpendicular to earth's field experiences a torque of 3 * 10 ^ - 4 * Nm The Magnetic moment of the magnet would be:
(take horizontal component of Earth's magnetic field at the place 0.4 * 10 ^ - 4 * T)
1. 7.5 JT-1
2. 5.7 JT-1
3. 0.75 JT-1
4. 0.57 JT-1

Solu. Given:
Torque experienced by the bar magnet (τ) = 3 × 10^-4 Nm
Horizontal component of Earth's magnetic field (B) = 0.4 × 10^-4 T
Using the formula for torque experienced by a magnetic dipole in a magnetic field:
τ = mB sin(θ)
Since the magnet is perpendicular to the Earth's magnetic field, θ = 90°, so sin(θ) = 1.
Now, rearranging the formula to solve for the magnetic moment (m):
m = τ / B
Substituting the given values:
m = (3 × 10^-4) / (0.4 × 10^-4)
m = 7.5 JT^-1
Therefore, the magnetic moment of the magnet would be 7.5 JT^-1.

Ques 149. Which of the following is connected to the coil of the galvanometer, to protect it from possible damages due to large current ?
1. High resistance wire in parallel
2. Low resistance wire in parallel
3. High resistance wire in series
4. Low resistance wire in series

Solu. The correct option is:

1. High resistance wire in parallel

Connecting a high resistance wire in parallel with the coil of the galvanometer creates a shunt. This shunt diverts most of the current away from the galvanometer coil, protecting it from possible damages due to large currents. The high resistance of the shunt ensures that only a small fraction of the total current passes through the galvanometer coil, allowing it to measure the desired current accurately without being damaged by excessive current flow.

Ques 150. If a copper wire carries a direct current, the magnetic field associated with the current would be:
1. Only inside the wire
2. Only outside the wire
3. Both inside and outside of the wire
4. No magnetic field would exists due to direct current

Solu. The correct option is:
3. Both inside and outside of the wire
When a current flows through a conductor like a copper wire, it creates a magnetic field around the wire according to Ampère's law. This magnetic field forms concentric circles around the wire, with the direction given by the right-hand rule (the direction of the magnetic field lines is

counterclockwise if the current is flowing towards you and clockwise if the current is flowing away from you).
So, the magnetic field associated with the current exists both inside and outside the wire.

Ques 153. The mutual inductance M12 of coil 1 with respect to coil 2:
1. depends on the current passing through the coil
2. increases when the coils are brought nearer
3. M21 of coil 2 with respect to the coil 1 is not same
4. increases when any one coil is rotated about its axis

Solu. The correct options are:

2. increases when the coils are brought nearer
4. increases when any one coil is rotated about its axis

Explanation:
1. Mutual inductance does not directly depend on the current passing through the coils; it depends on the geometry and relative positions of the coils.
2. Mutual inductance increases when the coils are brought nearer because closer proximity enhances magnetic coupling.
3. M21 represents the mutual inductance of coil 2 with respect to coil 1, and it is indeed the same as M12 if the coils are symmetrically arranged and exhibit linear coupling.
4. Mutual inductance increases when any one coil is rotated about its axis because the change in orientation affects the flux linkage between the coils, thereby altering the mutual inductance.

Ques 154. In a series LCR circuit an ac voltage source is connected. When inductor is removed from the circuit, the phase difference between the voltage and the current in the circuit is π/3. If capacitor is removed from the cirrcuit instead of inductor, the phase difference is again π/3. What is the power factor of the circuit?

1. 1/√3
2. 1/2
3.√3/2
4. 1

Solu. The power factor (PF) of an AC circuit is defined as the cosine of the phase angle (φ) between the voltage (V) and the current (I):
PF = cos(φ)
When the inductor is removed from the circuit, the phase difference (φ) between voltage and current is π/3. Similarly, when the capacitor is removed, the phase difference remains π/3.
For both cases, PF = cos(π/3) = 1/2.
So, the correct option is:
2. ½

Ques 156. What is the self inductance of a solenoid of length 50 cm, if area of cross section is 10 cm² and total number of turns is 600?
1. 1.44 * 10 ^ - 4 * H
2. 7.2 * 10 ^ - 4 * H
3. 2.88 * 10 ^ - 4 * H
4. 9.04 * 10 ^ - 4 * H

Solu. Given:
Length of solenoid (l) = 50 cm = 0.5 m
Area of cross-section (A) = 10 cm² = 10 × 10^-4 m²
Total number of turns (N) = 600
Using the formula for self-inductance of a solenoid:
L = (μ_0 * N² * A) / l
Substituting the given values:
L = (4π × 10^-7 * (600)^2 * 10 × 10^-4) / 0.5
L = (4π × 10^-7 * 600^2 * 10^-3) / 0.5
L = (4π × 36 × 10^-4 * 10^-3) / 0.5
L = (144π × 10^-7) / 0.5
L = (72π × 10^-7) / 0.25
L = (288π × 10^-7) / 1

Now, we can evaluate this expression:
L ≈ 9.04 × 10^-4 H
So, the correct option is:
4. 9.04 × 10^-4 H

Ques 157. Choose the correct statements from the following:
A. Induced emf opposes any change in the current in a circuit
B. Induced emf in a closed coil can be increased by increasing the number of turns in the coil
C. Varying current in a coil can not induce emf in a neighbouring coil.
D. An LCR circuit has zero impedance at resonant frequency
E. Average power supplied to an inductor over one complete cycle is zero
Choose the correct answer from the options given below:
1. A, C, D and E only
2. B, C and D only
3. A, B and E only
4. C, D and E only

Solu. A. Induced emf opposes any change in the current in a circuit.
True. According to Lenz's Law, the induced emf opposes any change in the current.

B. Induced emf in a closed coil can be increased by increasing the number of turns in the coil.
True. According to Faraday's law, increasing the number of turns increases the induced emf.

C. Varying current in a coil cannot induce emf in a neighboring coil.
False. According to Faraday's law, a varying current in one coil can induce emf in a neighboring coil linked by a magnetic field.

D. An LCR circuit has zero impedance at resonant frequency.
True. At resonance, inductive reactance equals capacitive reactance, resulting in zero net impedance.

E. Average power supplied to an inductor over one complete cycle is zero.
True. In an ideal inductor, energy is alternately stored and returned, resulting in zero net power over one complete cycle.

Therefore, the correct answer is:
3. A, B and E only

Ques 158. An alternating voltage V = 140 sin 100 at is connected across a pure resistor of resistance 40 2. What is the rms current through the resistor? (Take √2 = 1.4)
1.3.5 A
2. 2.5 A
3.4.9 A
4.0.1 A

Solu. Given:
Alternating voltage (V) = 140 sin(100t) V
Resistance (R) = 40 Ω
√2 = 1.4

To find the rms current (I_{rms}) through the resistor, we use the formula:
$I_{rms} = V_{rms} / R$
First, calculate the rms voltage (V_{rms}) using the formula:
$V_{rms} = V_{peak} / \sqrt{2}$
For a sinusoidal voltage, the peak voltage (V_{peak}) is the maximum value, which is the amplitude of the sine function. Here, Vpeak = 140 V.
$V_{rms} = 140 / 1.4 = 100$ V
Now, substitute Vrms and R into the formula for Irms:
Irms = 100 / 40 = 2.5 A
So, the rms current through the resistor is 2.5 A.

Ques 159. A flask contains Argon and Chlorine in the ratio of 2:1 by mass. The temperature of the mixture is 27°C. The ratio of root mean

square speed of molecules of two gases will be: (atomic mass of Argon =40 u and molecular mass of Chlorine = 71 u)
1.1.78
2. 1.33
3.2
4.1

Solu. The ratio of root mean square speeds of Argon and Chlorine molecules will be 1.33.
Explanation:
At the same temperature, the root mean square speed (v_rms) of gas molecules is inversely proportional to the square root of their mass. This can be derived from the kinetic theory of gases which states that the average kinetic energy of ideal gas molecules is directly proportional to the temperature.
Mass Ratio:

- Argon:Chlorine = 2:1

Molecular Masses:

- Argon (Ar) = 40 u
- Chlorine (Cl_2) = 71 u (Chlorine exists as a diatomic molecule)

Steps to solve:

1. Calculate the average molar mass of the mixture:
- Average molar mass = [(2 * 40) + (1 * 71)] / (2 + 1) = (80 + 71) / 3 = 50.33 u
2. Convert temperature to Kelvin:
- Temperature (K) = 27°C + 273.15 = 300.15 K
3. Calculate the root mean square speed (v_rms) for Argon and Chlorine:
- v_rms (Ar) = sqrt((3 * Boltzmann constant * Temperature) / (Ar molar mass))
- v_rms (Cl_2) = sqrt((3 * Boltzmann constant * Temperature) / (Cl_2 molar mass))

Note: Boltzmann constant (k) is a constant value (1.38 x 10^-23 J/K).

4. Calculate the ratio of v_rms (Cl_2) to v_rms (Ar):
- Ratio = v_rms (Cl_2) / v_rms (Ar)

Since the temperature and Boltzmann constant are the same for both gases, the ratio simplifies to the square root of the ratio of their molar masses.

- Ratio = sqrt(Cl_2 molar mass / Ar molar mass) = sqrt(71 u / 40 u) ≈ 1.33

Therefore, the ratio of the root mean square speeds of Chlorine and Argon molecules is approximately 1.33.

Ques 160. Which of the following statement is not true for the electromagnetic waves?
1. These waves have momentum
2. These waves travel at different speeds in vacuum depending upon their frequency
3. These waves transport energy
4. These waves travel at different speeds in a medium depending upon their frequency.

Solu. The statement that is not true for electromagnetic waves is:

2. These waves travel at different speeds in vacuum depending upon their frequency.

All electromagnetic waves in a vacuum travel at the same speed, which is the speed of light (approximately 3 x 10^8 meters per second). This speed is independent of the frequency or wavelength of the wave.
Here's why the other statements are true:

1. Electromagnetic waves have momentum: They can exert a force on objects, like in the case of solar radiation pressure on spacecraft.
2. Electromagnetic waves transport energy: This is the basic principle behind many technologies like radio waves, light, and X-rays.
3. Electromagnetic waves travel at different speeds in a medium depending upon their frequency: Light can slow down when it travels through a denser medium like water or glass. The speed change depends on the material and the frequency of the light.

Ques 161. Which one of the following cannot be polarised?
1. y-rays

2. Sound waves
3. Microwaves
4. Ultraviolet rays

Solu. Out of the given options, only sound waves cannot be polarized.
Here's the explanation:

- Polarization: It refers to the property of a wave where the vibrations occur in only one plane perpendicular to the direction of propagation.
- Transverse vs. Longitudinal Waves: Polarization applies to transverse waves where the vibrations are perpendicular to the direction of travel. Sound waves, on the other hand, are longitudinal waves where the vibrations occur in the same direction as the wave's propagation.
- Electromagnetic Waves: Microwaves, y-rays, and ultraviolet rays are all part of the electromagnetic spectrum. These are transverse waves and can be polarized.

Therefore, sound waves (option 2) cannot be polarized.

Ques 162. Choose the correct formula for magnifying power of a simple microscope from the following
1. m = 1 - d/f
2. m = 1 + d/f
3. m = 1 - f/d
4. m = 1 + f/d

Solu. The correct formula for magnifying power of a simple microscope is:
2. m = 1 + d/f
Here's why:

- m: Magnifying power of the microscope
- d: Least distance of distinct vision (usually taken as 25 cm for a young adult eye)
- f: Focal length of the objective lens

The formula essentially states that the magnifying power is achieved by adding the ability of the eye to see a close object (represented by d) to the magnifying effect of the lens (represented by 1/f). A shorter focal length (f) results in a higher magnifying power.

Ques 163. Light from a point source in air falls on spherical glass surface (n = 1.4 and radius of curvature 20 cm). The distance of light source from the glass surface is 150 cm, At what position is the image formed?

1. 150 cm from glass surface in the direction of incident light
2. 105 cm from glass surface in the direction of incident light
3. 150 cm from glass surface towards light source
4. 105 cm from glass surface towards light source

Solu. For this scenario, the image will be formed 4. 105 cm from the glass surface towards the light source.
Here's why:

- The given information describes a converging lens (convex spherical glass surface with refractive index greater than 1).
- Converging lenses tend to form real, inverted images for objects placed beyond the focal point.

We can't determine the exact solution using a simple formula due to the spherical shape of the lens. However, a technique called the lens maker's equation can be applied for such cases.
This equation relates the focal length (f) of the lens to its refractive index (n), radius of curvature (R), and the object distance (u) and image distance (v) from the lens.
However, solving for the image distance (v) in this specific case would be a complex process.
For practical purposes, we can use the concept of principal focus. A converging lens has two principal foci - one on either side of the lens. Light rays originating from a point source at one principal focus will converge to a point at the other principal focus.
Since the object (light source) is 150 cm away from the lens (with a focal length less than 150 cm), the image will be formed closer to the lens than the object. This eliminates options 1 and 3.
The remaining options (2 and 4) suggest the image is formed on the same side as the object (towards the light source). This is the correct scenario for a converging lens with an object beyond the focal point.

Therefore, based on the properties of converging lenses, the image is most likely formed 105 cm from the glass surface towards the light source (option 4).

Ques 166. A parallel beam of light of wavelength 500 nm is incident normally on a slit of width d. If the distance between slit and screen is 0.6 m and distance of second order minimum from the centre of the screen is 6.0 mm, What is the width of the slit?
1.0.1 mm
2.0.7 mm
3.0.2 mm
4. 0.5 mm

Solu. Certainly, I can help you calculate the width of the slit.
Given information:

- Wavelength of light (λ) = 500 nm = 500 x 10^-9 m
- Distance between slit and screen (L) = 0.6 m
- Distance of second-order minimum from the center (y) = 6.0 mm = 6.0 x 10^-3 m

Formula:
In single-slit diffraction, the position of the minima can be determined using the following formula:
y = nλd / L
where:

- y is the distance from the central maximum to the minimum on the screen
- n is the order of the minimum (n = 2 for the second-order minimum)
- λ is the wavelength of light
- d is the width of the slit
- L is the distance between the slit and the screen

Solving for d:

1. Rearrange the formula to isolate d:

d = yL / (nλ)

2. Plug in the known values:

d = (6.0 x 10^-3 m) * (0.6 m) / (2 * 500 x 10^-9 m)

3. Calculate the result:

d ≈ 0.000 72 m = 0.72 mm

Therefore, the width of the slit (d) is approximately 0.7 mm.

Choice: 2. 0.7 mm

Ques 167. Two polaroids P_1 and P_2 are set in crossed positions. A third polaroid P_3 is placed between the two making an angle α with the axis passing from the first polaroid P_1, In what orientation will the transmitted intensity be maximum?

1. **π/2**
2. **π/3**
3. **π/4**
4. **0**

Solu. The transmitted intensity will be maximum when the third polaroid P3 is oriented at an angle of:

3. π/4

Here's the explanation:

- Crossed Polaroids: When P1 and P2 are crossed (their polarization axes are perpendicular at 90 degrees), no light is transmitted because the light waves are blocked by P2.
- Polaroid P3: Introducing P3 allows some light to pass through depending on its orientation relative to P1 and P2.
- Malus' Law: The intensity of light transmitted through crossed polaroids follows Malus' Law:
  $I = I_0 * \cos^2\theta$
  - I: Transmitted intensity
  - I_0: Intensity of incident light
  - θ: Angle between the polarization axes of P1 and P3
- Maximizing Intensity: To achieve maximum transmitted intensity (I), we need to maximize $\cos^2\theta$. This happens when $\cos\theta$ is at its highest value, which is 1.
- Angle for Maximum Intensity: The cosine function reaches its maximum value of 1 at 0 degrees and 180 degrees. However, in the context of crossed polaroids, 0 degrees corresponds to both P1 and

P3 having their axes aligned, which wouldn't be a crossed configuration.

Therefore, for maximum intensity with crossed P1 and P2, the angle between P1 and P3 (θ) needs to be:

$\theta = \cos^{-1}(1) = 0°$

Since P1 and P2 are already at 90 degrees, P3 needs to be rotated by an angle of:

$\pi/2 - \theta = \pi/2 - 0° = \pi/2$

However, rotating P3 by π/2 is the same as rotating it by $\pi/2 + 2\pi n$ (where n is any integer) due to the periodic nature of the cosine function. So, another solution is:

$\pi/2 + \pi = 3\pi/2$

But this translates to P3 being aligned with P1, again not a crossed configuration for maximum intensity.

Therefore, considering the practicality of having P3 between crossed P1 and P2, the optimal angle for maximum transmitted intensity is:

π/4

At this angle, $\cos^2\theta = (\cos(\pi/4))^2 = (1/\sqrt{2})^2 = 1/2$, allowing for the highest possible transmitted light intensity through the system.

Ques 168. Which of the following statements are correct?

A. Number of photoelectrons emitted per second is directly proportional to the intensity of incident radiation

B. Cut off potential is the minimum negative potential given to the plate for which photocurrent becomes

maximum C. For a given frequency of the incident radiation, the stopping potential is independent of its intensity

D. Even for the exceedingly dim incident radiation apparent time lag is ~ 109s or less

E. Photons are electrically neutral and are not deflected by electric and magnetic fields

Choose the correct answer from the options given below:

1. B and D only

2. A. C. D and E only

3. A, B and E only

4. A. B. C. D and E

Solu. The correct answer is: 2. A, C, D and E only
Here's a breakdown of why each statement is true or false:
A. Number of photoelectrons emitted per second is directly proportional to the intensity of incident radiation (True)
Increasing the intensity of light (more photons) increases the number of collisions with metal electrons, leading to more photoelectrons being ejected.
B. Cut off potential is the minimum negative potential given to the plate for which photocurrent becomes maximum (False)
Cut-off potential is the minimum potential required to stop all ejected electrons from reaching the collecting plate. Photocurrent reaches its maximum value before the cut-off potential.
C. For a given frequency of incident radiation, the stopping potential is independent of its intensity (True)
The energy of an individual photon (and hence the maximum kinetic energy an electron can gain) depends only on the frequency, not the intensity of the light. Stopping potential is directly related to the maximum kinetic energy.
D. Even for the exceedingly dim incident radiation apparent time lag is ~ 10^-9s or less (True)
The photoelectric effect is an instantaneous process. Light interacts with electrons and ejects them almost instantly. The time lag is negligible (around 10^-9 seconds or less).
E. Photons are electrically neutral and are not deflected by electric and magnetic fields (True)
Photons are fundamental particles with no electric charge. They cannot be directly deflected by electric or magnetic fields.
Therefore, only statements A, C, D, and E are correct.

Ques 171. Choose the correct statements from the following:
A. The minimum energy required to free the electron from the ground state of the hydrogen atom is 13.6 J

B. The principle quantum number n labels the stationary states in the ascending order of energy
C. Bohr gave the basic idea of discrete energy levels
D. de Broglie hypothesis provided an explanation for Bohr's second postulate for the quantization of angular momentum of the orbiting electron
E. line spectrum provides useful information about the atomic structure.
Choose the correct answer from the options given below:
1. A, C, D and E only
2. A, B and D only
3. B, C, D and E only
4. A and E only

Solu. The correct statements are:
1. A, C, D and E only
Here's a breakdown of why each statement is true or false:

- A. The minimum energy required to free the electron from the ground state of the hydrogen atom is 13.6 J (True)

This is indeed the ground state energy of the hydrogen atom, known as the ionization energy.

- B. The principle quantum number n labels the stationary states in the ascending order of energy (False)

While higher principal quantum numbers (n) generally correspond to higher energy levels, the ordering isn't always strictly ascending due to sublevels within each main energy level.

- C. Bohr gave the basic idea of discrete energy levels (True)

Bohr's atomic model introduced the concept of quantized energy levels for electrons in atoms.

- D. de Broglie hypothesis provided an explanation for Bohr's second postulate for the quantization of angular momentum of the orbiting electron (True)

De Broglie's hypothesis of wave-particle duality for matter waves helped explain why electron angular momentum could only be specific quantized values in Bohr's model.

- E. Line spectrum provides useful information about the atomic structure (True)

The specific wavelengths of light emitted or absorbed by an atom (line spectrum) reveal the energy level transitions of its electrons, providing valuable information about its atomic structure.
Therefore, statements A, C, D, and E are all correct.

Ques 172. P-> n+v+ A
In this nuclear reaction A is a/an:
1. electron
2. gamma ray
3. positron
4. anti neutrino

Solu. In the nuclear reaction given:
P -> n + v + A
Here's what each symbol represents:

- P: Parent nucleus (reacting nucleus)
- n: Neutron
- v: Neutrino (antineutrino is denoted by an anti- symbol)
- A: An unknown product

Analyzing the reaction:

- A neutron (n) is produced. This eliminates option 1 (electron) as electrons are not typically products in nuclear reactions involving neutrons.
- A neutrino (v) is produced. This eliminates option 3 (positron) and 4 (antineutrino) because a neutrino and not its antiparticle is produced along with the neutron.

Therefore, based on the reaction and the conservation principles of charge and lepton number, the remaining option:
2. A is a gamma ray
is the most likely product. Gamma rays are high-energy photons emitted from the nucleus during energy level transitions. They carry no charge and have no mass, making them a suitable product in this scenario.

Ques 173. The nuclear force is:
1. independent of the nuclear charge
2. are central forces, independent of the spin of the nucleons
3. short range weak force
4. the strong forces between electron and proton bound in a nucleus

Solu. The correct statement about the nuclear force is:
2. A central force, independent of the spin of the nucleons
Here's a breakdown of why each statement is true or false:

- Independent of nuclear charge (False): The nuclear force acts between protons and neutrons, both of which have nuclear charge (protons have +1, neutrons have 0). However, the force isn't directly dependent on the charge itself.
- Central force, independent of spin (True): The nuclear force acts radially inward between the centers of nucleons, regardless of their spin orientation.
- Short-range weak force (False): The nuclear force is a strong force, acting over a very short range (femtometers) but significantly stronger than the electromagnetic force between protons. The weak force is a different fundamental force with a much longer range and governs different nuclear processes.
- Strong force between electron and proton (False): The strong force binds protons and neutrons within the nucleus. Electrons are bound to the nucleus by the electromagnetic force, not the strong force.

Ques 175. Why do light emitting diodes are preferred over conventional incandescent low power lamps?
1. High operational voltage and less power
2. Short life and ruggedness
3. The bandwidth of emitted light is 10 nm to 50 nm
4. Warm up time required

Solu. Light-emitting diodes (LEDs) are preferred over conventional incandescent low-power lamps for several reasons:

1. **High operational efficiency and less power consumption**: LEDs are highly efficient in converting electrical energy into light, resulting in lower power consumption compared to incandescent lamps. This efficiency translates to energy savings and reduced electricity costs over time.

2. **Longer lifespan and durability**: LEDs have a significantly longer operational lifespan compared to incandescent lamps. They can last tens of thousands of hours, whereas incandescent lamps typically last only a few thousand hours. Additionally, LEDs are more durable and resistant to shock and vibration, making them suitable for rugged environments.

3. **Narrow bandwidth of emitted light**: This statement is incorrect. LEDs can emit light across a wide range of wavelengths depending on the semiconductor materials used. They are available in various colors and can emit light in specific wavelengths, making them versatile for different applications. The bandwidth of emitted light is not typically restricted to 10 nm to 50 nm but can vary widely depending on the LED type.

4. **Instantaneous illumination**: Unlike incandescent lamps, which require a warm-up time to reach full brightness, LEDs provide instantaneous illumination. This feature is advantageous in applications where immediate light output is required, such as in traffic signals or emergency lighting.

Given these points, the most suitable option would be **option 1: High operational voltage and less power**, as it highlights the energy efficiency and lower power consumption characteristic of LEDs compared to incandescent lamps.

Ques 182. Two sitar stings A and B playing a note are slightly out of tune and produces beats of frequency 5 Hz. The tension in string B is slightly increased and beat frequency become 3 Hz. What is the original frequency of B if frequency of A is 427 Hz.
1. 432 Hz
2. 430 Hz

3. 424 Hz
4. 422 Hz

Solu. Here's how to solve this problem to find the original frequency of string B:
Given information:

- Frequency of string A (f_A) = 427 Hz
- Beat frequency before adjustment (f_beat1) = 5 Hz
- Beat frequency after adjustment (f_beat2) = 3 Hz

Concept:
The beat frequency (f_beat) is the absolute difference between the frequencies of the two strings (f_A and f_B).
f_beat = |f_A - f_B|
Before adjustment:
f_beat1 = |427 - f_B| = 5 Hz (Equation 1)
After adjustment:
f_beat2 = |427 - f_B (adjusted)| = 3 Hz (Equation 2)
Since increasing the tension of string B generally increases its frequency, we can infer that f_B (adjusted) is greater than f_B.
Solving for f_B:

1. Approach 1 (Using Equation 1):

- We know f_beat1 = 5 Hz and f_A = 427 Hz.
- From Equation 1: 5 = |427 - f_B|

Since f_B (adjusted) is greater than f_B, we can rewrite the absolute value as:
5 = 427 - f_B f_B = 427 - 5 = 422 Hz (This is a possible value for the original frequency of B)

2. Approach 2 (Using the change in beat frequency):

- The beat frequency decreased from 5 Hz to 3 Hz after the adjustment.
- This decrease (f_beat1 - f_beat2) represents the difference between the original frequency of B (f_B) and its adjusted frequency (f_B (adjusted)).

f_beat1 - f_beat2 = f_B - f_B (adjusted)

Since the tension increased and frequency likely increased, this difference (f_beat1 - f_beat2) is positive.
5 Hz - 3 Hz = 2 Hz
We can now use Equation 1 again, but with this difference (2 Hz) representing the change in frequency due to the adjustment:
f_beat1 = |427 - f_B| = 2 Hz
As before, since f_B (adjusted) is greater than f_B:
2 = 427 - f_B f_B = 427 - 2 = 425 Hz (This is the original frequency of B before adjustment)
Reconciling the solutions:

- Approach 1 gives f_B = 422 Hz.
- Approach 2 gives f_B = 425 Hz.

The second approach seems more logical because increasing tension typically increases frequency. Therefore, the original frequency of B (f_B) is likely closer to 425 Hz before adjustment.
However, there might be a scenario where the tension increase has a complex effect, and the frequency could potentially decrease slightly. In that case, 422 Hz (from approach 1) could be a possibility.
Considering the usual behavior of tension and frequency, the most likely answer is:
3. 424 Hz
This value is a compromise between the two possible solutions from the approaches, taking into account the expected effect of tension on frequency.

Ques 184. At what distance should an object be placed from a convex lens of focal length 15 cm to obtain a real image three times the size of the object?
1. 10 cm
2. 20 cm
3.40 cm
4.50 cm

Solu.

- Focal length of the convex lens, $f = 15$ cm
- Magnification, $M = -3$ (image three times the size of the object)

We know that magnification is given by:

$$M = -\frac{d_i}{d_o}$$

Since the image is three times the size of the object, $d_i = 3d_o$.

Substituting into the lens equation:

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

We get:

$$\frac{1}{15} = \frac{1}{d_o} + \frac{1}{3d_o}$$

$$\frac{1}{15} = \frac{1+3}{3d_o}$$

$$\frac{1}{15} = \frac{4}{3d_o}$$

Solving for d_o:

$$d_o = \frac{4\times15}{3}$$

$$d_o = \frac{60}{3}$$

$$d_o = 20\,\text{cm}$$

So, the object should be placed 20 cm away from the convex lens to obtain a real image three times the size of the object.

Therefore, the correct answer is $\boxed{2.\ 20\ \text{cm}}$.