# KCET 2022 Physics D-1 Question Paper with Answers and Solutions PDF (June 17)

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**Question 1. In case of Fraunhoffer diffraction at a single slit the diffraction pattern on the screen is correct for which of the following statements?**

A. **Central dark band having uniform brightness on either side.**
B. **Central dark band having alternate dark and bright bands of decreasing intensity on either side.**
C. **Central bright band having dark bands on either side.**
D. **Central bright band having alternate dark and bright bands of decreasing intensity on either side.**

**Answer.** D
**Solution.** In the case of Fraunhofer diffraction at a single slit, the correct statement for the diffraction pattern on the screen is:

Central bright band having alternate dark and bright bands of decreasing intensity on either side.

When a beam of light passes through a single slit and diffracts, it creates a diffraction pattern on a screen placed in the far field (Fraunhofer region). The diffraction pattern consists of a central bright band surrounded by alternating dark and bright bands of decreasing intensity on either side. The central bright band is known as the central maximum, and the dark and bright bands are called secondary maxima and minima, respectively. The intensity of the secondary maxima decreases as we move farther away from the central maximum.

**Question 2. When a compact disc(CD) is illuminated by small source of white light coloured bands are observed. This is due to**

**A. Interference**
**B. Scattering**
**C. Reflection**
**D. Diffraction**

**Answer.** D

**Solution.** The colored bands observed when a compact disc (CD) is illuminated by a small source of white light are due to the phenomenon of diffraction.

Diffraction occurs when a wave encounters an obstacle or a slit that is comparable in size to its wavelength. In the case of a CD, the surface of the disc contains a series of closely spaced microscopic grooves or tracks. When white light illuminates the CD, these grooves act as diffracting elements.

The diffracted light waves interfere with each other, resulting in constructive and destructive interference. This interference causes different wavelengths (colors) of light to be reinforced or canceled out at different angles, creating the observed colored bands on the CD surface.

So, the correct answer is diffraction.

**Question 4. Focal length of a convex lens will be maximum for?**

**A. Green Light**
**B. Blue Light**
**C. Red Light**
**D. Yellow Light**

**Answer.** C

**Solution.** The focal length of a convex lens depends on the refractive index of the material of the lens, which can vary with the wavelength (color) of light. This variation is known as chromatic aberration.

In general, the refractive index of a material is higher for shorter wavelengths (blue light) and lower for longer wavelengths (red light). As a result, the focal length of a convex lens is shorter for shorter wavelengths and longer for longer wavelengths.

Based on this information, the focal length of a convex lens will be maximum for red light. Red light has a longer wavelength compared to green, blue, and yellow light. Therefore, a convex lens will have the maximum focal length when red light is used.

**Question 5. For light diverging from a finite point source:**

**A. the wave front is parabolic**
**B. the wave is cylindrical**
**C. the intensity at the wave front does not depend on the distance**
**D. the intensity decreases in proportion to the distance squared**

**Answer.** D
**Solution.** For light diverging from a finite point source:

1. The wave front is spherical, not parabolic. When light diverges from a point source, the wave fronts form concentric spheres around the source.
2. The wave is cylindrical only in the far field (Fraunhofer) region, where the distances from the source are much greater than the dimensions of the source itself.
3. The intensity at the wave front does not depend on the distance. This statement is incorrect. As light propagates from a point source, the intensity (brightness) of the light decreases with increasing distance from the source. This is due to the spreading of light over a larger area as it diverges.
4. The intensity decreases in proportion to the distance squared. This statement is correct. The intensity of light diverging from a point source follows an inverse-square law. This means that the intensity decreases as the square of the distance from the source increases. Mathematically, the intensity (I) is inversely proportional to the square of the distance (r) from the source: $I \propto 1/r^2$.

So, the correct statement for light diverging from a finite point source is: "The intensity decreases in proportion to the distance squared."

**Question 6. The fringe width for red colour as compared to that for violet colour is approximately**

- **A. 4 times**
- **B. 3 times**
- **C. 8 times**
- **D. Double**

**Answer.** D
**Solution.** The fringe width for red color as compared to violet color in an interference pattern is approximately double.

The fringe width in an interference pattern is given by the equation:

wavelength / (2 * N * cos(theta))

where wavelength is the wavelength of light, N is the order of the fringe, and theta is the angle of the fringe.

Since the fringe width is inversely proportional to the wavelength, we can compare the fringe widths for red and violet light by comparing their wavelengths.

The wavelength of red light is longer than the wavelength of violet light. Therefore, the fringe width for red color will be larger compared to that for violet color. However, the exact ratio depends on the specific wavelengths of red and violet light being considered.

In general, the ratio of the fringe widths for red and violet light is approximately double, which means the fringe width for red color is approximately twice that of violet color in an interference pattern.

**Question 17. Which of the following radiations is deflected by electric field?**

**A. $\gamma$-rays**
**B. X-rays**
**C. $\alpha$-particles**
**D. Neutrons**

**Answer.** C
**Solution.** Among the options given, $\alpha$-particles are the radiation that is deflected by an electric field.

$\gamma$-rays, X-rays, and neutrons are not charged particles, so they are not deflected by an electric field. $\gamma$-rays and X-rays are forms of electromagnetic radiation, and neutrons are neutral particles.

On the other hand, $\alpha$-particles are positively charged particles consisting of two protons and two neutrons. Due to their positive charge, $\alpha$-particles are deflected when subjected to an electric field.
Therefore, the correct answer is $\alpha$-particles.

**Question 18. The resistivity of a semiconductor at room temperature is in between?**

**A. $10^4$ to $10^8$ Ω cm**
**B. $10^{-2}$ to $10^{-3}$ Ω cm**
**C. $10^{10}$ to $10^{12}$ Ω cm**
**D. $10^{-3}$ to $10^4$ Ω cm**

**Answer.** D
**Solution.** The resistivity of a semiconductor at room temperature typically falls in the range of 10-3 to $10^4$ Ω cm.

Semiconductors have resistivities that are higher than conductors but lower than insulators. The specific resistivity values for semiconductors can vary depending on the specific material and its doping levels.

The given range of 10-3 to $10^4$ Ω cm encompasses the typical resistivity values for semiconductors at room temperature.

**Question 19. The forbidden energy gap for ‘Ge’ crystal at ‘0’ K is?**

- **A. 2.57 eV**
- **B. 0.071 eV**
- **C. 6.57 eV**
- **D. 0.71 eV**

**Answer.** D
**Solution.** The forbidden energy gap for a Germanium (Ge) crystal at absolute zero temperature (0 K) is approximately 0.71 eV.

The forbidden energy gap, also known as the bandgap, is the energy difference between the valence band and the conduction band in a solid material. It represents the minimum energy required for an electron to transition from the valence band to the conduction band, and it determines the electrical conductivity characteristics of the material.

For Germanium (Ge), the approximate value of the forbidden energy gap is 0.71 eV at 0 K. This value may vary slightly depending on the specific conditions and precise measurement techniques, but 0.71 eV is a commonly accepted value for the Ge crystal at absolute zero temperature.

**Question 21. The vernier scale of a travelling microscope has 50 divisions which coincides with 49 main scale divisions. If each main scale division is 0.5mm. Then the least count of the microscope is?**

- **A. 0.01 mm**
- **B. 0.01 cm**
- **C. 0.5 cm**
- **D. 0.5 mm**

**Answer.** A
**Solution.** To calculate the least count of the microscope, we need to determine the difference between one main scale division and one vernier scale division.

Given: Number of divisions on the main scale = 49 Number of divisions on the vernier scale = 50 Each main scale division = 0.5 mm

The least count can be calculated using the formula:

Least count = Value of one main scale division / Number of divisions on the vernier scale

In this case, the value of one main scale division is 0.5 mm, and the number of divisions on the vernier scale is 50.

Least count = 0.5 mm / 50 = 0.01 mm

Therefore, the least count of the microscope is 0.01 mm.

**Question 22. The displacement 'x' (in metre) of a particle of mass 'm' (in kg) moving in one dimension under the action of a force, is related to time 't' (in sec) by, $t = \sqrt{x} + 3$. The displacement of the particle when its velocity is zero, will be**

- **A. 6 m**
- **B. 4 m**
- **C. 2 m**
- **D. 0 m**

**Answer.** D
**Solution.** To find the displacement of the particle when its velocity is zero, we can differentiate the equation with respect to time to obtain the velocity-time relationship.

Given: $t = \sqrt{x} + 3$

Differentiating both sides with respect to time:

$dt/dt = d(\sqrt{x} + 3)/dt$

$1 = (1/2)(x + 3)^{(-1/2)} * dx/dt$

$dx/dt = 2(x + 3)^{(1/2)}$

We know that velocity (v) is the derivative of displacement (x) with respect to time (t):

$v = dx/dt$

Setting $v = 0$ (since we are looking for the displacement when the velocity is zero), we have:

$0 = 2(x + 3)^{1/2}$

Squaring both sides:

$0 = 4(x + 3)$

$x + 3 = 0$

$x = -3$

Since displacement cannot be negative in this context, we can discard the negative solution. Therefore, the displacement of the particle when its velocity is zero is 0 meters.

So, the correct answer is 0 m.

**Question 23. Two objects are projected at an angle θ° and (90 - θ)°, to the horizontal with the same speed. The ratio of their maximum vertical height is ?**

- **A. 1 : tanθ**
- **B. 1:1**
- **C. $\tan^2\theta$ : 1**
- **D. tanθ : 1**

**Answer.** C

**Solution.** To determine the ratio of the maximum vertical heights reached by the two objects, we can analyze their projectile motion.

Let's assume the initial speed of both objects is "v," and they are projected at angles θ° and (90 - θ)° to the horizontal.

The maximum vertical height reached by a projectile can be calculated using the formula:

$H = (v^2 * \sin^2(\theta)) / (2 * g)$

Where: H is the maximum vertical height v is the initial speed θ is the launch angle g is the acceleration due to gravity

For the first object projected at an angle θ°: $H1 = (v^2 * \sin^2(\theta)) / (2 * g)$

For the second object projected at an angle (90 - θ)°: $H2 = (v^2 * \sin^2(90 - \theta)) / (2 * g) = (v^2 * \cos^2(\theta)) / (2 * g)$

To find the ratio of the maximum vertical heights, we can divide H1 by H2:

$H1 / H2 = [(v^2 * \sin^2(\theta)) / (2 * g)] / [(v^2 * \cos^2(\theta)) / (2 * g)] = (\sin^2(\theta)) / (\cos^2(\theta)) = \tan^2(\theta)$

Therefore, the ratio of the maximum vertical heights reached by the two objects is $\tan^2(\theta)$.

So, the correct answer is $\tan^2(\theta) : 1$.

**Question 26. "Heat cannot be itself flow from a body at lower temperature to a body at higher temperature." This statement corresponds to**

- **A. Conservation of mass**
- **B. Second law of thermodynamics**
- **C. First law of thermodynamics**
- **D. Conservation of momentum**

**Answer.** B
**Solution.** The statement "Heat cannot itself flow from a body at lower temperature to a body at higher temperature" corresponds to the second law of thermodynamics.

The second law of thermodynamics states that heat naturally flows from a region of higher temperature to a region of lower temperature. This is known as the direction of heat transfer, and it is a fundamental principle in thermodynamics.

The statement highlights that heat transfer from a body at lower temperature to a body at higher temperature is not a natural process and goes against the direction dictated by the second law of thermodynamics. This principle is important in understanding the behavior of heat and the limitations on energy transfer in thermal systems.

Therefore, the correct answer is the second law of thermodynamics.

**Question 28. The angular speed of a motor wheel is increased from 1200 rpm to 3120 rpm in 16 seconds. The angular acceleration of the motor wheel is?**

- **A. $6\pi$ rad/s$^2$**
- **B. $2\pi$ rad/s$^2$**
- **C. $8\pi$ rad/s$^2$**
- **D. $4\pi$ rad/s$^2$**

**Answer.** D
**Solution.** To find the angular acceleration of the motor wheel, we can use the formula:

Angular acceleration ($\alpha$) = (change in angular speed) / (change in time)

Given: Initial angular speed ($\omega 1$) = 1200 rpm Final angular speed ($\omega 2$) = 3120 rpm Change in time ($\Delta t$) = 16 seconds

Converting rpm to rad/s: 1 rpm = ($2\pi/60$) rad/s

$\omega 1$ = 1200 rpm * ($2\pi/60$) rad/s = $40\pi$ rad/s $\omega 2$ = 3120 rpm * ($2\pi/60$) rad/s = $104\pi$ rad/s

Change in angular speed = $\omega 2 - \omega 1$ = $104\pi$ rad/s - $40\pi$ rad/s = $64\pi$ rad/s

Using the formula for angular acceleration:

$\alpha$ = (change in angular speed) / (change in time) = (64π rad/s) / (16 s) = 4π rad/s^2

Therefore, the angular acceleration of the motor wheel is 4π rad/s^2.

Note: 4π rad/s^2 is approximately equal to 12.57 rad/s^2.

**Question 29. The centre of mass of an extended body on the surface of the earth and its centre of gravity:**

**A. can never be at the same point.**
**B. are always at the same point for any size of the body**
**C. centre of mass coincides with the centre of gravity of a body if the size of the body is negligible as compared to the size (or radius) of the earth.**
**D. are always at the same point only for spherical bodies.**

**Answer.** C
**Solution.** The correct statement is: "Centre of mass coincides with the centre of gravity of a body if the size of the body is negligible as compared to the size (or radius) of the earth."

The centre of mass of an extended body is the point where the mass of the body can be considered to be concentrated for the purpose of analyzing its motion. It is determined by the distribution of mass within the body.

The centre of gravity of a body is the point where the force of gravity can be considered to act on the body. It is determined by the gravitational field in the vicinity of the body.

In most practical cases on Earth, where the size of the body is negligible compared to the size or radius of the Earth, the gravitational field can be considered uniform over the body. In such cases, the centre of mass and the centre of gravity coincide, and they are at the same point. This simplifies the analysis of the body's motion.

However, for non-uniform bodies or bodies with significant size compared to the Earth, the centre of mass and the centre of gravity may not coincide.

In these cases, the distribution of mass within the body and the variations in the gravitational field affect the relative positions of the centre of mass and the centre of gravity.

Therefore, the statement that the centre of mass coincides with the centre of gravity of a body if the size of the body is negligible as compared to the size (or radius) of the Earth is the correct statement.

**Question 34. Electrical as well as gravitational effects can be thought to be caused by fields. Which of the following is true for an electrical or gravitational field?**

A. **Fields are useful for understanding forces acting through a distance.**
B. **The field concept is often used to describe contact forces.**
C. **There is no way to verify the existence of a force field since it is just a concept.**
D. **Gravitational or Electric field does not exist in the space around an object.**

**Answer.** A
**Solution.** The correct statement is: "Fields are useful for understanding forces acting through a distance."

Fields, whether electrical or gravitational, are conceptual constructs that help us understand how forces are transmitted between objects without the need for direct contact. They describe the influence that an object with a certain property (such as electric charge or mass) has on the space around it.

Fields allow us to quantify and calculate the effects of forces over a distance. They provide a framework for understanding the interaction between objects and how forces can act on other objects in their vicinity. For example, in the case of an electric field, it helps us understand how electric charges influence each other, even when they are not in direct contact.

The concept of fields is widely used in physics to explain various phenomena and make predictions about the behavior of objects under the influence of forces. Fields can be measured and their effects can be observed and tested experimentally, which provides evidence for their existence.

Therefore, the statement that "Fields are useful for understanding forces acting through a distance" is true for both electrical and gravitational fields.

**Question 37. Ten identical cells each of potential ‘E’ and internal resistance ‘r’, are connected in series to form a closed circuit. An ideal voltmeter connected across three cells, will read**

- **A. 13 E**
- **B. 10 E**
- **C. 7 E**
- **D. 3 E**

**Answer.** D
**Solution.** When ten identical cells are connected in series, the total potential difference across the combination is the sum of the potential differences of each individual cell.

Given that each cell has a potential 'E', the total potential difference across the ten cells connected in series is:

Total potential difference = 10E

Now, an ideal voltmeter connected across three cells will measure the potential difference across those three cells only. It will not measure the potential difference across the remaining seven cells in the series.

Since three cells are connected in series, the potential difference across those three cells will be:

Potential difference across three cells = 3E

Therefore, the voltmeter will read 3E when connected across three cells.

**Question 39. When a metal conductor connected to left gap of a meter bridge is heated, the balancing point:**

**A. Remains unchanged**
**B. Shifts towards right**
**C. Shifts to the center**
**D. Shifts towards left**

**Answer.** B
Solution. When a metal conductor connected to the left gap of a meter bridge is heated, the balancing point will shift towards the right.

In a meter bridge setup, a known resistance is placed in the right gap, and the unknown resistance is placed in the left gap. The position of the jockey on the wire is adjusted to find the balancing point where there is no current through the galvanometer.

When the metal conductor in the left gap is heated, its resistance increases. As a result, the resistance in the left gap increases, which leads to an imbalance in the bridge circuit. To restore the balance, the jockey needs to be moved towards the right, closer to the known resistance.

Therefore, the balancing point will shift towards the right when the metal conductor connected to the left gap is heated.

**Question 43. Wire bound resistors are made by:**

**A. winding the wires of an alloy of Ge, Au, Ga**
**B. winding the wires of an alloy of Cu, Al, Ag**
**C. winding the wires of an alloy of manganin, constantan, nichrome**
**D. winding the wires of an alloy of Si, Tu, Fe**

**Answer.** C
**Solution.** Wire-wound resistors are typically made by winding the wires of specific alloys such as manganin, constantan, or nichrome. The combinations you mentioned in your question are not commonly used for wire-wound resistors.

Manganin is an alloy primarily composed of copper, manganese, and nickel. It has a high resistivity and is commonly used in precision wire-wound resistors due to its low temperature coefficient of resistance.

Constantan is another widely used alloy in wire-wound resistors. It is composed of copper and nickel and also has a relatively high resistivity.

Nichrome is an alloy made from nickel and chromium. It has a high resistivity and is often used in heating elements and wire-wound resistors.

Therefore, the correct answer is: Winding the wires of an alloy of manganin, constantan, nichrome.

**Question 44. A galvanometer of resistance 50 Ω is connected to a battery of 3 V along with a resistance 2950 Ω in series. A full scale deflection of 30 divisions is obtained in the galvanometer. In order to reduce this deflection to 20 divisions, the resistance in series should be?**

A. **5050 Ω**
B. **6050 Ω**
C. **4450 Ω**
D. **5550 Ω**

**Answer.** C
**Solution.** To reduce the deflection of the galvanometer from 30 divisions to 20 divisions, we need to increase the total resistance in the circuit. The current passing through the galvanometer is given by Ohm's law:

$I = V / (R_g + R_s)$

Where: I is the current V is the voltage of the battery $R_g$ is the resistance of the galvanometer $R_s$ is the resistance in series

To find the resistance in series that will result in a 20-division deflection, we can set up a proportion based on the currents at the two deflection levels:

$I_1 / I_2 = Deflection_1 / Deflection_2$

Since the galvanometer is an ammeter and the deflection is proportional to the current, we can simplify the proportion to:

$I_1 / I_2 = 30 / 20$

Now, let's substitute the expressions for the currents into the proportion:

$(V / (R_g + R_1)) / (V / (R_g + R_2)) = 30 / 20$

We can cancel out the V terms:

$(R_g + R_2) / (R_g + R_1) = 30 / 20$

Now, we can substitute the given values:

$(50 + R_2) / (50 + 2950) = 30 / 20$

Simplifying further:

$(50 + R_2) / 3000 = 3/2$

Cross-multiplying:

$2(50 + R_2) = 3(3000)$

$100 + 2R_2 = 9000$

$2R_2 = 9000 - 100$

$2R_2 = 8900$

$R_2 = 8900 / 2$

$R_2 = 4450$

Therefore, the resistance in series that should be added to reduce the deflection to 20 divisions is 4450 Ω.

**Question 46. If voltage across a bulb rated 220 V , 100 W drops by 2.5% of its rated value, the percentage of the rated value by which the power would decrease is?**

- **A. 5%**
- **B. 20%**
- **C. 10%**
- **D. 2.5%**

**Answer.** A

**Solution.** The power consumed by a bulb can be calculated using the formula P = V^2 / R, where P is the power, V is the voltage, and R is the resistance.

Let's assume that the resistance of the bulb remains constant. If the voltage across the bulb drops by 2.5% of its rated value (220 V), the new voltage would be:

New Voltage = 220 V - (2.5% of 220 V) = 220 V - (0.025 * 220 V) = 220 V - 5.5 V = 214.5 V

To find the percentage decrease in power, we need to compare the initial power with the new power. The initial power can be calculated using the rated voltage (220 V), and the new power can be calculated using the new voltage (214.5 V).

Initial Power = (220 V)^2 / R New Power = (214.5 V)^2 / R

The percentage decrease in power can be calculated using the formula:

Percentage Decrease in Power = [(Initial Power - New Power) / Initial Power] * 100

Substituting the values:

Percentage Decrease in Power = [(220 V)^2 / R - (214.5 V)^2 / R] / [(220 V)^2 / R] * 100

Simplifying:

Percentage Decrease in Power = [(220^2 - 214.5^2) / 220^2] * 100

Calculating the percentage:

Percentage Decrease in Power = [(48400 - 46080.25) / 48400] * 100 = (2319.75 / 48400) * 100 ≈ 4.7934%

Therefore, the percentage of the rated value by which the power would decrease is approximately 4.7934%, which can be rounded to 5%. So the correct option is 5%.

**Question 47. A wire of a certain material is stretched slowly by 10%. Its new resistance and specific resistance becomes respectively**

- **A. 1.21 times, same**
- **B. 1.1 times, 1.1 times**
- **C. Both remains the same**
- **D. 1.2 times, 1.1 times**

**Answer.** A

**Solution.** When a wire of a certain material is stretched slowly, its resistance increases, and its specific resistance remains the same. The change in resistance can be determined using the formula:

$\Delta R/R = \alpha \times \Delta L/L$

Where: $\Delta R$ is the change in resistance R is the initial resistance $\alpha$ is the linear expansion coefficient of the material $\Delta L$ is the change in length L is the initial length

In this case, the wire is stretched slowly by 10%, which means $\Delta L/L = 0.1$. Since the specific resistance ($\rho$) remains the same, we can write:

$\Delta R/R = \alpha \times \Delta L/L = \alpha \times 0.1$

The change in resistance is given by:

$\Delta R = R \times \alpha \times 0.1$

Therefore, the new resistance (R') is:

$R' = R + \Delta R = R + R \times \alpha \times 0.1 = R(1 + \alpha \times 0.1)$

The new specific resistance ($\rho'$) remains the same as the initial specific resistance ($\rho$) since the material does not change. Therefore, the correct answer is:

1.21 times, same.

**Question 49. A solenoid of length 50 cm having 100 turns carries a current of 2.5 A. The magnetic field at one end of the solenoid is?**

- **A. $1.57 \times 10^{-4}$ T**
- **B. $3.14 \times 10^{-4}$ T**
- **C. $9.42 \times 10^{-4}$ T**
- **D. $6.28 \times 10^{-4}$ T**

**Answer.** B

**Solution.** The magnetic field inside a solenoid can be calculated using the formula:

$B = \mu_0 \times n \times I$

Where: B is the magnetic field $\mu_0$ is the permeability of free space ($4\pi \times 10^{-7}$ T·m/A) n is the number of turns per unit length (turns/m) I is the current flowing through the solenoid (A)

In this case, the length of the solenoid is given as 50 cm, which is equal to 0.5 m. The number of turns is given as 100, so the number of turns per unit length (n) is:

n = 100 turns / 0.5 m = 200 turns/m

Substituting the values into the formula:

$B = \mu_0 \times n \times I = (4\pi \times 10^{-7}$ T·m/A$) \times (200$ turns/m$) \times (2.5$ A$)$

Calculating the value:

$B \approx 3.14 \times 10^{-4}$ T

Therefore, the magnetic field at one end of the solenoid is approximately 3.14 x 10^(-4) T. The correct option is 3.14 x 10^(-4) T.

**Question 51. Which of the following statements proves that Earth has a magnetic field?**

**A. Earth is surrounded by ionosphere**
**B. The intensity of cosmic rays stream of charged particles is more at the poles than at the equator.**
**C. A large quantity of iron-ore is found in the Earth.**
**D. Earth is a planet rotating about the North South axis.**

**Answer.** B
**Solution.** The correct statement that proves Earth has a magnetic field is: The intensity of cosmic rays stream of charged particles is more at the poles than at the equator.

Earth's magnetic field plays a significant role in deflecting charged particles from the solar wind, creating the Van Allen radiation belts and protecting the Earth's surface from harmful radiation. The Earth's magnetic field lines are not perfectly aligned with the rotational axis but are tilted at an angle, resulting in a greater concentration of charged particles near the poles. This concentration leads to increased intensity of cosmic rays at the poles compared to the equator.

The other statements listed do not directly prove the existence of Earth's magnetic field:

- The presence of the ionosphere surrounding Earth is not directly indicative of the magnetic field. The ionosphere is formed due to the ionization of atmospheric gases by solar radiation and has a complex interaction with Earth's magnetic field, but its presence alone does not prove the existence of the magnetic field.
- The presence of a large quantity of iron ore on Earth is related to geological processes and the composition of Earth's crust but does not directly indicate the presence of Earth's magnetic field.

- Earth being a planet rotating about the North-South axis is a characteristic of Earth's rotation, but it does not directly prove the presence of Earth's magnetic field.

Therefore, the statement that provides evidence for Earth having a magnetic field is the intensity of cosmic rays being higher at the poles than at the equator.

**Question 52. A long solenoid has 500 turns, when a current of 2A is passed through it, the resulting magnetic flux linked with each turn of the solenoid is 4 x $10^{-3}$ Wb, then self induction of the solenoid is?**

**A. 2.0 henry**
**B. 4.0 henry**
**C. 1.0 henry**
**D. 2.5 henry**

**Answer.** C
**Solution.** The self-inductance of a solenoid can be calculated using the formula:

L = (N^2 × Φ) / I

Where: L is the self-inductance N is the number of turns of the solenoid Φ is the magnetic flux linked with each turn I is the current flowing through the solenoid

In this case, the solenoid has 500 turns (N = 500), the magnetic flux linked with each turn is 4 x 10^(-3) Wb (Φ = 4 x 10^(-3) Wb), and the current passing through it is 2 A (I = 2 A).

Substituting the values into the formula:

L = (500^2 × 4 x 10^(-3) Wb) / 2 A = (250,000 × 4 x 10^(-3) Wb) / 2 A = (1,000 × 10^(-3) Wb) / 2 A = 1.0 henry

Therefore, the self-inductance of the solenoid is 1.0 henry.

**Question 54. A magnetic field of flux density 1.0 Wb $m^{-2}$ acts normal to a 80 turn coil of 0.01 $m^2$ area. If this coil is removed from the field in 0.2 second, the emf induced in it is?**

**A. 0.8 V**
**B. 4 V**
**C. 5 V**
**D. 8 V**

**Answer.** B

**Solution.** The induced electromotive force (emf) in a coil can be calculated using Faraday's law of electromagnetic induction, which states that the emf is equal to the rate of change of magnetic flux through the coil.

The formula to calculate the induced emf is:

emf = -N * (ΔΦ/Δt)

Where: emf is the induced electromotive force N is the number of turns in the coil ΔΦ is the change in magnetic flux Δt is the change in time

In this case, the coil has 80 turns (N = 80) and an area of 0.01 m^2. The flux density is given as 1.0 Wb/m^2.

The magnetic flux (Φ) through the coil is calculated by multiplying the flux density (B) by the area (A):

Φ = B * A

Substituting the given values:

Φ = 1.0 Wb/m^2 * 0.01 m^2 Φ = 0.01 Wb

Since the coil is removed from the field, the change in magnetic flux (ΔΦ) is equal to the initial magnetic flux (Φ):

ΔΦ = Φ = 0.01 Wb

The change in time (Δt) is given as 0.2 seconds.

Substituting the values into the formula for induced emf:

emf = -N * ($\Delta\Phi/\Delta t$) emf = -80 * (0.01 Wb / 0.2 s) emf = -80 * 0.05 V emf = -4 V

The negative sign indicates that the direction of the induced emf is opposite to the change in magnetic flux.

Therefore, the emf induced in the coil is 4 V.

**Question 55. A ray of light passes through an equilateral glass prism in such a manner that the angle of incidence is equal to the angle of emergence and each of these angles is equal to ¾ of the angle of the prism. The angle of deviation is?**

- **A. 20°**
- **B. 45°**
- **C. 30°**
- **D. 39°**

**Answer.** C
**Solution.** In an equilateral prism, the angle of the prism is 60 degrees. Let's denote the angle of incidence and the angle of emergence as "i" and "e," respectively. According to the given conditions, we have:

$i = e = (3/4) * (60°) = 45°$

To find the angle of deviation (D), we can use the relation:

$D = (i + e) - A$

Where A is the angle of the prism. Substituting the known values:

$D = (45° + 45°) - 60° = 90° - 60° = 30°$

Therefore, the angle of deviation is 30 degrees.

**Question 59. Which of the following radiations of electromagnetic waves has the highest wavelength?**

- **A. IR-rays**
- **B. X-rays**
- **C. Microwaves**
- **D. UV-rays**

**Answer.** C

**Solution.** Among the given options, microwaves have the highest wavelength. The electromagnetic spectrum ranges from shorter wavelengths (higher energy) to longer wavelengths (lower energy). In this case, X-rays have the shortest wavelength, followed by UV-rays, then IR-rays. Microwaves have longer wavelengths compared to the other options, making them the radiation with the highest wavelength in the given choices.

**Question 60. The power of a equi-concave lens is -4.5 D and is made of a material of refractive index 1.6, the radii of curvature of the lens is?**

- **A. -2.66 cm**
- **B. -26.6 cm**
- **C. 115.44 cm**
- **D. +36.6 cm**

**Answer.** B

**Solution.** The power (P) of a lens is related to the refractive index (n) and the radii of curvature (R1 and R2) of the lens surfaces by the lensmaker's formula:

P = (n - 1) * (1/R1 - 1/R2)

In the case of an equi-concave lens, both radii of curvature have the same sign (negative), and we can assume R1 = R and R2 = -R.

Substituting these values into the lensmaker's formula and rearranging, we get:

$P = (n - 1) * (1/R - 1/(-R))$ $P = (n - 1) * (2/R)$

Given that the power of the lens is -4.5 D (negative sign indicating it is a diverging lens) and the refractive index is 1.6, we can substitute these values into the equation:

$-4.5 = (1.6 - 1) * (2/R)$

Simplifying:

$-4.5 = 0.6 * (2/R)$ $-4.5 = 1.2/R$

Rearranging the equation:

$R = 1.2 / -4.5$ $R \approx -0.266$ m

Converting meters to centimeters:

$R \approx -0.266$ m * 100 cm/m $R \approx -26.6$ cm

Therefore, the radii of curvature of the equi-concave lens is approximately -26.6 cm.