MHT-CET Physics Sample Paper-19

Duration: 45 Minutes **Maximum Marks: 50**

Instructions

- This paper contains a total of **50** Multiple Choice Questions.
- Each correct answer carries **+1 marks**.
- No negative marking for incorrect questions.
- Use of mobile phones, smartwatches, or any electronic gadgets is strictly prohibited.
- No marks will be deducted for questions that are left unattempted.

Q1. A hollow sphere of mass M and radius R is rotating about its diameter. A point mass M is attached to its surface. The new moment of inertia of the system about the same axis is:

(A) $\frac{2}{3}MR^2$

(B) $\frac{5}{3}MR^2$

(C) $\frac{7}{5}MR^2$

(D) $2MR^2$

Q2. The potential energy of a particle performing SHM is $U = \frac{1}{2}kx^2$. At what displacement from the mean position is the kinetic energy equal to the potential energy?

(A) $A/2$

(B) $A/\sqrt{2}$

(C) $A/4$

(D) $\sqrt{2}A$

Q3. An electric dipole consists of two opposite charges of 2×10^{-6} C separated by a distance of 3 cm. It is placed in an electric field of 2×10^5 N/C. The maximum torque on the dipole is:

(A) 1.2×10^{-2} N m

(B) 0.6×10^{-2} N m

(C) 2.4×10^{-2} N m

(D) 12×10^{-2} N m

Q4. A carbon resistor has colored bands: Yellow, Violet, Brown, and Gold. Its resistance value is:

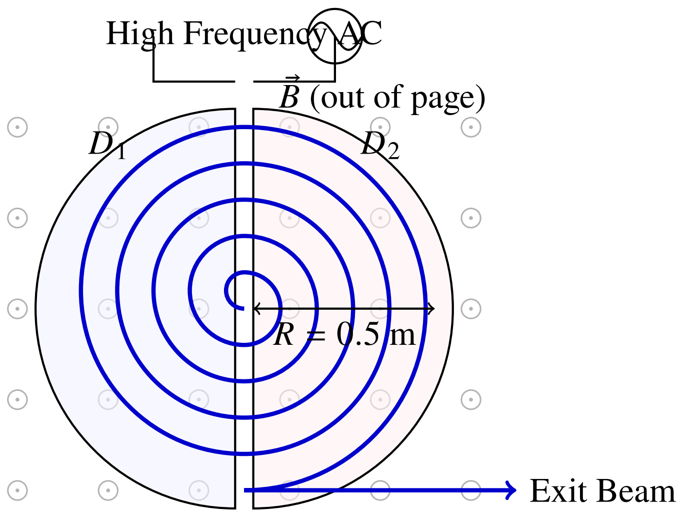
(A) $470\Omega \pm 5\%$

(B) $47\Omega \pm 10\%$

(C) $4700\Omega \pm 5\%$

(D) $570\Omega \pm 5\%$

Q5. A cyclotron is used to accelerate protons. If the magnetic field is 1.5 T and the radius of the dees is 0.5 m, the maximum kinetic energy of the protons is approximately ($m_p = 1.67 \times 10^{-27}$ kg):



(A) 28 MeV

(B) 45 MeV

(C) 18 MeV

(D) 5 MeV

Q6. A transformer has 500 turns in the primary and 1000 turns in the secondary. If a 120 V AC is applied to the primary, the output voltage is:

(A) 240 V

(B) 60 V

(C) 120 V

(D) 480 V

Q7. In a single slit diffraction experiment, the width of the central maximum is 2 mm. If the slit width is doubled and the distance to the screen is halved, the new width of the central maximum is:

(A) 1 mm

(B) 0.5 mm

(C) 2 mm

(D) 4 mm

Q8. The molar heat capacity of a gas at constant volume is $C_v = \frac{3}{2}R$. The molar heat capacity at constant pressure is:

(A) $\frac{5}{2}R$

(B) $\frac{1}{2}R$

(C) $3R$

(D) $\frac{7}{2}R$

Q9. The work function of a certain metal is 4.2 eV. The stopping potential for incident radiation of wavelength 2000 Å is:

(A) 2.0 V

(B) 1.0 V

(C) 4.2 V

(D) 6.2 V

Q10. A body of mass 2 kg is moving with a velocity of $(3\hat{i} + 4\hat{j})$ m/s. Its kinetic energy is:

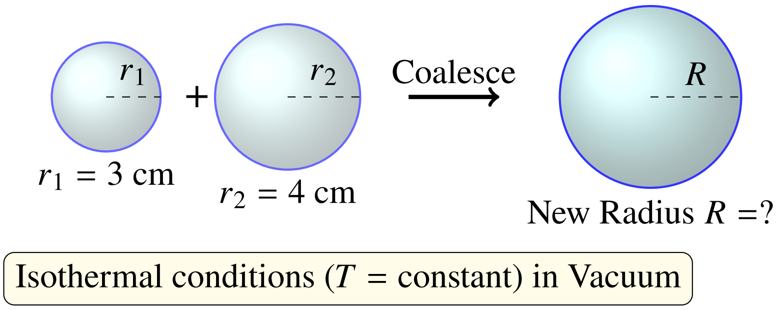
(A) 25 J

(B) 50 J

(C) 12.5 J

(D) 7 J

Q11. Two soap bubbles of radii 3 cm and 4 cm coalesce under isothermal conditions in vacuum to form a single bubble. The radius of the new bubble is:



(A) 5 cm

(B) 7 cm

(C) 3.5 cm

(D) $\sqrt{7}$ cm

Q12. The value of g at a depth d from the Earth's surface becomes $g/4$. The depth d in terms of Earth's radius R is:

(A) $3R/4$

(B) $R/4$

(C) $R/2$

(D) $R/3$

Q13. A sonometer wire of length 110 cm is divided into three segments whose fundamental frequencies are in the ratio 1 : 2 : 3. The lengths of the segments are:

(A) 60 cm, 30 cm, 20 cm

(B) 30 cm, 40 cm, 40 cm

(C) 20 cm, 30 cm, 60 cm

(D) 50 cm, 30 cm, 30 cm

Q14. A $p - n$ junction diode is reverse biased. The width of the depletion layer:

(A) Increases

(B) Decreases

(C) Remains same

(D) Becomes zero

Q15. If the error in measuring the radius of a sphere is 2%, the error in the measurement of its volume is:

(A) 2%

(B) 4%

(C) 6%

(D) 8%

Q16. The escape velocity on the surface of a planet is v_e. If the mass of the planet is doubled and its radius is halved, the new escape velocity will be:

(A) v_e

(B) $2v_e$

(C) $4v_e$

(D) $\sqrt{2}v_e$

Q17. A convex lens of focal length 20 cm is placed in contact with a concave lens of focal length 40 cm. The power of the combination is:

(A) +2.5 D

(B) −2.5 D

(C) +5.0 D

(D) −5.0 D

Q18. The magnetic field at a distance r from a long straight wire carrying current I is 0.4 T. The magnetic field at a distance $2r$ is:

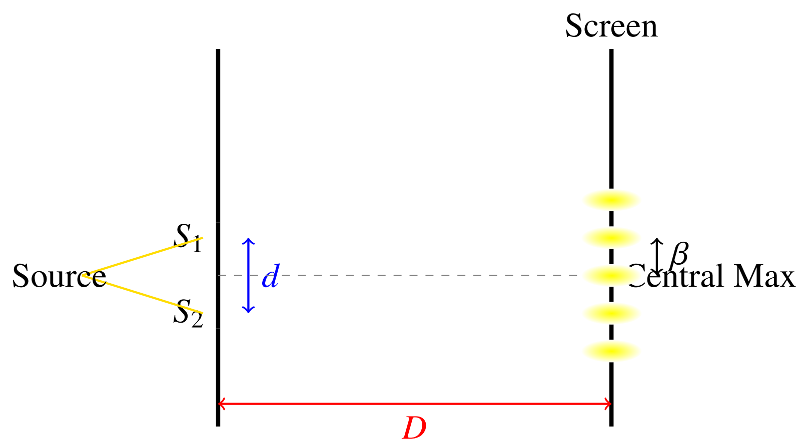
(A) 0.1 T

(B) 0.2 T

(C) 0.8 T

(D) 1.6 T

Q19. In a Young's double slit experiment, if the distance between the slits is halved and the distance between the slits and the screen is doubled, the fringe width becomes:



(A) Half

(B) Double

(C) Four times

(D) Unchanged

Q20. The ratio of the speed of an electron in the first Bohr orbit of Hydrogen to the speed of light is (where α is the fine structure constant):

(A) $1/137$

(B) 137

(C) $1/274$

(D) 1

Q21. A refrigerator works between 4°C and 30°C. The coefficient of performance (COP) is approximately:

(A) 10.6

(B) 1.15

(C) 8.5

(D) 5.4

Q22. The threshold frequency for a metal is 10^{15} Hz. When light of frequency 2×10^{15} Hz is incident, the maximum kinetic energy of photoelectrons is ($h = 6.6 \times 10^{-34}$ J s):

(A) 6.6×10^{-19} J

(B) 3.3×10^{-19} J

(C) 1.32×10^{-18} J

(D) 6.6×10^{-20} J

Q23. Which of the following properties shows that light is a transverse wave?

(A) Reflection

(B) Interference

(C) Diffraction

(D) Polarization

Q24. A capillary tube of radius r is immersed in water and water rises in it to a height h. The mass of water in the capillary tube is M. If the radius of the tube is doubled, the mass of water that will rise is:

(A) M

(B) $2M$

(C) $4M$

(D) $M/2$

Q25. The average power dissipated in a pure inductor L connected to an AC source $e = E_0 \sin \omega t$ is:

(A) $\frac{1}{2}LI_0^2$

(B) $E_{rms}I_{rms}$

(C) Zero

(D) $\frac{E_0 I_0}{\sqrt{2}}$

Q26. Two tuning forks A and B produce 4 beats/s. The frequency of A is 256 Hz. When B is loaded with wax, the beats decrease to 2 beats/s. The frequency of B is:

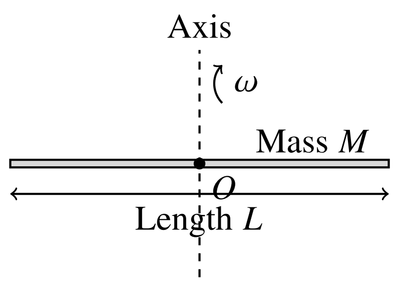
(A) 252 Hz

(B) 260 Hz

(C) 254 Hz

(D) 258 Hz

Q27. A uniform metal wire of length L and mass M is rotating with angular velocity ω about an axis passing through its center and perpendicular to its length. Its kinetic energy is: This TikZ diagram illustrates a uniform rod rotating about its center.



(A) $\frac{1}{12}ML^2\omega^2$

(B) $\frac{1}{24}ML^2\omega^2$

(C) $\frac{1}{6}ML^2\omega^2$

(D) $\frac{1}{2}ML^2\omega^2$

Q28. An ideal gas is compressed at constant temperature. Its internal energy:

(A) Increases

(B) Decreases

(C) Remains constant

(D) First increases then decreases

Q29. The SI unit of magnetic dipole moment is:

(A) A m

(B) A m^2

(C) T m/A

(D) A/m^2

Q30. In a common emitter amplifier, the input resistance is 200Ω and the load resistance is 2 kΩ. If the current gain $\beta = 50$, the voltage gain is:

(A) 500

(B) 50

(C) 100

(D) 250

Q31. The phase difference between input and output voltage in a common emitter (CE) amplifier is:

(A) 0°

(B) 90°

(C) 180°

(D) 270°

Q32. A mass M is suspended from a light spring. An additional mass m added to it displaces the spring further by distance x. The time period of oscillation of the spring-mass system is:

(A) $2\pi\sqrt{\frac{Mg}{x}}$

(B) $2\pi\sqrt{\frac{x(M+m)}{mg}}$

(C) $2\pi\sqrt{\frac{mx}{(M+m)g}}$

(D) $2\pi\sqrt{\frac{mg}{x(M+m)}}$

Q33. The ratio of magnetic induction at the center of a circular coil of radius R to that at a distance R on its axis is:

(A) $\sqrt{2} : 1$

(B) $2 : 1$

(C) $2\sqrt{2} : 1$

(D) $1 : 2\sqrt{2}$

Q34. Two droplets of mercury of each radius r coalesce to form a single drop. The ratio of the total surface energy of the two droplets to that of the single drop is:

(A) $2^{1/3} : 1$

(B) $2^{2/3} : 1$

(C) $2 : 1$

(D) $1 : 2^{1/3}$

Q35. In a meter bridge experiment, the null point is obtained at 20 cm from the left end. If the resistance in the left gap is 10Ω, the resistance in the right gap is:

(A) 40Ω

(B) 30Ω

(C) 20Ω

(D) 50Ω

Q36. The length of a second's pendulum on the surface of Earth is L. Its length on the surface of the Moon, where g is $1/6$th that of Earth, would be:

(A) $6L$

(B) $L/6$

(C) $L/36$

(D) $36L$

Q37. If the frequency of incident light is doubled, the maximum velocity of photo-electrons emitted from a metal surface will:

(A) Be doubled

(B) Be halved

(C) Increase by a factor greater than $\sqrt{2}$

(D) Increase by a factor less than $\sqrt{2}$

Q38. The energy of an electron in the n^{th} orbit of Hydrogen atom is $E_n = -13.6/n^2$ eV. The energy required to excite an electron from the ground state to the second excited state is:

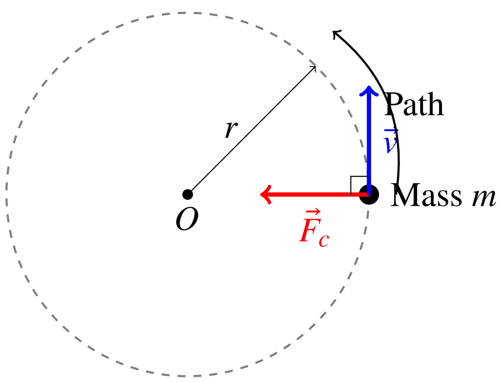
(A) 10.2 eV

(B) 12.09 eV

(C) 13.6 eV

(D) 3.4 eV

Q39. A body of mass m is moving in a circle of radius r with a constant speed v. The work done by the centripetal force in half a revolution is:



(A) mv^2

(B) $\frac{1}{2}mv^2$

(C) πr^2

(D) Zero

Q40. The refractive index of a prism is $\sqrt{2}$ and its refracting angle is $60°$. For minimum deviation, the angle of incidence is:

(A) $30°$

(B) $45°$

(C) $60°$

(D) $15°$

Q41. The Boolean expression for the output of a XOR gate with inputs A and B is:

(A) $A + B$

(B) $A \cdot B$

(C) $A\bar{B} + \bar{A}B$

(D) $\overline{A + B}$

Q42. Two spheres of same material have radii in the ratio 1 : 2. The ratio of their thermal capacities is:

(A) 1 : 2

(B) 1 : 4

(C) 1 : 8

(D) 1 : 1

Q43. In an LCR series circuit, at resonance, the phase difference between voltage and current is:

(A) $\pi/2$

(B) $\pi/4$

(C) Zero

(D) π

Q44. The intensity of radiation emitted by a black body at temperature T is I. If the temperature is doubled, the intensity becomes:

(A) $2I$

(B) $4I$

(C) $8I$

(D) $16I$

Q45. The magnetic field lines inside a current-carrying solenoid are:

(A) Circular

(B) Parabolic

(C) Straight and parallel

(D) Diverging

Q46. The displacement of a particle is given by $y = 5\sin(100t - 0.4x)$ m. The velocity of the wave is:

(A) 250 m/s

(B) 40 m/s

(C) 20 m/s

(D) 500 m/s

Q47. If the pressure of a gas is increased by 2%, the percentage decrease in its volume at constant temperature is:

(A) 2%

(B) 1%

(C) 4%

(D) 0.5%

Q48. A wire of length L and resistance R is stretched to double its length. Its new resistance will be:

(A) $2R$

(B) $4R$

(C) $R/2$

(D) $R/4$

Q49. The dimensional formula for Surface Tension is:

(A) $[M^1L^0T^{-2}]$

(B) $[M^1L^1T^{-2}]$

(C) $[M^1L^2T^{-2}]$

(D) $[M^1L^{-1}T^{-2}]$

Q50. Which of the following remains constant in a uniform circular motion?

(A) Velocity

(B) Acceleration

(C) Kinetic Energy

(D) Momentum

Detailed Solutions

Q1.

Solution

Concept:
The moment of inertia (I) of a composite system is the sum of the moments of inertia of its individual components about the same axis. For a hollow sphere of mass M and radius R about its diameter:

$$I_{sphere} = \frac{2}{3}MR^2$$

For a point mass M at a distance R from the axis:

$$I_{point} = MR^2$$

Solution:
1. The axis passes through the diameter of the hollow sphere. 2. The point mass M is attached to the surface, meaning its distance from the central axis is exactly R. 3. Total moment of inertia of the system:

$$I_{total} = I_{sphere} + I_{point}$$

$$I_{total} = \frac{2}{3}MR^2 + MR^2$$

4. Perform the addition:

$$I_{total} = \left(\frac{2}{3} + 1\right)MR^2 = \frac{5}{3}MR^2$$

Final Answer: The new moment of inertia is $\frac{5}{3}MR^2$.

Answer: (B)

Q2.

Solution

Concept:

The total energy (E) in SHM is the sum of Kinetic Energy (K) and Potential Energy (U), and it remains constant:

$$E = K + U = \frac{1}{2}kA^2$$

The potential energy at displacement x is $U = \frac{1}{2}kx^2$. We are looking for the condition $K = U$.

Solution:

1. From the energy conservation principle:

$$E = K + U$$

2. Substitute the condition $K = U$:

$$E = U + U = 2U$$

3. Substitute the expressions for E and U:

$$\frac{1}{2}kA^2 = 2\left(\frac{1}{2}kx^2\right)$$

4. Simplify the equation:

$$A^2 = 2x^2$$

5. Solve for x:

$$x^2 = \frac{A^2}{2} \implies x = \frac{A}{\sqrt{2}}$$

Final Answer: The displacement is $A/\sqrt{2}$.

Answer: (B)

Q3.

Solution

Concept:

The torque (τ) experienced by an electric dipole in a uniform electric field is given by:

$$\tau = pE \sin\theta$$

where p is the dipole moment ($p = q \times 2l$) and E is the electric field strength. The torque is maximum when the dipole is perpendicular to the field ($\theta = 90°$).

Solution:

1. Calculate the dipole moment (p): $q = 2 \times 10^{-6}$ C Separation $2l = 3$ cm $= 0.03$ m

$$p = (2 \times 10^{-6}) \times 0.03 = 0.06 \times 10^{-6} = 6 \times 10^{-8} \text{ C m}$$

2. Maximum torque occurs at $\sin(90°) = 1$:

$$\tau_{max} = p \times E$$

3. Substitute the values:

$$\tau_{max} = (6 \times 10^{-8}) \times (2 \times 10^{5})$$

4. Calculate the result:

$$\tau_{max} = 12 \times 10^{-3} = 1.2 \times 10^{-2} \text{ N m}$$

Final Answer: The maximum torque is 1.2×10^{-2} N m.

Answer: (A)

Q4.

Solution

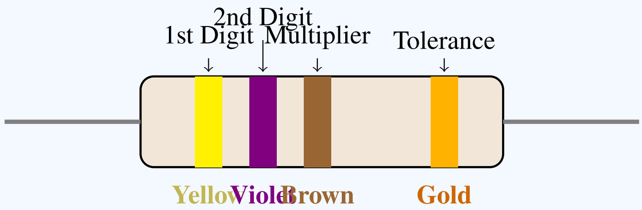
Concept:

The value of a carbon resistor is determined by a standard color code: Black (0), Brown (1), Red (2), Orange (3), Yellow (4), Green (5), Blue (6), Violet (7), Gray (8), White (9). The first two bands represent the digits, the third band is the multiplier (10^n), and the fourth band is the tolerance (Gold: 5%, Silver: 10%).

Solution:

1. First band (Yellow): 4 2. Second band (Violet): 7 3. Third band (Brown): Multiplier 10^1 4. Fourth band (Gold): Tolerance ±5% 5. Combine the values:

$$R = 47 \times 10^1 \Omega \pm 5\% = 470\Omega \pm 5\%$$



Final Answer: The resistance is $470\Omega \pm 5\%$.

Answer: (A)

Q5.

Solution

Concept:

The maximum velocity (v_{max}) of a particle in a cyclotron is achieved at the maximum radius (R) of the dees:

$$v_{max} = \frac{qBR}{m}$$

The maximum kinetic energy is:

$$K.E._{max} = \frac{1}{2}mv_{max}^2 = \frac{q^2B^2R^2}{2m}$$

Solution:

1. Identify parameters for a proton: $q = 1.6 \times 10^{-19}$ C, $m = 1.67 \times 10^{-27}$ kg. 2. Given: $B = 1.5$ T, $R = 0.5$ m. 3. Calculate energy in Joules:

$$K.E. = \frac{(1.6 \times 10^{-19})^2 \times (1.5)^2 \times (0.5)^2}{2 \times 1.67 \times 10^{-27}}$$

$$K.E. \approx \frac{2.56 \times 10^{-38} \times 2.25 \times 0.25}{3.34 \times 10^{-27}} \approx 4.31 \times 10^{-13} \text{ J}$$

4. Convert to MeV (1 MeV $= 1.6 \times 10^{-13}$ J):

$$K.E.\,(\text{MeV}) = \frac{4.31 \times 10^{-13}}{1.6 \times 10^{-13}} \approx 27 - 28 \text{ MeV}$$

Final Answer: The maximum kinetic energy is approximately 28 MeV.

Answer: (A)

Q6.

Solution

Concept:

An ideal transformer works on the principle of mutual induction. The ratio of the secondary voltage (V_s) to the primary voltage (V_p) is equal to the ratio of the number of turns in the secondary (N_s) to the number of turns in the primary (N_p):

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

Solution:

1. Identify given values: $N_p = 500$, $N_s = 1000$, and $V_p = 120$ V. 2. Arrange the formula to solve for V_s:

$$V_s = V_p \times \left(\frac{N_s}{N_p}\right)$$

3. Substitute the values:

$$V_s = 120 \times \left(\frac{1000}{500}\right)$$

4. Since the turns ratio is 2 (a step-up transformer):

$$V_s = 120 \times 2 = 240 \text{ V}$$

Final Answer: The output voltage is 240 V.

Answer: (A)

Q7.

Solution

Concept:

In a single slit diffraction experiment, the width of the central maximum (W) is given by the formula:

$$W = \frac{2\lambda D}{d}$$

where λ is the wavelength, D is the distance from the slit to the screen, and d is the width of the slit.

Solution:

1. Let the initial width be $W_1 = \frac{2\lambda D}{d} = 2$ mm. 2. According to the problem, the new slit width is $d' = 2d$ and the new distance is $D' = D/2$. 3. The new width of the central maximum W_2 is:

$$W_2 = \frac{2\lambda(D/2)}{(2d)}$$

4. Simplify the expression:

$$W_2 = \frac{1}{4} \times \left(\frac{2\lambda D}{d}\right)$$

5. Substitute W_1:

$$W_2 = \frac{1}{4} \times 2 \text{ mm} = 0.5 \text{ mm}$$

Final Answer: The new width of the central maximum is 0.5 mm.

Answer: (B)

Q8.

Solution

Concept:

Mayer's Relation for an ideal gas relates the molar heat capacity at constant pressure (C_p) and the molar heat capacity at constant volume (C_v):

$$C_p - C_v = R$$

where R is the universal gas constant.

Solution:

1. Given $C_v = \frac{3}{2}R$ (which corresponds to a monatomic gas). 2. Use Mayer's Relation to find C_p:

$$C_p = C_v + R$$

3. Substitute the value of C_v:

$$C_p = \frac{3}{2}R + R$$

4. Combine the terms:

$$C_p = \left(\frac{3}{2} + 1\right) R = \frac{5}{2}R$$

Final Answer: The molar heat capacity at constant pressure is $\frac{5}{2}R$.

Answer: (A)

Q9.

Solution

Concept:

Einstein's photoelectric equation relates the energy of the incident photon (E), the work function of the metal (ϕ_0), and the stopping potential (V_0):

$$eV_0 = E - \phi_0$$

where $E = \frac{hc}{\lambda}$. Using the approximation $hc \approx 12400$ eV Å, we can find E in eV.

Solution:

1. Calculate the energy of the incident photon (E):

$$E = \frac{12400}{2000\text{ Å}} = 6.2\text{ eV}$$

2. Use the given work function $\phi_0 = 4.2$ eV:

$$eV_0 = 6.2\text{ eV} - 4.2\text{ eV} = 2.0\text{ eV}$$

3. The stopping potential V_0 is the voltage value:

$$V_0 = 2.0\text{ V}$$

Final Answer: The stopping potential is 2.0 V.

Answer: (A)

Q10.

Solution

Concept:

Kinetic energy ($K.E.$) is a scalar quantity given by:

$$K.E. = \frac{1}{2}mv^2$$

where v is the speed (magnitude of the velocity vector). For a velocity vector $\vec{v} = x\hat{i} + y\hat{j}$, the speed squared is $v^2 = x^2 + y^2$.

Solution:

1. Calculate the square of the speed v^2 from the velocity vector $\vec{v} = 3\hat{i} + 4\hat{j}$:

$$v^2 = 3^2 + 4^2 = 9 + 16 = 25$$

2. Given mass $m = 2$ kg, substitute into the kinetic energy formula:

$$K.E. = \frac{1}{2} \times 2 \times 25$$

3. Simplify:

$$K.E. = 25 \text{ J}$$

Final Answer: The kinetic energy is 25 J.

Answer: (A)

Q11.

Solution

Concept:
When two soap bubbles coalesce under isothermal conditions in a vacuum, the total surface area is not conserved, but the total energy (which is proportional to the surface area in this context) or the balance of internal pressure and volume work leads to the relation:

$$R^2 = r_1^2 + r_2^2$$

where R is the radius of the new bubble, and r_1, r_2 are the radii of the original bubbles.
Solution:
1. Given $r_1 = 3$ cm and $r_2 = 4$ cm. 2. Apply the relation for isothermal coalescence in vacuum:

$$R^2 = 3^2 + 4^2$$

3. Calculate the squares:

$$R^2 = 9 + 16 = 25$$

4. Take the square root:

$$R = \sqrt{25} = 5 \text{ cm}$$

Final Answer: The radius of the new bubble is 5 cm.

Answer: (A)

Q12.

Solution

Concept:
The acceleration due to gravity at a depth d below the Earth's surface is given by:

$$g_d = g\left(1 - \frac{d}{R}\right)$$

where g is the acceleration at the surface and R is the radius of the Earth.

Solution:
1. According to the problem, $g_d = g/4$. 2. Substitute this into the formula:

$$\frac{g}{4} = g\left(1 - \frac{d}{R}\right)$$

3. Cancel g from both sides:

$$\frac{1}{4} = 1 - \frac{d}{R}$$

4. Rearrange to solve for d/R:

$$\frac{d}{R} = 1 - \frac{1}{4} = \frac{3}{4}$$

5. Therefore:

$$d = \frac{3R}{4}$$

Final Answer: The depth d is $3R/4$.

Answer: (A)

Q13.

Solution

Concept:

The fundamental frequency (f) of a stretched string is inversely proportional to its length (l):

$$f \propto \frac{1}{l} \implies f_1 l_1 = f_2 l_2 = f_3 l_3 = k$$

where k is a constant.

Solution:

1. Total length $L = l_1 + l_2 + l_3 = 110$ cm. 2. Given frequency ratio $f_1 : f_2 : f_3 = 1 : 2 : 3$. 3. Since $l \propto 1/f$, the ratio of lengths is:

$$l_1 : l_2 : l_3 = \frac{1}{1} : \frac{1}{2} : \frac{1}{3}$$

4. Multiply by the LCM (6) to get whole numbers:

$$l_1 : l_2 : l_3 = 6 : 3 : 2$$

5. Calculate individual lengths: Sum of ratios $= 6 + 3 + 2 = 11$. $l_1 = (6/11) \times 110 = 60$ cm $l_2 = (3/11) \times 110 = 30$ cm $l_3 = (2/11) \times 110 = 20$ cm

Final Answer: The lengths are 60 cm, 30 cm, and 20 cm.

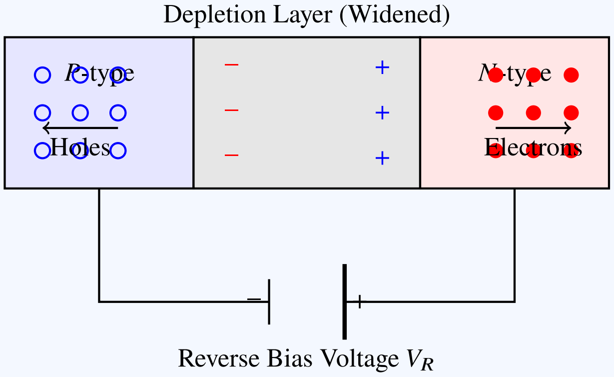
Answer: (A)

Q14.

Solution

Concept:
In a $p - n$ junction diode, the depletion layer consists of immobile ions. - In **forward bias**, the majority carriers are pushed toward the junction, reducing the width. - In **reverse bias**, the majority carriers are pulled away from the junction, leaving behind more immobile ions.

Solution:
1. During reverse biasing, the positive terminal of the battery is connected to the n-side and the negative terminal to the p-side. 2. Holes in the p-region and electrons in the n-region move away from the junction. 3. This increases the region depleted of mobile charge carriers. 4. Consequently, the width of the depletion layer increases.



Final Answer: The width of the depletion layer increases.

Answer: (A)

Q15.

Solution

Concept:
For a quantity calculated using a power formula, like the volume of a sphere $V = \frac{4}{3}\pi r^3$, the relative error is given by the power multiplied by the relative error of the base variable.

$$\frac{\Delta V}{V} = 3\frac{\Delta r}{r}$$

Solution:
1. The percentage error in volume is $3 \times$ (percentage error in radius). 2. Given error in radius $\frac{\Delta r}{r} \times 100 = 2\%$. 3. Percentage error in volume:

$$\% \text{ Error in } V = 3 \times 2\% = 6\%$$

Final Answer: The error in the measurement of volume is 6%.

Answer: (C)

Q16.

Solution

Concept: The escape velocity (v_e) from the surface of a planet is given by:

$$v_e = \sqrt{\frac{2GM}{R}}$$

where M is the mass and R is the radius.

Solution: 1. New mass $M' = 2M$ and new radius $R' = R/2$. 2. New escape velocity v'_e:

$$v'_e = \sqrt{\frac{2G(2M)}{R/2}} = \sqrt{\frac{8GM}{R}}$$

3. Comparing with original v_e:

$$v'_e = \sqrt{4 \times \frac{2GM}{R}} = 2 \times \sqrt{\frac{2GM}{R}} = 2v_e$$

Final Answer: The new escape velocity will be $2v_e$.

Answer: (B)

Q17.

Solution

Concept: The power of a lens is $P = 1/f$ (where f is in meters). For a combination of lenses in contact:

$$P_{total} = P_1 + P_2 = \frac{1}{f_1} + \frac{1}{f_2}$$

Convex lens focal length is positive; concave lens focal length is negative.

Solution: 1. $f_1 = +20\text{ cm} = +0.2\text{ m} \implies P_1 = 1/0.2 = +5\text{ D}$. 2. $f_2 = -40\text{ cm} = -0.4\text{ m} \implies P_2 = 1/(-0.4) = -2.5\text{ D}$. 3. $P_{total} = +5 + (-2.5) = +2.5\text{ D}$.

Final Answer: The power of the combination is +2.5 D.

Answer: (A)

Q18.

Solution

Concept: The magnetic field (B) due to a long straight wire is inversely proportional to the distance (r):

$$B = \frac{\mu_0 I}{2\pi r} \implies B \propto \frac{1}{r}$$

Solution: 1. Initial field $B_1 = 0.4\text{ T}$ at distance r. 2. New distance $r' = 2r$. 3. New field $B_2 = B_1 \times (r/2r) = 0.4/2 = 0.2\text{ T}$.

Final Answer: The magnetic field at $2r$ is 0.2 T.

Answer: (B)

Q19.

Solution

Concept: Fringe width (β) in YDSE is given by:

$$\beta = \frac{\lambda D}{d}$$

where D is the distance to the screen and d is the slit separation.

Solution: 1. New separation $d' = d/2$ and new distance $D' = 2D$. 2. New fringe width β':

$$\beta' = \frac{\lambda(2D)}{(d/2)} = 4 \times \frac{\lambda D}{d} = 4\beta$$

Final Answer: The fringe width becomes four times.

Answer: (C)

Q20.

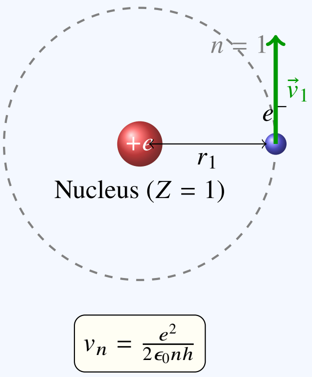
Solution

Concept: The velocity of an electron in the n^{th} Bohr orbit is $v_n = \frac{e^2}{2\epsilon_0 nh}$. For $n = 1$, v_1/c is defined as the fine structure constant ($\alpha \approx 1/137$).

Solution: 1. In the first orbit of Hydrogen ($n = 1$):

$$\frac{v_1}{c} = \alpha$$

2. The value of α is approximately $1/137$.



Final Answer: The ratio is $1/137$.

Answer: (A)

Q21.

Solution

Concept:
The Coefficient of Performance (COP) of a refrigerator is the ratio of the heat removed from the cold reservoir (Q_2) to the work input (W). For an ideal (Carnot) refrigerator:

$$\text{COP} = \frac{T_2}{T_1 - T_2}$$

where T_1 is the temperature of the hot reservoir and T_2 is the temperature of the cold reservoir (both in Kelvin).

Solution:
1. Convert temperatures to Kelvin: $T_2 = 4 + 273 = 277$ K (Cold) $T_1 = 30 + 273 = 303$ K (Hot) 2. Apply the COP formula:

$$\text{COP} = \frac{277}{303 - 277}$$

3. Calculate the difference:

$$\text{COP} = \frac{277}{26} \approx 10.65$$

4. The closest value provided is 10.6.
Final Answer: The COP is approximately 10.6.

Answer: (A)

Q22.

Solution

Concept:
According to Einstein's photoelectric equation, the maximum kinetic energy (K_{max}) of emitted electrons is:

$$K_{max} = h\nu - h\nu_0 = h(\nu - \nu_0)$$

where ν is the incident frequency and ν_0 is the threshold frequency.
Solution:
1. Given $\nu = 2 \times 10^{15}$ Hz, $\nu_0 = 10^{15}$ Hz, and $h = 6.6 \times 10^{-34}$ J s. 2. Calculate the difference in frequency:

$$\Delta\nu = (2 \times 10^{15} - 1 \times 10^{15}) = 10^{15} \text{ Hz}$$

3. Calculate the kinetic energy:

$$K_{max} = (6.6 \times 10^{-34}) \times (10^{15})$$

$$K_{max} = 6.6 \times 10^{-19} \text{ J}$$

Final Answer: The maximum kinetic energy is 6.6×10^{-19} J.

Answer: (A)

Q23.

Solution

Concept:
Polarization is a phenomenon exclusive to transverse waves. In a transverse wave, the oscillations are perpendicular to the direction of propagation. A polarizer can restrict these oscillations to a single plane. Longitudinal waves (like sound) cannot be polarized because their oscillations are parallel to the direction of travel.
Solution:
1. Reflection, interference, and diffraction are properties exhibited by both transverse and longitudinal waves. 2. Polarization can only occur if the wave has a specific orientation perpendicular to the direction of travel. 3. Therefore, the fact that light can be polarized is the definitive proof that light is a transverse wave.
Final Answer: Polarization shows that light is a transverse wave.

Answer: (D)

Q24.

Solution

Concept:
The height of liquid rise in a capillary is $h \propto 1/r$. The mass of the liquid in the column is $M = \text{Volume} \times \text{Density} = (\pi r^2 h) \times \rho$. Substituting $h \propto 1/r$, we find $M \propto r^2 \times (1/r) \implies M \propto r$.
Solution:
1. Initially, mass M rises in a tube of radius r. 2. Since $M \propto r$, if the radius is doubled ($r' = 2r$):

$$M' = 2M$$

3. Even though the height h halves, the cross-sectional area increases fourfold, leading to a net doubling of the mass.
Final Answer: The mass of water that will rise is $2M$.

Answer: (B)

Q25.

Solution

Concept:
In an AC circuit containing only a pure inductor, the current lags the voltage by a phase angle of $\phi = \pi/2$ (90°). The average power dissipated (P_{avg}) is given by:

$$P_{avg} = E_{rms} I_{rms} \cos\phi$$

The term $\cos\phi$ is called the power factor.
Solution:
1. For a pure inductor, the phase difference $\phi = 90°$. 2. The power factor $\cos(90°) = 0$. 3. Therefore, $P_{avg} = E_{rms} I_{rms} \times 0 = 0$. 4. A pure inductor (and a pure capacitor) is a "wattless" component in an AC circuit.
Final Answer: The average power dissipated is zero.

Answer: (C)

Q26.

Solution

Concept:
When two tuning forks produce beats, the beat frequency is the difference between their individual frequencies ($n_b = |f_A - f_B|$). Loading a fork with wax **decreases** its frequency. We must analyze how this decrease affects the beat count to determine the original frequency.
Solution:
1. Frequency of A (f_A) = 256 Hz. Beats = 4/s. 2. Possible frequencies for B (f_B) are $256 + 4 = 260$ Hz or $256 - 4 = 252$ Hz. 3. When B is loaded with wax, f_B decreases. - If f_B was 260 Hz: Decreasing it (e.g., to 258 Hz) makes it closer to 256, so beats decrease ($4 \rightarrow 2$). This matches the problem. - If f_B was 252 Hz: Decreasing it (e.g., to 250 Hz) makes it further from 256, so beats would increase ($4 \rightarrow 6$). This contradicts the problem. 4. Therefore, the original frequency of B must be 260 Hz.
Final Answer: The frequency of B is 260 Hz.

Answer: (B)

Q27.

Solution

Concept:

The rotational kinetic energy ($K.E._{rot}$) of a body is given by:

$$K.E._{rot} = \frac{1}{2}I\omega^2$$

where I is the moment of inertia and ω is the angular velocity. For a thin rod of mass M and length L rotating about its center:

$$I = \frac{1}{12}ML^2$$

Solution:

1. Identify the moment of inertia for the given axis: $I = \frac{1}{12}ML^2$. 2. Substitute I into the kinetic energy formula:

$$K.E. = \frac{1}{2} \times \left(\frac{1}{12}ML^2\right) \times \omega^2$$

3. Simplify the coefficients:

$$K.E. = \frac{1}{24}ML^2\omega^2$$

Final Answer: The kinetic energy is $\frac{1}{24}ML^2\omega^2$.

Answer: (B)

Q28.

Solution

Concept:

The internal energy (U) of an **ideal gas** depends solely on its absolute temperature (T). This is expressed as $U = f(T)$. In an isothermal process, the temperature remains constant by definition ($\Delta T = 0$).

Solution:

1. Compression at constant temperature is an isothermal process. 2. Since the gas is "ideal," there are no intermolecular forces of attraction, so internal energy does not change with volume or pressure changes. 3. Because T is constant, the average kinetic energy of the molecules remains constant. 4. Thus, the internal energy remains constant.

Final Answer: The internal energy remains constant.

Answer: (C)

Q29.

Solution

Concept:
The magnetic dipole moment ($\vec{m}$) of a current-carrying loop is defined as the product of the current (I) and the area of the loop ($\vec{A}$):

$$m = I \times A$$

Solution:
1. The unit for current (I) is Ampere (A). 2. The unit for area (A) is square meter (m^2). 3. Multiplying them gives the unit for magnetic dipole moment:

$$\text{Unit} = \text{A} \cdot \text{m}^2$$

Final Answer: The SI unit is A m^2.

Answer: (B)

Q30.

Solution

Concept:
The voltage gain (A_v) of a transistor amplifier in common emitter configuration is given by the product of the current gain (β) and the resistance gain (R_{out}/R_{in}):

$$A_v = \beta \times \frac{R_L}{R_i}$$

Solution:
1. Given: $\beta = 50$, $R_i = 200\Omega$, and $R_L = 2\text{ k}\Omega = 2000\Omega$. 2. Substitute the values into the formula:

$$A_v = 50 \times \frac{2000}{200}$$

3. Simplify the resistance ratio:

$$A_v = 50 \times 10 = 500$$

Final Answer: The voltage gain is 500.

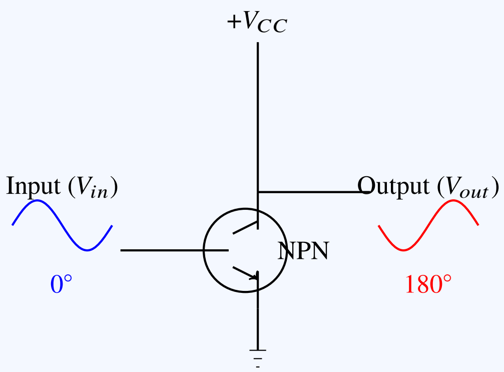
Answer: (A)

Q31.

Solution

Concept: In a Common Emitter (CE) amplifier, an increase in input base current leads to an increase in collector current. This causes a larger voltage drop across the load resistor (R_C), which in turn decreases the output collector-emitter voltage (V_{CE}).

Solution: 1. When the input signal goes positive, the output signal goes negative. 2. This indicates that the input and output signals are exactly out of phase. 3. The phase difference between the input voltage and output voltage in a CE amplifier is 180° (or π radians).



Final Answer: The phase difference is 180°.

Answer: (C)

Q32.

Solution

Concept: The time period of a spring-mass system is $T = 2\pi\sqrt{M_{total}/k}$. The spring constant k can be determined by the force required to produce a specific displacement: $F = kx$.

Solution: 1. When mass m is added, it exerts an additional force $F = mg$. 2. This force produces displacement x, so $mg = kx \implies k = mg/x$. 3. The total mass oscillating is $(M + m)$. 4. Substitute M_{total} and k into the period formula:

$$T = 2\pi\sqrt{\frac{M + m}{mg/x}} = 2\pi\sqrt{\frac{x(M + m)}{mg}}$$

Final Answer: The time period is $2\pi\sqrt{\frac{x(M+m)}{mg}}$.

Answer: (B)

Q33.

Solution

Concept: The magnetic field at the center of a coil is $B_c = \frac{\mu_0 n I}{2R}$. The magnetic field on the axis at distance x is $B_a = \frac{\mu_0 n I R^2}{2(R^2+x^2)^{3/2}}$.
Solution: 1. At $x = R$:

$$B_a = \frac{\mu_0 n I R^2}{2(R^2 + R^2)^{3/2}} = \frac{\mu_0 n I R^2}{2(2R^2)^{3/2}} = \frac{\mu_0 n I R^2}{2(2\sqrt{2}R^3)} = \frac{\mu_0 n I}{4\sqrt{2}R}$$

2. Ratio B_c/B_a:

$$\frac{B_c}{B_a} = \frac{\frac{\mu_0 n I}{2R}}{\frac{\mu_0 n I}{4\sqrt{2}R}} = \frac{4\sqrt{2}}{2} = 2\sqrt{2}$$

Final Answer: The ratio is $2\sqrt{2} : 1$.

Answer: (C)

Q34.

Solution

Concept: Surface energy $E = T \times A$ (Surface Tension $\times$ Area). When droplets coalesce, volume is conserved: $2 \times \frac{4}{3}\pi r^3 = \frac{4}{3}\pi R^3 \implies R = 2^{1/3} r$.
Solution: 1. Initial Area $A_i = 2 \times (4\pi r^2) = 8\pi r^2$. 2. Final Area $A_f = 4\pi R^2 = 4\pi(2^{1/3} r)^2 = 4\pi(2^{2/3})r^2$. 3. Ratio of initial energy to final energy (A_i/A_f):

$$\frac{8\pi r^2}{4\pi \cdot 2^{2/3} r^2} = \frac{2}{2^{2/3}} = 2^{1-2/3} = 2^{1/3}$$

Final Answer: The ratio is $2^{1/3} : 1$.

Answer: (A)

Q35.

Solution

Concept: A meter bridge works on the principle of a Wheatstone bridge:

$$\frac{R}{X} = \frac{l}{100 - l}$$

where R is the left resistance, X is the right resistance, and l is the balance point from the left.
Solution: 1. Given $R = 10\Omega$ and $l = 20$ cm. 2. $\frac{10}{X} = \frac{20}{100-20} = \frac{20}{80}$ 3. $\frac{10}{X} = \frac{1}{4} \implies X = 40\Omega$.
Final Answer: The resistance in the right gap is 40Ω.

Answer: (A)

Q36.

Solution

Concept: The time period of a simple pendulum is given by $T = 2\pi\sqrt{L/g}$. A "second's pendulum" is defined as a pendulum with a fixed time period of 2 seconds. To maintain this period on different planets, the length must change in proportion to the local gravity.

Solution: 1. For T to be constant:

$$\frac{L}{g} = \text{constant} \implies \frac{L_{earth}}{g_{earth}} = \frac{L_{moon}}{g_{moon}}$$

2. Given $L_{earth} = L$ and $g_{moon} = \frac{1}{6}g_{earth}$. 3. Substitute into the proportion:

$$\frac{L}{g_{earth}} = \frac{L_{moon}}{\frac{1}{6}g_{earth}}$$

4. Solving for L_{moon}:

$$L_{moon} = L \times \frac{1}{6} = \frac{L}{6}$$

Final Answer: The length on the Moon would be $L/6$.

Answer: (B)

Q37.

Solution

Concept: Einstein's photoelectric equation is $K_{max} = \frac{1}{2}mv_{max}^2 = h\nu - \phi$, where $h\nu$ is the incident energy and ϕ is the work function.

Solution: 1. Let the initial state be: $\frac{1}{2}mv_1^2 = h\nu - \phi$. 2. When the frequency is doubled ($\nu' = 2\nu$):

$$\frac{1}{2}mv_2^2 = h(2\nu) - \phi = 2h\nu - \phi$$

3. We can rewrite the new energy as:

$$\frac{1}{2}mv_2^2 = 2(h\nu - \phi) + \phi$$

4. Since $h\nu - \phi$ is the original kinetic energy (K_1):

$$K_2 = 2K_1 + \phi$$

5. Because $\phi > 0$, it follows that $K_2 > 2K_1$. 6. For velocity: $v_2^2 > 2v_1^2 \implies v_2 > \sqrt{2}v_1$.

Final Answer: The velocity increases by a factor greater than $\sqrt{2}$.

Answer: (C)

Q38.

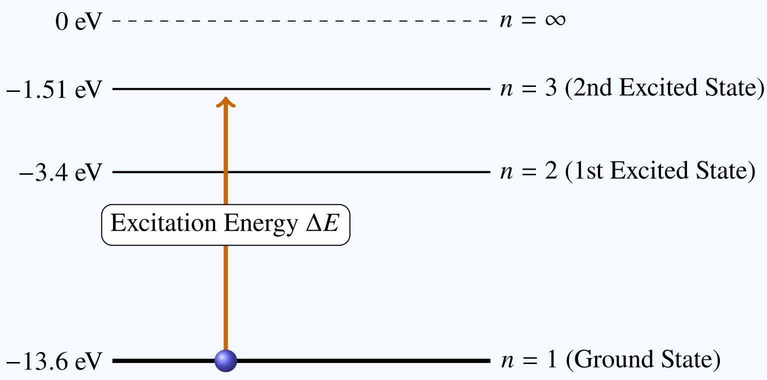
Solution

Concept: Excitation energy is the difference between the energy of the target state and the ground state ($n = 1$). Note: The "second excited state" is $n = 3$ (the "first" is $n = 2$).

Solution: 1. Energy at ground state ($n = 1$): $E_1 = -13.6/1^2 = -13.6$ eV. 2. Energy at second excited state ($n = 3$): $E_3 = -13.6/3^2 = -13.6/9 \approx -1.51$ eV. 3. Energy required (ΔE):

$$\Delta E = E_3 - E_1 = -1.51 - (-13.6)$$

$$\Delta E = 12.09 \text{ eV}$$



Final Answer: The energy required is 12.09 eV.

Answer: (B)

Q39.

Solution

Concept: Work done is defined as $W = \vec{F} \cdot \vec{s} = Fs\cos\theta$. Centripetal force $\vec{F}_c$ always acts towards the center of the circle, while displacement $\vec{s}$ is always tangential.

Solution: 1. In circular motion, the angle θ between the force vector and the displacement vector is always 90°. 2. $\cos(90°) = 0$. 3. Therefore, no matter how much distance the body covers (half a revolution or a full one), the work done by the centripetal force is always zero.

Final Answer: The work done is zero.

Answer: (D)

Q40.

Solution

Concept: At minimum deviation (D_m), the ray inside the prism is parallel to the base, and $r_1 = r_2 = A/2$. The refractive index is given by Snell's law: $n = \sin i / \sin r$.

Solution: 1. Given $A = 60°$, the angle of refraction is $r = A/2 = 30°$. 2. Given $n = \sqrt{2}$. 3. Apply Snell's law:

$$\sqrt{2} = \frac{\sin i}{\sin 30°}$$

4. Substitute $\sin 30° = 0.5$:

$$\sin i = \sqrt{2} \times 0.5 = \frac{\sqrt{2}}{2} = \frac{1}{\sqrt{2}}$$

5. Therefore, $i = \sin^{-1}(1/\sqrt{2}) = 45°$.

Final Answer: The angle of incidence is 45°.

Answer: (B)

Detailed Solutions

Q41.

Solution

Concept: The **XOR (Exclusive OR)** gate is a logic gate that outputs high (1) only when the inputs are different. Its truth table dictates that the output is 1 if ($A = 0, B = 1$) or ($A = 1, B = 0$).

Solution: 1. For input $A = 1$ and $B = 0$, the expression is $A\bar{B}$. 2. For input $A = 0$ and $B = 1$, the expression is $\bar{A}B$. 3. Since either condition yields a high output, we use the OR operator (+):

$$Y = A\bar{B} + \bar{A}B$$

4. This is the standard Boolean representation for the Exclusive OR operation.

Final Answer: The Boolean expression is $A\bar{B} + \bar{A}B$.

Answer: (C)

Q42.

Solution

Concept: **Thermal capacity** (S) is defined as the product of mass (m) and specific heat capacity (s): $S = m \times s$. For objects of the same material, the specific heat is constant.

Solution: 1. Mass m = density × volume = $\rho \times \frac{4}{3}\pi r^3$. 2. Since ρ, π, and s are constant for both spheres, we have $S \propto r^3$. 3. Given the ratio of radii $r_1 : r_2 = 1 : 2$. 4. The ratio of thermal capacities is:

$$\frac{S_1}{S_2} = \left(\frac{r_1}{r_2}\right)^3 = \left(\frac{1}{2}\right)^3 = \frac{1}{8}$$

Final Answer: The ratio of their thermal capacities is 1 : 8.

Answer: (C)

Detailed Solution

Q43.

Solution

Concept: In an AC circuit containing an Inductor (L), Capacitor (C), and Resistor (R) in series, the relationship between the voltage and the current is governed by the total impedance (Z) and the phase angle (ϕ).

Solution: 1. **Impedance and Phase Angle:** The phase difference ϕ between the voltage and the current in an LCR circuit is given by the formula:

$$\tan\phi = \frac{X_L - X_C}{R}$$

where X_L is the inductive reactance and X_C is the capacitive reactance.
2. **Condition for Resonance:** Resonance occurs when the inductive reactance exactly cancels out the capacitive reactance:

$$X_L = X_C$$

3. **Calculation of Phase Difference:** Substituting the resonance condition into the phase angle formula:

$$\tan\phi = \frac{X_L - X_L}{R} = \frac{0}{R} = 0$$

Since $\tan\phi = 0$, the phase angle is:

$$\phi = 0$$

4. **Physical Interpretation:** At resonance, the circuit behaves as a **purely resistive** circuit. The voltage and current reach their peak values at the same time, meaning they are in phase.
Final Answer: At resonance, the phase difference between voltage and current is **Zero**.

Answer: (C)

Q44.

Solution

Concept: According to the **Stefan-Boltzmann Law**, the total intensity (I) of radiation emitted by a black body is directly proportional to the fourth power of its absolute temperature (T).

$$I = \sigma T^4$$

Solution: 1. Initial state: $I_1 \propto T^4$. 2. New temperature $T' = 2T$. 3. New intensity $I_2 \propto (2T)^4$:

$$I_2 = 16 \times T^4$$

4. Comparing I_1 and I_2, we see $I_2 = 16I_1$.
Final Answer: The intensity becomes $16I$.

Answer: (D)

Detailed Solution

Q45.

Solution

Concept: A solenoid is a long coil of wire wrapped in a helical shape. When an electric current flows through it, it generates a magnetic field. The pattern of this field depends on whether we are looking inside or outside the coils.

Solution:

1. **Field Generation:** According to Ampere's Law, each loop of the solenoid acts like a tiny bar magnet. Inside the solenoid, the magnetic fields produced by each individual turn of the wire add together. 2. **Uniformity:** In an ideal (long) solenoid, the magnetic field is very strong and uniform in the interior region. A uniform magnetic field is visually represented by field lines that are equally spaced, **straight, and parallel** to the axis of the solenoid. 3. **Direction:** The lines run from the South pole to the North pole inside the solenoid, forming continuous closed loops when they return through the outside space. 4. **Comparison:** Outside the solenoid, the field lines curve and spread out (diverge), similar to a bar magnet, but **inside**, they remain strictly parallel.

Final Answer: The magnetic field lines inside a current-carrying solenoid are **Straight and parallel**.

Answer: (C)

Q46.

Solution

Concept: The general equation of a progressive wave is $y = A\sin(\omega t - kx)$. The velocity of the wave (v) is given by the ratio of the angular frequency (ω) to the wave number (k):

$$v = \frac{\omega}{k}$$

Solution: 1. Compare $y = 5\sin(100t - 0.4x)$ with the general form. 2. $\omega = 100$ rad/s and $k = 0.4\ \text{m}^{-1}$. 3. Calculate the velocity:

$$v = \frac{100}{0.4} = \frac{1000}{4} = 250\ \text{m/s}$$

Final Answer: The velocity of the wave is 250 m/s.

Answer: (A)

Q47.

Solution

Concept: At a constant temperature, Boyle's Law states that PV = constant. For small changes, the relationship between fractional changes is:

$$\frac{\Delta P}{P} + \frac{\Delta V}{V} = 0 \implies \frac{\Delta V}{V} = -\frac{\Delta P}{P}$$

Solution: 1. Given that the pressure is increased by 2%, so $\frac{\Delta P}{P} \times 100 = +2\%$. 2. From the derivative of Boyle's Law ($P\Delta V + V\Delta P = 0$):

$$\frac{\Delta V}{V} = -2\%$$

3. The negative sign indicates a decrease. Therefore, the volume decreases by 2%.
Final Answer: The percentage decrease in volume is 2%.

Answer: (A)

Q48.

Solution

Concept: The resistance of a wire is $R = \rho\frac{L}{A}$. When a wire is stretched, its volume ($V = AL$) remains constant. If the length becomes nL, the area must become A/n.

$$R' = \rho\frac{(nL)}{(A/n)} = n^2\left(\rho\frac{L}{A}\right) = n^2R$$

Solution: 1. The wire is stretched to double its length, so $n = 2$. 2. The new resistance $R' = n^2R = 2^2R$. 3. $R' = 4R$.
Final Answer: The new resistance will be $4R$.

Answer: (B)

Q49.

Solution

Concept: Surface tension (T) is defined as the force (F) per unit length (L):

$$T = \frac{F}{L}$$

Solution: 1. Dimensions of Force $[F] = [M^1L^1T^{-2}]$. 2. Dimensions of Length $[L] = [L^1]$. 3. Dimensions of Surface Tension:

$$[T] = \frac{[M^1L^1T^{-2}]}{[L^1]} = [M^1L^0T^{-2}]$$

Final Answer: The dimensional formula is $[M^1L^0T^{-2}]$.

Answer: (A)

Q50.

Solution

Concept: **Uniform Circular Motion (UCM)** is defined as the motion of an object traveling along a circular path at a **constant speed**. However, because the direction of motion is constantly changing, the physics of vectors vs. scalars is crucial here.

Solution:

1. **Velocity (A):** Velocity is a vector quantity ($\vec{v}$). While the *magnitude* (speed) is constant in UCM, the *direction* is always tangential to the circle and changes at every point. Since direction changes, velocity is **not constant**. 2. **Acceleration (B):** In UCM, there is a centripetal acceleration ($\vec{a}_c$) directed toward the center. Like velocity, its magnitude (v^2/r) is constant, but its direction constantly rotates to point toward the center. Thus, acceleration is **not constant**. 3. **Momentum (D):** Momentum is a vector ($\vec{p} = m\vec{v}$). Since the direction of velocity is changing, the direction of momentum also changes. Thus, momentum is **not constant**. 4. **Kinetic Energy (C):** Kinetic Energy ($K.E.$) is a **scalar quantity** defined as:

$$K.E. = \frac{1}{2}mv^2$$

In UCM, the mass (m) and the speed (v) are both constant. Since $K.E.$ does not depend on direction, it remains **constant** throughout the motion.

Final Answer: **Kinetic Energy** remains constant in a uniform circular motion.

Answer: (C)

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	B	3	A	4	A	5	A
6	A	7	B	8	A	9	A	10	A
11	A	12	A	13	A	14	A	15	C
16	B	17	A	18	B	19	C	20	A
21	A	22	A	23	D	24	B	25	C
26	B	27	B	28	C	29	B	30	A
31	C	32	B	33	C	34	A	35	A
36	B	37	C	38	B	39	D	40	B
41	C	42	C	43	C	44	D	45	C
46	A	47	A	48	B	49	A	50	C