Learne2i most important questions for JEE Mains 2025 April Session

Welcome to this curated collection of questions designed to reflect key concepts and high-priority topics from past JEE Mains examinations. While these samples aim to highlight recurring themes, they are not exact replicas—the JEE ensures originality in every paper.

Subject Insights

- Mathematics: Strongest predictive patterns due to structured problem-solving frameworks.
- Physics: Moderate consistency in thematic approaches (e.g., mechanics, electromagnetism).
- Chemistry: Least predictable trends, given its diverse topics and experimental formats.

Study Smart

- Master core principles, not just questions.
- Practice varied formats to adapt to new problem structures.
- Use this as a guide, not a substitute for comprehensive preparation.

Disclaimer for Predicted Questions in JEE Mains

The following set of questions has been curated as part of an analytical study aimed at identifying patterns and trends in past JEE Mains examinations. These questions are intended to serve as **sample questions** or representations of **important topics** that have historically appeared in the exam. It is crucial to understand that while these questions provide valuable insight into the types of problems that may be encountered, they are not exact replicas nor guaranteed predictions of future examination content. Instead, they are designed to highlight **key concepts** and areas of focus that students should prioritize during their preparation.

Nature of Predictions and Their Limitations

The methodology behind this analysis involves identifying similarities among questions from previous years, focusing on recurring themes, concepts, and problem-solving approaches. However, it is essential to note that:

1. **Questions will not be repeated verbatim**: JEE Mains strictly adheres to a policy of non-repetition in its question papers. The questions provided here are not exact duplicates but are conceptually similar to those seen in past exams. Students should use them as a tool for understanding the underlying principles and problem-solving techniques rather than expecting identical questions in the future.
2. **Focus on conceptual understanding**: The similarity analysis primarily emphasizes thematic connections between questions rather than their specific wording or structure. This means that while certain topics may appear repeatedly in different forms, the way they are presented can vary significantly. To succeed, students must develop a deep understanding of the concepts behind these sample questions.
3. **Subject-specific variability in prediction accuracy**: The effectiveness of these predictions varies across subjects:
    - **Mathematics**: The predictive accuracy for mathematics is notably higher due to the structured nature of mathematical problems and their reliance on well-defined concepts and formulae. Students can expect a closer alignment between sample questions and exam trends in this subject.
    - **Physics**: Predictions for physics exhibit moderate accuracy. While many physics problems share common themes (e.g., mechanics, electromagnetism), variations in question framing and numerical details can introduce unpredictability.
    - **Chemistry**: Chemistry demonstrates the lowest predictive accuracy due to its diverse range of topics, including organic reactions, inorganic properties, and physical chemistry calculations. The subject's variability makes it challenging to identify consistent patterns across years.

Recommendations for Students

To maximize the utility of these sample questions, students are advised to adopt the following approach:

- **Study the concepts thoroughly**: Treat each question as a gateway to understanding broader concepts rather than an isolated problem. For example, if a question pertains to integration techniques in mathematics or electrostatics principles in physics, focus on mastering those areas comprehensively.
- **Practice applying concepts in varied scenarios**: Since examiners often reframe similar ideas in different ways, students should practice solving problems across multiple formats and difficulty levels within each topic.
- **Do not rely solely on predictions**: While these sample questions provide valuable guidance, they should not replace a complete study plan or comprehensive syllabus coverage. JEE Mains is designed to test a student's grasp of fundamental principles across all topics in the syllabus.
- **Pay attention to weak areas**: Given the variability in prediction accuracy across subjects, students may need to allocate additional time and effort toward subjects like chemistry where trends are less predictable.

Final Note

The sample questions provided here are meant to assist students in identifying high-priority topics and honing their problem-solving skills. However, success in JEE Mains requires more than familiarity with past trends; it demands a robust understanding of core concepts, consistent practice, and adaptability to new challenges. Students are encouraged to use these resources responsibly as part of a balanced preparation strategy that includes textbooks, reference materials, coaching guidance, and mock tests.

By focusing on conceptual clarity and disciplined preparation, students can build the confidence and skills necessary to tackle any variation of questions presented in the examination effectively.

Question 1: A boy's catapult is made of rubber cord which is 42 cm long, with 6 mm diameter of cross-section and of negligible mass. The boy keeps a stone weighing 0.02 kg on it and stretches the cord by 20 cm by applying a constant force. When released, the stone flies off with a velocity of $20\ ms^{-1}$. Neglect the change in the area of cross-section of the cord while stretched. The Young's modulus of rubber is closest to:

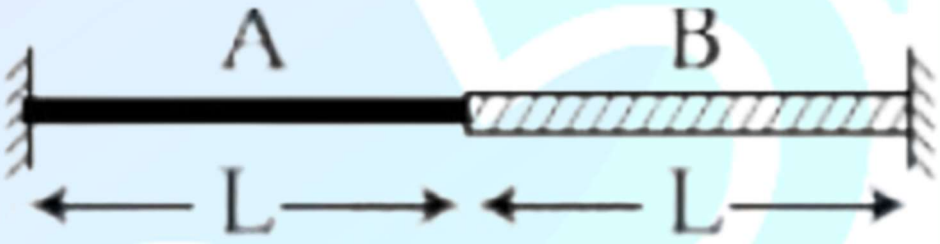
Option: (1) $10^6\ N\ m^{-2}$

Option: (2) $10^4\ N\ m^{-2}$

Option: (3) $10^8\ N\ m^{-2}$

Option: (4) $10^3\ N\ m^{-2}$

Question 2: A wire of length 2L, is made by joining two wires A and B of same length but different radii r and $2r$ and made of the same material. It is vibrating at a frequency such that the joint of the two wires forms a node. If
the number of antinodes in wire A is p and that in B is q then ratio $p:q$ is:



Option: (1) $3:5$

Option: (2) $4:9$

Option: (3) $1:4$

Option: (4) $1:2$

Question 3: Calculate the limit of resolution of a telescope objective having a diameter of 200 cm , if it has to detect light of wavelength 500 nm coming from a star.

Option: (1) 305×10^{-9} radian

Option: (2) 610×10^{-9} radian

Option: (3) 152.5×10^{-9} radian

Option: (4) 457.5×10^{-9} radian

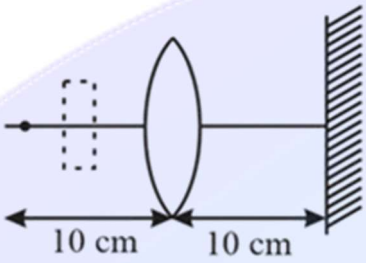
Question 4: An HCl molecule has rotational, translational and vibrational motions. If the rms velocity of HCl molecules in its gaseous phase is $\bar{v}, m$ is its mass and k_B is Boltzmann's constant, then its temperature will be:

Option: (1) $\frac{m^2}{5k_B}$

Option: (2) $\frac{\bar{m}^{-2}}{6k_B}$

Option: (4) $\frac{m^2}{7k_B}$

Question 5: A convex lens is put 10 cm from a light source and it makes a sharp image on a screen, kept 10 cm from the lens. Now a glass block (refractive index 1.5) of 1.5 cm thickness is placed in between the light source and the
lens. To get the sharp image again, the screen is shifted by a distance d. Then d is:



Option: (1) 0

Option: (2) 0.55 cm away from the lens

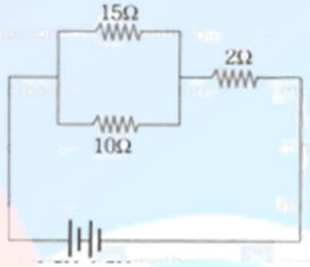
Option: (3) 0.55 cm towards the lens

Option: (4) 1.1 cm away from the lens

Question 6: In the given circuit, an ideal voltmeter connected across the 10Ω resistance reads 2 V . The internal resistance r, of each cell is:

$1.5\ V, 1.5\ V$

$r\Omega r\Omega$



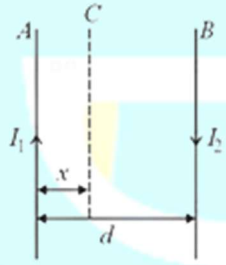
Option: (1) 0Ω

Option: (2) 1.5Ω

Option: (3) 0.5Ω

Option: (4) 1Ω

Question 7: Two wires A \& B are carrying currents I_1 and I_2 as shown in the figure. The separation between them is d.A third wire C carrying a current I is to be kept parallel to them at a distance x from A such that the net force acting on it is zero. The possible values of x are:



Option: (1) $x = \pm\frac{I_d}{(I_1 - I_2)}$

Option: (2) $x = \left(\frac{I_1}{I_1+I_2}\right)d$ and $x = \frac{I_2}{(I_1-I_2)}d$

Option: (3) $x = \left(\frac{I_2}{I_1+I_2}\right)d$ and $x = \left(\frac{I_2}{I_1-I_2}\right)d$

Option: (4) $x = \left(\frac{I_1}{I_1-I_2}\right)d$ and $x = \frac{I_2}{(I_1+I_2)}d$

Question 8: A bullet of mass 20 g has an initial speed of $1\ m\ s^{-1}$, just before it starts penetrating a mud wall of thickness 20 cm . If the wall offers a mean resistance of $2.5 \times 10^{-2}\ N$, the speed of the bullet after emerging from the other side of the wall is close to:

Option: (1) $0.7\ m\ s^{-1}$

Option: (2) $0.3\ m\ s^{-1}$

Option: (3) $0.1\ m\ s^{-1}$

Option: (4) $0.4\ m\ s^{-1}$

Question 9: A string of length 1 m and mass 5 g is fixed at both ends. The tension in the string is 8.0 N . The string is set into vibration using an external vibrator of frequency 100 Hz . The separation between successive nodes on the string is close to

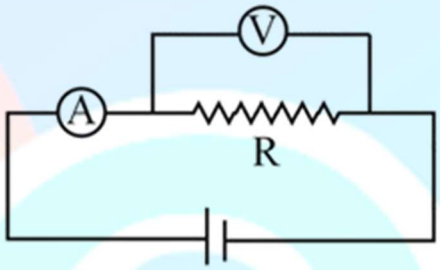
Option: (1) 20.0 cm

Option: (2) 10.0 cm

Option: (3) 16.6 cm

Option: (4) 33.3 cm

Question 10: The actual value of resistance R, shown in the figure is 30Ω. This is measured in an experiment as shown using the standard formula $R = \frac{V}{I}$, where V and I are the readings of the voltmeter and ammeter, respectively. If the measured value of R is 5% less, then the internal resistance of the voltmeter is:



Option: (1) 35Ω

Option: (2) 600Ω

Option: (3) 570Ω

Option: (4) 350Ω

Question 11: Equation of travelling wave on a stretched string of linear density $5\ g/m$ is $y = 0.03sin(450t - 9x)$ where distance and time are measured in SI units. The tension in the string is:

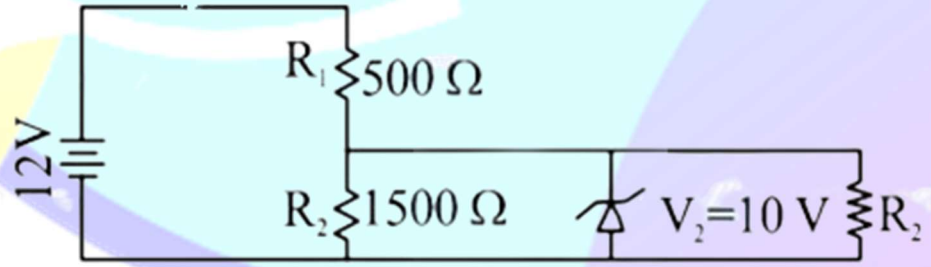
Option: (1) 10 N

Option: (2) 7.5 N

Option: (3) 12.5 N

Option: (4) 5 N

Question 12: In the given circuit the current through Zener Diode is close to:



Option: (1) 0.0 mA

Option: (2) 6.7 mA

Option: (3) 4.0 mA

Option: (4) 6.0 mA

Question 13: The region between $y = 0$ and $y = d$ contains a magnetic field $\vec{B} = B\hat{z}$. A particle of mass m and charge q enters the region with a velocity $\vec{v} = v\hat{\imath}$. if $d = \frac{mv}{2qB}$, the acceleration of the charged particle at the point of its emergence at the other side is :

Option: (1) $\frac{qv\,B}{m}\left(\frac{1}{2}\hat{\imath} - \frac{\sqrt{3}}{2}\hat{j}\right)$

Option: (2) $\frac{qvB}{m}\left(\frac{\sqrt{3}}{2}\hat{\imath} + \frac{1}{2}\hat{j}\right)$

Option: (3) $\frac{qv\,B}{m}\left(\frac{-\hat{j}+\hat{\imath}}{\sqrt{2}}\right)$

Option: (4) None of the above

Question 14: A person of mass M is sitting on a swing of length L and swinging with and an angular amplitude θ_0. If the person stands up when the swing passes through its lowest point, the work done by him, assuming that his centre of mass moves by a distance $ll \ll L$, is close to:

Option: (1) $Mgl(1 - \theta_0^2)$

Option: (2) $Mgl\left(1 + \frac{\theta_0^2}{2}\right)$

Option: (3) Mgl

Option: (4) $Mgl(1 + \theta_0^2)$

Question 15: When M_1 gram of ice at $-10°C$ (specific heat $= 0.5 cal g^{-1}\ \ °C^{-1}$) is added to M_2 gram of water at $50\ \ °C$, finally no ice is left and the water is at $0°C$. The value of latent heat of ice, in cal g^{-1} is:

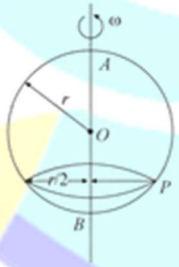
Option: (1) $\frac{50M_2}{M_1}$

Option: (2) $\frac{5M_1}{M_2} - 50$

Option: (3) $\frac{5M_2^1}{M_1} - 5$

Option: (4) $\frac{50M_2}{M_1} - 5$

Question 16: A smooth wire of length $2\pi r$ is bent into a circle and kept in a vertical plane. A bead can slide smoothly on the wire. When the circle is rotating with angular speed ω about the vertical diameter AB , as shown in figure, the
bead is at rest with respect to the circular ring at position P as shown. Then the value of ω^2 is equal to:



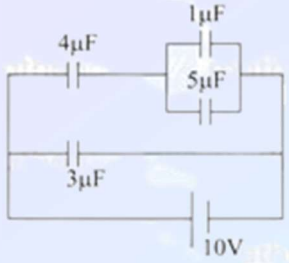
Option: (1) $2\ g/r$

Option: (2) $\frac{\sqrt{3}g}{2r}$

Option: (3) $2\ g/\left(r\sqrt{3}\right)$

Option: (4) $\left(g\sqrt{3}\right)/r$

Question 17: In the given circuit, the charge on $4\mu\ F$ capacitor will be:



Option: (1) $9.6\mu C$

Option: (2) $5.4\mu C$

Option: (3) $24\mu C$

Option: (4) $13.4\mu C$

Question 18: A light wave is incident normally on a glass slab of refractive index 1.5 . If 4% of light gets reflected and the amplitude of the electric field of the incident light is $30\frac{V}{m}$, then the amplitude of the electric field for the wave propagating in the glass medium will be:

Option: (1) $30\frac{V}{m}$

Option: (2) $6\frac{V}{m}$

Option: (3) $24\frac{V}{m}$

Option: (4) $10\frac{V}{m}$

Question 19: A simple harmonic motion is represented by:

$$y = 5\left(sin3\pi t + \sqrt{3}cos3\pi t\right)cm$$

The amplitude and time period of the motion are:

Option: (1) $5\ cm, \frac{2}{3}\ s$

Option: (2) $10\ cm, \frac{2}{3}\ s$

Option: (3) $5\ cm, \frac{3}{2}\ s$

Option: (4) $10\ cm, \frac{3}{2}\ s$

Question 20: A parallel plate capacitor with plates of area $1\ m^2$ each, are at a separation of 0.1 m . If the electric field between the plates is $100\ N/C$, the magnitude of charge on each plate is:

(Take $\epsilon_0 = 8.85 \times 10^{-12}\frac{C^2}{N-m^2}$)

Option: (1) $8.85 \times 10^{-1}\ C$

Option: (2) $6.85 \times 10^{-10}C$

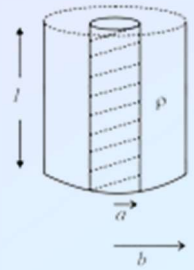
Option: (3) $9.85 \times 10^{-10}C$

Option: (4) $7.85 \times 10^{-10}C$

Question 21: An ideal gas in a closed container is slowly heated. As its temperature increases, which of the following statements are true?

(A) the mean free path of the molecules decreases

(B) the mean collision time between the molecules decreases.
(C) the mean free path remains unchanged.
(D) the mean collision time relations unchanged.
Option: (1) (B) and (C)
Option: (2) (A) and (B)
Option: (3) (C) and (D)
Option: (4) (A) and (D)
Question 22: Model a torch battery of length l to be made up of a thin cylindrical bar of radius a and a concentric thin cylindrical shell of radius b filled in between with an electrolyte of resistivity ρ (see figure). If the battery is connected to a resistance of value R, the maximum Joule heating in R will take place for :

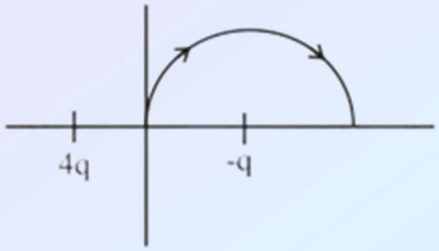


Option: (1) $R = \frac{\rho}{2\pi\ell}\left(\frac{b}{a}\right)$
Option: (2) $R = \frac{\rho}{2\pi\ell} ln\left(\frac{b}{a}\right)$
Option: (3) $R = \frac{\rho}{\pi\ell} In\left(\frac{b}{a}\right)$
Option: (4) $R = \frac{2\rho}{\pi\ell} ln\left(\frac{b}{a}\right)$
Question 23: Two resistors 400Ω and 800Ω are connected in series across a 6 V battery. The potential difference measured by a voltmeter of $10k\Omega$ across 400Ω resistor is close to:
Option: (1) 2 V
Option: (2) 1.8 V
Option: (3) 2.05 V
Option: (4) 1.95 V
Question 24: A uniform magnetic field B exists in a direction perpendicular to the plane of a square loop made of a metal wire. The wire has a diameter of 4 mm and a total length of 30 cm . The magnetic field changes with time at a steady rate $dB/dt = 0.032Ts^{-1}$. The induced current in the loopis close to (Resistivity of the metal wire is $1.23 \times 10^{-8}\Omega\, m$)
Option: (1) 0.43 A
Option: (2) 0.61 A
Option: (3) 0.34 A
Option: (4) 0.53 A
Question 25: The electric field of a plane electromagnetic wave propagating along the x direction is given by

Option: (1) $\vec{B} = \frac{E_0}{\sqrt{\mu_0\epsilon_0}} cos(kx)\hat{k}$
Option: (2) $\vec{B} = E_0\sqrt{\mu_0\epsilon_0} cos(kx)\hat{j}$
Option: (3) $\vec{B} = E_0\sqrt{\mu_0\varepsilon_0} cos(kx)\hat{k}$

Option: (4) $\vec{B} = \frac{E_0}{\sqrt{\mu_0 \epsilon_0}} cos(kx)\hat{j}$

Question 26: A two point charges $4q$ and $-q$ are fixed on the x-axis at $x = \frac{-d}{2}$ and $x = \frac{d}{2}$, respectively. If the third point charge ' q ' is taken from the origin to $x = d$ along the semicircle as shown in the figure, the energy of the charge will:



Option: (1) Increase by $\frac{3q^2}{4\pi\epsilon_0 d}$

Option: (2) Increase by $\frac{2q^2}{3\pi\epsilon_0 d}$

Option: (3) decrease by $\frac{q^2}{4\pi\epsilon_0 d}$

Option: (4) decrease by $\frac{4q^2}{3\pi\epsilon_0 d}$

Question 27: A small bar magnet is placed with its axis at $30°$ with an external magnetic field of 0.06 T experiences a torque of 0.018 Nm . The minimum work required to rotate it from its stable to unstable equilibrium position is:

Option: (1) $6.4 \times 10^{-2}\ J$

Option: (2) $9.2 \times 10^{-3}\ J$

Option: (3) $7.2 \times 10^{-2}\ J$

Option: (4) $11.7 \times 10^{-3}\ J$

Question 28: A closed vessel contains 0.1 mole of a monoatomic ideal gas at 200 K . If 0.05 mole of the same gas at 400 K is added to it, the final equilibrium temperature (in K) of the gas in the vessel will be close to

Question 29: A galvanometer of resistance G is converted into a voltameter of range $0 - 1\ V$ by connecting a resistance R in series with it. The additional resistance that should be connected in series with R_1 to increase the range of the voltmeter to $0 - 2\ V$ will be :

Option: (1) G

Option: (2) R_1

Option: (3) $R_1 - G$

Option: (4) $R_1 + G$

Question 30: Mass per unit area of a circular disc of radius a depends on the distance r from its centre as $\sigma(r) = A + Br$. The moment of inertia of the disc about the axis, perpendicular to the plane and passing through its centre is:

Option: (1) $2\pi a^4 \left(\frac{A}{4} + \frac{aB}{5}\right)$

Option: (2) $2\pi a^4 \left(\frac{aA}{4} + \frac{B}{5}\right)$

Option: (3) $\pi a^4 \left(\frac{A}{4} + \frac{aB}{5}\right)$

Option: (4) $2\pi a^4 \left(\frac{A}{4} + \frac{B}{5}\right)$

Question 31: Under an adiabatic process, the volume of an ideal gas gets doubled. Consequently, the mean collision time between the gas molecule changes from τ_1 to τ_2. If $\frac{C_P}{C_v} = \gamma$ for this gas then a good estimate for $\frac{\tau_2}{\tau_1}$ is given by

Option: (1) 2

Option: (2) $\frac{1}{2}$

Option: (3) $\left(\frac{1}{2}\right)^{\gamma}$

Option: (4) $\left(\frac{1}{2}\right)^{\frac{\gamma+1}{2}}$

Question 32: When photon of energy 4.0 eV strikes the surface of a metal A, the ejected photoelectrons have maximum kinetic energy $\mathrm{T}_A\, eV$ and de-Broglie wavelength λ_A. The maximum kinetic energy of photoelectrons liberated from another metal B by photon of energy 4.50 eV is $T_B = (T_A - 1.5)eV$. If the de-Broglie wavelength of these photoelectrons $\lambda_B = 2\lambda_A$, then the work function of metal B is:

Option: (1) 4 eV

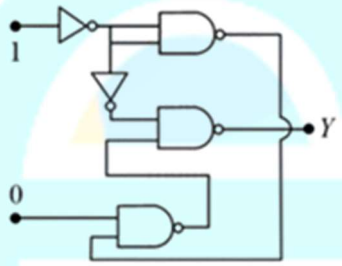
Option: (2) 2 eV

Option: (3) 1.5 eV

Option: (4) 3 eV

Question 33: A body A of mass $m = 0.1\ kg$ has an initial velocity of $3\hat{\imath}ms^{-1}$. It collides elastically with another body B of the same mass which has an initial velocity of $5\hat{\jmath}\ \widehat{m\,s^{-1}}$. After the collision, A moves with a velocity $\vec{v} = 4(\hat{\imath} + \hat{\jmath})ms^{-1}$. The energy of B after the collision is written as $\frac{x}{10}\ J$. The value of x is

Question 34: In the given circuit, value of Y is:



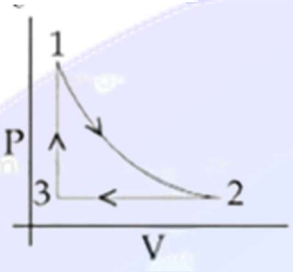
Option: (1) 0

Option: (2) toggles between 0 and 1

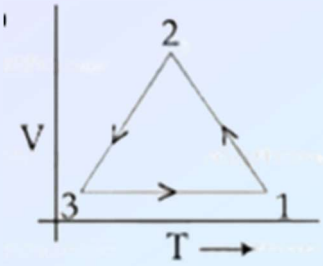
Option: (3) will not execute

Option: (4) 1

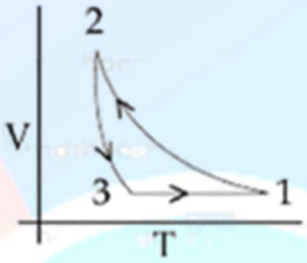
Question 35: Which of the following is an equivalent cyclic process corresponding to the thermodynamic cyclic given in the figure? Where, $1 \rightarrow 2$ is adiabatic. (Graphs are schematic and are not to scale)



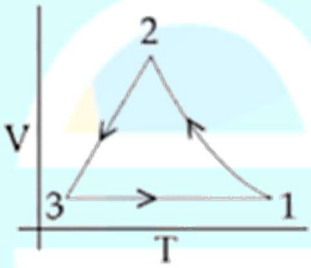
Option: (1)



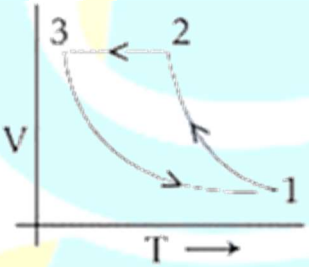
Option: (2)



Option: (3)



Option: (4)



Question 36: A vessel of depth 2 h is half filled with a liquid of refractive index $2\sqrt{2}$ and the upper half with another liquid of refractive index $\sqrt{2}$. The liquids are immiscible. The apparent depth of the inner surface of the bottom of the vessel will be

Option: (1) $\frac{h}{\sqrt{2}}$

Option: (2) $\frac{h}{2(\sqrt{2}+1)}$

Option: (3) $\frac{h}{3\sqrt{2}}$

Option: (4) $\frac{3\sqrt{2}h}{4}$

Question 37: In LC circuit the inductance $L = 40mH$ and capacitance $C = 100\mu\ F$. If a voltage $V(t) = 10sin(314t)$ is applied to the circuit, the current in the circuit is given as:

Option: (1) $0.52cos(314t)$

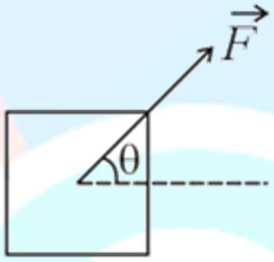
Option: (2) $10cos(314t)$

Option: (3) $5.2cos(314t)$

Option: (4) $0.52sin(314t)$

Question 38: Starting at temperature $300K$, one mole of an ideal diatomic gas $(\gamma = 1.4)$ is first compressed adiabatically from volume V_1 to $V_2 = \frac{V_1}{16}$. It is then allowed to expand isobarically to volume $2V_2$. If all the processes are the quasi-static then the final temperature of the gas (in $^\circ K$) is (to the nearest integer) .

Question 39: A block of mass m slides along a floor while a force of magnitude F is applied to it at angle θ as shown in figure. The coefficient of kinetic friction is μ_K. Then, the block's acceleration a is given by : g is acceleration due to gravity)



Option: (1) $-\frac{F}{m}cos\theta - \mu_K\left(g - \frac{F}{m}sin\theta\right)$

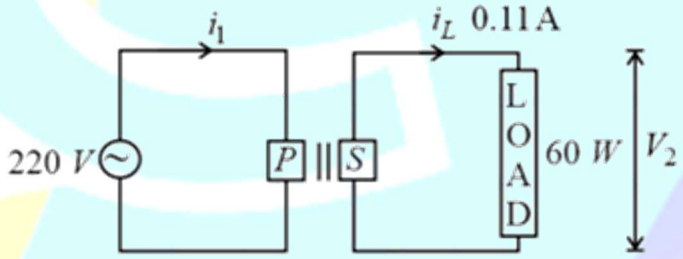
Option: (2) $\frac{F}{m}cos\theta - \mu_K\left(g - \frac{F}{m}sin\theta\right)$

Option: (3) $\frac{F}{m}cos\theta - \mu_K\left(g + \frac{F}{m}sin\theta\right)$

Option: (4) $\frac{F}{m}cos\theta + \mu_K\left(g - \frac{F}{m}sin\theta\right)$

Question 40: In the logic circuit shown in the figure, if input A and B are 0 to 1 respectively, the output at Y would be x. The value of x is -.

Question 41: For the given circuit, comment on the type of transformer used :



Option: (1) Auxilliary transformer

Option: (2) Auto transformer

Option: (3) Step-up transformer

Option: (4) Step down transformer

Question 42: A boy is rolling a 0.5 kg ball on the frictionless floor with the speed of $20\ m\ s^{-1}$. The ball gets deflected by an obstacle on the way. After deflection it moves with 5% of its initial kinetic energy. What is the speed of the ball now?

Option: (1) $19.0\ m\ s^{-1}$

Option: (2) $4.4\ m\ s^{-1}$

Option: (3) $14.41\ m\ s^{-1}$

Option: (4) $1.00\ m\ s^{-1}$

Question 43: An electron of mass m and a photon have same energy E. The ratio of wavelength of electron to that of photon is : (c being the velocity of light)

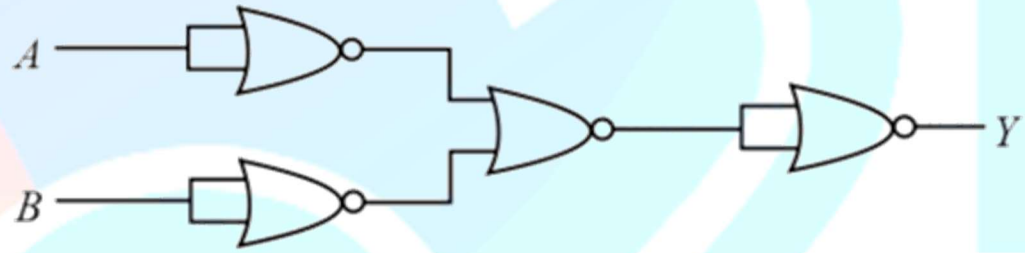
Option: (1) $\frac{1}{c}\left(\frac{2m}{E}\right)^{\frac{1}{2}}$

Option: (2) $\frac{1}{c}\left(\frac{E}{2m}\right)^{\frac{1}{2}}$

Option: (3) $\left(\frac{E}{2m}\right)^{\frac{1}{2}}$

Option: (4) $c(2mE)^{\frac{1}{2}}$

Question 44: The output of the given combination gates represents:



Option: (1) XOR Gate

Option: (2) NAND Gate

Option: (3) AND Gate

Option: (4) NOR Gate

Question 45: Two blocks ($m = 0.5\ kg$ and $M = 4.5\ kg$) are arranged on a horizontal frictionless table as shown in the figure. The coefficient of static friction between the two blocks is $\frac{3}{7}$. Then the maximum horizontal force that can be applied on the larger block so that the blocks move together is N. (Round off to the Nearest Integer) [Take g as $9.8\ m\ s^{-2}$]

Question 46: A constant power delivering machine has towed a box, which was initially at rest, along a horizontal straight line. The distance moved by the box in time t is proportional to :-

Option: (1) $t^{\frac{2}{3}}$

Option: (2) $t^{\frac{3}{2}}$

Option: (3) t

Option: (4) $t^{\frac{1}{2}}$

Question 47: In the experiment of Ohm's law, a potential difference of 5.0 V is applied across the end of a conductor of length 10.0 cm and diameter of 5.00 mm . The measured current in the conductor is 2.00 A . The maximum permissible percentage error in the resistivity of the conductor is :-

Option: (1) 3.9

Option: (2) 8.4

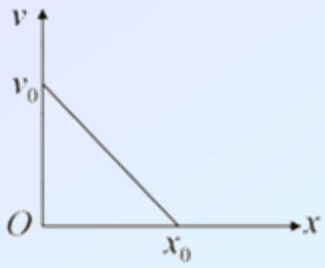
Option: (3) 7.5

Option: (4) 3.0

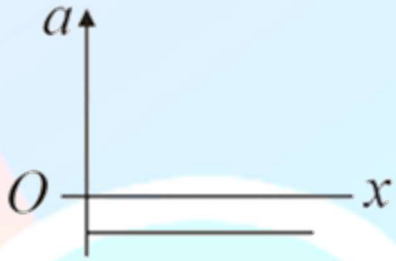
Question 48: An npn transistor operates as a common emitter amplifier with a power gain of 10^6. The input circuit resistance is 100Ω and the output load resistance is $10k\Omega$. The common emitter current gain β will be (Round off to the Nearest Integer)

Question 49: The velocity-displacement graph of a particle is shown in the figure.

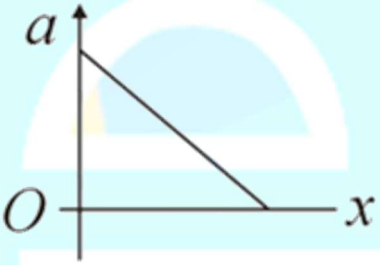
The acceleration-displacement graph of the same particle is represented by :



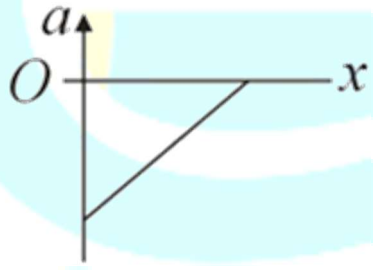
Option: (1)



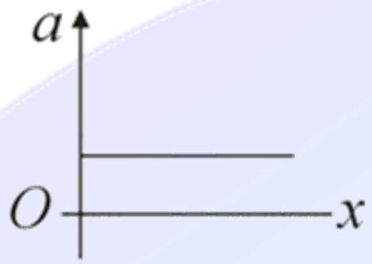
Option: (2)



Option: (3)



Option: (4)



Question 50: An object viewed from a near point distance of 25 cm , using a microscopic lens with magnification 6 , gives an unresolved image. A resolved image is observed at infinite distance with a total magnification double the earlier using an eyepiece along with the given lens and a tube of length 0.6 m , if the focal length of the eyepiece is equal to cm .

Question 51: Two small drops of mercury each of radius R coalesce to form a single large drop. The ratio of total surface energy before and after the change is

Option: (1) $2^{\frac{1}{3}}:1$

Option: (2) $1:2^{\frac{1}{3}}$

Option: (3) $2:1$

Option: (4) $1:2$

Question 52: The correct relation between the degrees of freedom f and the ratio of specific heat γ is:

Option: (1) $f=\frac{2}{\gamma-1}$

Option: (2) $f=\frac{2}{\gamma+1}$

Option: (3) $f=\frac{\gamma+1}{2}$

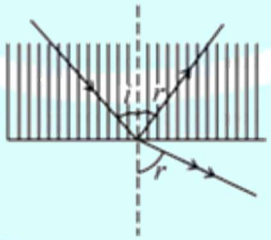
Option: (4) $f=\frac{1}{\gamma+1}$

Question 53: Two bodies, a ring and a solid cylinder of same material are rolling down without slipping an inclined plane. The radii of the bodies are same. The ratio of velocity of the centre of mass at the bottom of the inclined plane of the ring to that of the cylinder is $\frac{\sqrt{x}}{2}$. Then, the value of x is

Question 54: For the forward biased diode characteristics shown in the figure, the dynamic resistance at $I_D=3\ mA$ will be

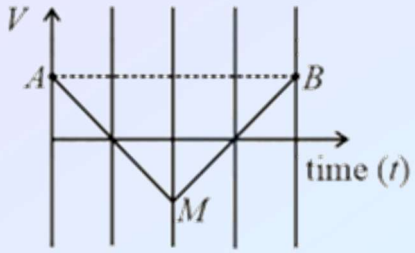
Ω.

Question 55: A ray of light passes from a denser medium to a rarer medium at an angle of incidence i. The reflected and refracted rays make an angle of 90° with each other. The angle of reflection and refraction are respectively r and r'. The critical angle is given by,

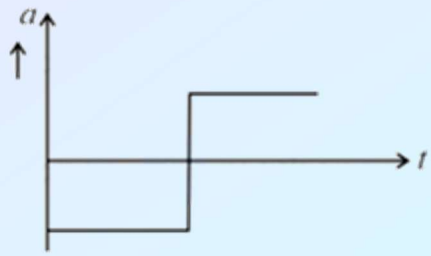


Option: (1) $sin^{-1}(cotr)$

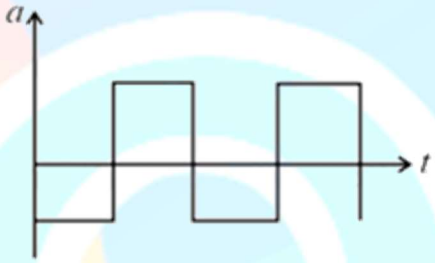
Option: (2) $tan^{-1}(sini)$
Option: (3) $sin^{-1}(tanr')$
Option: (4) $sin^{-1}(tanr)$
Question 56: If the velocity-time graph has the shape AMB, what would be the shape of the corresponding acceleration-time graph?



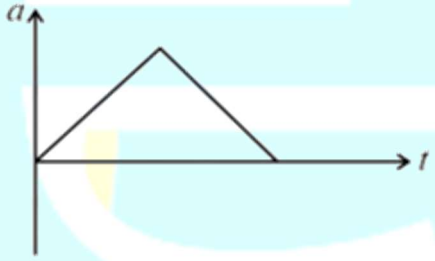
Option: (1)



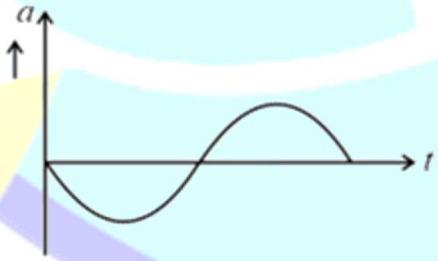
Option: (2)



Option: (3)



Option: (4)



Question 57: Two stars of masses m and $2m$ at a distance d rotate about their common centre of mass in free space. The period of revolution is

Option: (1) $2\pi\sqrt{\frac{d^3}{3Gm}}$

Option: (2) $2\pi\sqrt{\frac{3Gm}{d^3}}$

Option: (3) $\frac{1}{2\pi}\sqrt{\frac{3Gm}{d^3}}$

Option: (4) $\frac{1}{2\pi}\sqrt{\frac{d^3}{3Gm}}$

Question 58: If Y, K and η are the values of Young's modulus, bulk modulus and modulus of rigidity of any material respectively. Choose the correct relation for these parameters.

Option: (1) $Y = \frac{9K\eta}{3K-\eta} Nm^{-2}$

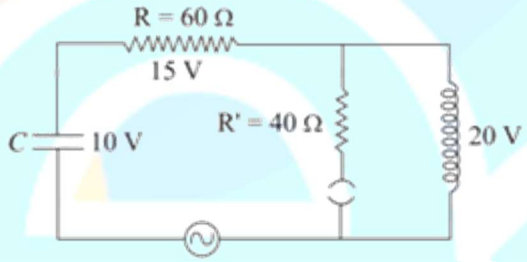
Option: (2) $\eta = \frac{3YK}{9K+Y}\ N\ m\ m^{-2}$

Option: (3) $K = \frac{Y\eta}{9\eta-3Y} \times m^{-2}$

Option: (4) $Y = \frac{9K\eta}{2\eta+3K}\ N\ m\ m^{-2}$

Question 59: In connection with the circuit drawn below, the value of current flowing through $2k\Omega$ resistor is $\times 10^{-4}\ A$.

Question 60: The angular frequency of alternating current in a L-C-R circuit is $100 rads^{-1}$. The components connected are shown in the figure. Find the value of inductance of the coil and capacity of condenser.



Option: (1) 1.33 H and $150\mu\ F$

Option: (2) 0.8 H and $150\mu\ F$

Option: (3) 1.33 H and $250\mu\ F$

Option: (4) 0.8 H and $250\mu\ F$

Question 61: A coil of inductance 2 H having negligible resistance is connected to a source of supply whose voltage is given by $V = 3t$ volt. (where t is in second). If the voltage is applied when $t = 0$, then the energy stored in the coil
after 4 s in J ,

Question 62: Two particles having masses 4 g and 16 g respectively are moving with equal kinetic energies. The ratio of the magnitudes of their linear momentum is $n: 2$. The value of n will be _.

Question 63: What should be the order of arrangement of de-Broglie wavelength of electron λ_e, an α-particle λ_α and proton λ_p given that all have the same kinetic energy ?

Option: (1) $\lambda_e = \lambda_p = \lambda_\alpha$

Option: (2) $\lambda_e < \lambda_p < \lambda_\alpha$

Option: (3) $\lambda_e > \lambda_p > \lambda_\alpha$

Option: (4) $\lambda_e = \lambda_p > \lambda_\alpha$

Question 64: The coefficient of static friction between two blocks is 0.5 and the table is smooth. The maximum horizontal force that can be applied to move the blocks together is $N($ take $g = 10\ m\ s^{-2})$

Question 65: As shown in the figure, a block of mass $\sqrt{3}\ kg$ is kept on a horizontal rough surface of coefficient of friction $\frac{1}{3\sqrt{3}}$. The critical force to be applied on the vertical surface as shown at an angle $60°$ with horizontal such that it does not move, will be $3x$. The value of x will

$$\left[g = 10\ m\ s^{-2}; sin60° = \frac{\sqrt{3}}{2}; cos60° = \frac{1}{2}\right]$$

Question 66: A point source of light S, placed at a distance 60 cm infront of the centre of a plane mirror of width 50 cm , hangs vertically on a wall. A man walks infront of the mirror along a line parallel to the mirror at a distance 1.2 m from it (see in the figure). The distance between the extreme points where he can see the image of the light source in the mirror is_cm

Question 67: The voltage drop across 15Ω resistance in the given figure will be v.

Question 68: At very high frequencies, the effective impedance of the given circuit will be Ω.

Question 69: A projectile is projected with velocity of $25\ m\ s^{-1}$ at an angle θ with the horizontal. After t seconds its inclination with horizontal becomes zero. If R represents horizontal range of the projectile, the value of θ will be : [use use $g = 10\ m\ s^{-2}$]

Option: (1) $\frac{1}{2} sin^{-1}\left(\frac{5t^2}{4R}\right)$

Option: (2) $\frac{1}{2} sin^{-1}\left(\frac{4R}{5t^2}\right)$

Option: (3) $tan^{-1}\left(\frac{4t^2}{5R}\right)$

Option: (4) $cot^{-1}\left(\frac{R}{20t^2}\right)$

Question 70: The magnetic field at the centre of a circular coil of radius r, due to current I flowing through it, is B. The magnetic field at a point along the axis at a distance $\frac{r}{2}$ from the centre is :

Option: (1) $\frac{B}{2}$

Option: (2) $2B$

Option: (3) $\left(\frac{2}{\sqrt{5}}\right)^3$ B

Option: (4) $\left(\frac{2}{\sqrt{3}}\right)^3 B$

Question 71: A ball of mass 100 g is dropped from a height $h = 10\ cm$ on a platform fixed at the top of a vertical spring (as shown in figure). The ball stays on the platform and the platform is depressed by a distance $\frac{h}{2}$. The spring constant is Nm^{-1}

(Use $g = 10\ m\ s^{-2}$)

Question 72: As shown in the figure an inductor of inductance 200 mH is connected to an AC source of emf 220 Vand frequency 50 Hz . The instantaneous voltage of the source is 0 V when the peak value of current is $\frac{\sqrt{\ }\bar{a}}{\pi}\ A$. The value of a is .

Question 73: Sodium light of wavelengths 650 nm and 655 nm is used to study diffraction at a single slit of aperture 0.5 mm . The distance between the slit and the screen is 2.0 m . The

separation between the positions of the first maxima of diffraction pattern obtained in the two cases is $\times 10^{-5}\ m$

Question 74: A transistor is used in common-emitter mode in an amplifier circuit. When a signal of 10 mV is added to the base-emitter voltage, the base current changes by $10\mu\ A$ and the collector current changes by 1.5 mA . The load resistance is $5k\Omega$. The voltage gain of the transistor will be .

Question 75: An object of mass 5 kg is thrown vertically upwards from the ground. The air resistance produces a constant retarding force of 10 N throughout the motion. The ratio of time of ascent to the time of descent will be equal to : [Use $g = 10\ m\ s^{-2}$].

Option: (1) $1:1$

Option: (2) $\sqrt{2}:\sqrt{3}$

Option: (3) $\sqrt{3}:\sqrt{2}$

Option: (4) $2:3$

Question 76: A wire of length L and radius r is clamped rigidly at one end. When the other end of the wire is pulled by a force F, its length increases by 5 cm . Another wire of the same material of length 4 L and radius $4r$ is pulled by a force $4F$ under same conditions. The increase in length of this wire is cm.

Question 77: Two billiard balls of mass 0.05 kg each moving in opposite directions with $10\ ms^{-1}$ collide and rebound with the same speed. If the time duration of contact is $t = 0.005\ s$, then what is the force exerted on the ball due to each other?

Option: (1) 100 N

Option: (2) 200 N

Option: (3) 300 N

Option: (4) 400 N

Question 78: The length of a seconds pendulum at a height $h = 2R$ from earth surface will be: (Given: $R =$ Radius of earth and acceleration due to gravity at the surface of earth $g = \pi^2\ m\ s^{-2}$)

Option: (1) $\frac{2}{9}\ m$

Option: (2) $\frac{4}{9}\ m$

Option: (3) $\frac{8}{9}\ m$

Option: (4) $\frac{1}{9}\ m$

Question 79: The electric current in a circular coil of 2 turns produces a magnetic induction B_1 at its centre. The coil is unwound and is rewound into a circular coil of 5 turns and the same current produces a magnetic induction B_2 at its centre.

The ratio of $\frac{B_2}{B_1}$ is:

Option: (1) $\frac{5}{2}$

Option: (2) $\frac{25}{4}$

Option: (3) $\frac{5}{4}$

Option: (4) $\frac{25}{2}$

Question 80: A particle is moving in a straight line such that its velocity is increasing at $5\ m\ s^{-1}$ per meter. The acceleration of the particle is ms^{-2} at a point where its velocity is $20\ m\ s^{-1}$.

Question 81: If wattless current flows in the AC circuit, then the circuit is :

Option: (1) Purely Resistive circuit

Option: (2) Purely Inductive circuit

Option: (3) LCR series circuit

Option: (4) RC series circuit only

Question 82: The two light beams having intensities I and $9I$ interfere to produce a fringe pattern on a screen. The phase difference between the beams is $\frac{\pi}{2}$ at point P and π at point Q. Then the difference between the resultant intensities at P and Q will be :

Option: (1) $2I$

Option: (2) $6I$

Option: (3) $5I$

Option: (4) $7I$

Question 83: A signal of 100 THz frequency can be transmitted with maximum efficiency by

Option: (1) Coaxial cable

Option: (2) Optical fibre

Option: (3) Twisted pair of copper wires

Option: (4) Water

Question 84: A solid metallic cube having total surface area $24\ m^2$ is uniformly heated. If its temperature is increased by 10°C, calculate the increase in volume of the cube. (Given $\alpha = 5.0 \times 10^{-4}\ °C^{-1}$).

Option: (1) $2.4 \times 10^6\ cm^3$

Option: (2) $1.2 \times 10^5\ cm^3$

Option: (3) $6 \times 10^4\ cm^3$

Option: (4) $4.8 \times 10^5\ cm^3$

Question 85: A sinusoidal voltage $Vt = 210sin3000t$ volt is applied to a series LCR circuit in which $L = 10mH, C = 25\mu\ F$ and $R = 100\Omega$. The phase difference Φ between the applied voltage and resultant current will be

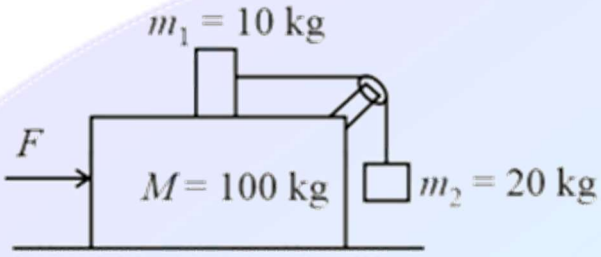
Option: (1) $tan^{-1}0.17$

Option: (2) $tan^{-1}9.46$

Option: (3) $tan^{-1}0.30$

Option: (4) $tan^{-1}13.33$

Question 86: Three masses $M = 100\ kg, m_1 = 10\ kg$ and $m_2 = 20\ kg$ are arranged in a system as shown in figure. All the surfaces are frictionless and strings are inextensible and weightless. The pulleys are also weightless and frictionless. A force F is applied on the system so that the mass m_2 moves upward with an acceleration of $2\ ms^{-2}$. The value of F is (Take $g = 10\ ms^{-2}$)



Option: (1) 3360 N

Option: (2) 3380 N

Option: (3) 3120 N

Option: (4) 3240 N

Question 87: B_X and B_Y are the magnetic field at the centre of two coils of two coils X and Y respectively, each carrying equal current. If coil X has 200 turns and 20 cm radius and coil Y has 400 turns and 20 cm radius, the ratio of B_X and B_Y is

Option: (1) $1:1$

Option: (2) $1:2$

Option: (3) $2:1$

Option: (4) $4:1$

Question 88: The effective current I in the given circuit at very high frequencies will be A.

Question 89: The graph between $\frac{1}{u}$ and $\frac{1}{v}$ for a thin convex lens in order to determine its focal length is plotted as shown in the figure. The refractive index of lens is 1.5 and its both the surfaces have same radius of curvatures R. The value of R will be cm .

(Where $u =$ object distance, $v =$ image distance)

Question 90: Two projectiles are thrown with same initial velocity making an angle of $45°$ and $30°$ with the horizontal respectively. The ratio of their respective ranges will be

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

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

Option: (3) $2:\sqrt{3}$

Option: (4) $\sqrt{3}:2$

Question 91: The maximum and minimum voltage of an amplitude modulated signal are 60 V and 20 V respectively. The percentage modulation index will be

Option: (1) 0.5%

Option: (2) 50%

Option: (3) 2%

Option: (4) 30%

Question 92: In the given figure, the face AC of the equilateral prism is immersed in a liquid of refractive index n. For incident angle $60°$ at the side AC, the refracted light beam just grazes along face AC. The refractive index of the liquid $n = \frac{\sqrt{x}}{4}$. The value of x is -

(Given refractive index of glass $= 1.5$)

Question 93: The efficiency of a Carnot's engine, working between steam point and ice point, will be

Option: (1) 26.81%

Option: (2) 37.81%

Option: (3) 47.81%

Option: (4) 57.81%

Question 94: An aluminium wire is stretched to make its length, 0.4% larger. The percentage change in resistance is

Option: (1) 0.4%

Option: (2) 0.2%

Option: (3) 0.8%

Option: (4) 0.6%

Question 95: An ideal fluid of density $800\ kg\ m^{-3}$, flows smoothly through a bent pipe (as shown in figure) that tapers in cross-sectional area from a to $\frac{a}{2}$. The pressure difference between the wide and narrow sections of pipe is 4100 Pa . At wider section, the velocity of fluid is $\frac{\sqrt{x}}{6}\ m\ s^{-1}$ for $x =$. (Given $g = 10\ m\ s^{-2}$)

Question 96: As per the given circuit, the value of current through the battery will be A.

Question 97: A sinusoidal wave $y(t) = 40sin(10 \times 10^6 \pi t)$ is amplitude modulated by another sinusoidal wave $x(t) = 20sin(1000\pi t)$. The amplitude of minimum frequency component of modulated signal is

Option: (1) 0.5

Option: (2) 0.25

Option: (3) 20

Option: (4) 10

Question 98: A batsman hits back a ball of mass 0.4 kg straight in the direction of the bowler without changing its initial speed of $15\ m\ s^{-1}$. The impulse imparted to the ball is N s.

Question 99: A small bulb is placed at the bottom of a tank containing water to a depth of $\sqrt{7}\ m$. The refractive index of water is $\frac{4}{3}$. The area of the surface of water through which light from the bulb can emerge out is $x\pi\ m^2$. The value of x is .

Question 100: A bag is gently dropped on a conveyor belt moving at a speed of $2\ m\ s^{-1}$. The coefficient of friction between the conveyor belt and bag is 0.4 Initially, the bag slips on the belt before it stops due to friction. The distance travelled by the bag on the belt during slipping motion is : [Take $g = 10\ m\ s^{-2}$]

Option: (1) 2 m

Option: (2) 0.5 m

Option: (3) 3.2 m

Option: (4) 0.8 ms

Question 101: A ball of mass m is thrown vertically upward. Another ball of mass 2 m is thrown an angle θ with the vertical. Both the balls stay in air for the same period of time. The ratio of the heights attained by the two balls respectively is $\frac{1}{x}$. The value of x is -.

Question 102: A block A takes 2 s to slide down a frictionless incline of 30° and length l, kept inside a lift going up with uniform velocity v. If the incline is changed to 45°, the time taken by the block, to slide down the incline, will be approximately:

Option: (1) 2.66 s

Option: (2) 0.83 s

Option: (3) 1.68 s

Option: (4) 0.70 s

Question 103: A series LCR circuit has $L = 0.01H, R = 10\Omega$ and $C = 1\mu F$ and it is connected to ac voltage of amplitude $(V_m)50\ V$. At frequency 60% lower than resonant frequency, the amplitude of current will be approximately

Option: (1) 466 mA

Option: (2) 312 mA

Option: (3) 238 mA

Option: (4) 196 mA

Question 104: With reference to the observations in photo-electric effect, identify the correct statements from below:

A. The square of maximum velocity of photoelectrons varies linearly with frequency of incident light.

B. The value of saturation current increases on moving the source of light away from the metal surface.

C. The maximum kinetic energy of photo-electrons decreases on decreasing the power of LED (light emitting diode) source of light.

D. The immediate emission of photo-electrons out of metal surface can not be explained by particle nature of light/electromagnetic waves.

E. Existence of threshold wavelength can not be explained by wave nature of light/electromagnetic waves.

Choose the correct answer from the options given below:

Option: (1) A and B only

Option: (2) A and E only

Option: (3) C and E only

Option: (4) D and E only

Question 105: A conducting circular loop is placed in $X - Y$ plane in presence of magnetic field $\vec{B} = \left(3t^3\hat{j} + 3t^2\hat{k}\right)$ in SI unit. If the radius of the loop is 1 m , the induced emf in the loop, at time, $t = 2\ s$ is $n\pi\ V$. The value of n is

.

Question 106: The area of cross-section of a large tank is $0.5\ m^2$. It has a narrow opening near the bottom having area of cross-section $1\ cm^2$. A load of 25 kg is applied on the water at the top in the tank. Neglecting the speed of water in the tank, the velocity of the water, coming out of the opening at the time when the height of water level in the tank is 40 cm above the bottom, will be cms^{-1}. [Take $g = 10\ m\ s^{-2}$]

Question 107: In Young's double slit experiment the two slits are 0.6 mm distance apart. Interference pattern is observed on a screen at a distance 80 cm from the slits. The first dark fringe is observed on the screen directly opposite to one of the slits. The wavelength of light will be nm .

Question 108: A stone tide to a string of length L is whirled in a vertical circle with the other end of the string at the centre. At a certain instant of time, the stone is at its lowest position and has a speed u. The magnitude of change in its velocity, as it reaches a position where the string is horizontal, is $\sqrt{x(u^2 - gL)}$. The value of x is

Option: (1) 2

Option: (2) 3

Option: (3) 4

Option: (4) 1

Question 109: A rolling wheel of 12 kg is on an inclined plane at position P and connected to a mass of 3 kg through a string of fixed length and pulley as shown in figure.

Consider PR as friction free surface.

The velocity of centre of mass of the wheel when it reaches at the bottom Q of the inclined plane PQ will be $\frac{1}{2}\sqrt{xgh}\ m\ s^{-1}$. The value of x (rounded off to the nearest integer) is $-$

Question 110: A particle executes simple harmonic motion. Its amplitude is 8 cm and time period is 6 s . The time it will take to travel from its position of maximum displacement to the point corresponding to half of its amplitude, is S

Question 111: In the wave equation $y = 0.5sin\frac{2\pi}{\lambda}400t - xm$ the velocity of the wave will be:

Option: (1) $200\ m\ s^{-1}$

Option: (2) $200\sqrt{2}\ m\ s^{-1}$

Option: (3) $400\ m\ s^{-1}$

Option: (4) $400\sqrt{2}\ m\ s^{-1}$

Question 112: A wire of resistance R_1\$R_\{1\}\$ is drawn out so that its length is increased by twice of its original length. The ratio of new resistance to original resistance is:

Option: (1) $9:1$

Option: (2) $1:9$

Option: (3) $4:1$

Option: (4) $3:1$

Question 113: The equation $\lambda = \frac{1.227}{x}\ nm$ can be used to find the de-Broglie wavelength of an electron. In this equation x stands for :

Where,

$m =$ mass of electron

$P =$ momentum of electron

$K =$ Kinetic energy of electron

$V =$ Accelerating potential in volts for electron

Option: (1) $\sqrt{mK}$

Option: (2) $\sqrt{P}$

Option: (3) $\sqrt{K}$

Option: (4) $\sqrt{V}$

Question 114: The diameter of an air bubble which was initially 2 mm , rises steadily through a solution of density \$1750 \ mathrm \{\sim kg\}/\ mathrm \{m\} \wedge 3\$ at the rate of \$0.35\ mathrm \{\sim cm\}/\ mathrm \{s\}\$. Coefficient of viscosity of the solution is (Assume mass of the bubble to be negligible) (Answer in Poise to the nearest integer)**Question 115:** A pressure-pump has a horizontal tube of cross-sectional area $10\ cm^2$ for the outflow of water at a speed of $20\ m\ s^{-1}$. The force exerted on the vertical wall just in front of the tube which stops water horizontally flowing out of the tube, is: [given : density of water $= 1000\ kg\ m^{-3}$]

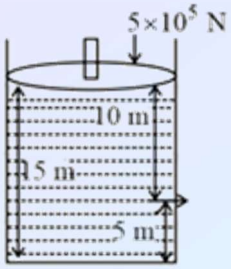
Option: (1) 300 N

Option: (2) 500 N

Option: (3) 250 N

Option: (4) 400 N

Question 116: Consider a cylindrical tank of radius 1 m is filled with water. The top surface of water is at 15 m from the bottom of the cylinder. There is a hole on the wall of cylinder at a height of 5 m from the bottom. A force of $5 \times 10^5\ N$ is applied an the top surface of water using a piston. The speed of efflux from the hole will be : (given atmospheric pressure $P_A = 1.01 \times 10^5 Pa$, density of water $\rho_w = 1000\ kg\ m^{-3}$ and gravitational acceleration $g = 10\ m\ s^{-2}$)



Option: (1) $11.6\ m\ s^{-1}$

Option: (2) $10.8\ m\ s^{-1}$

Option: (3) $17.8\ m\ s^{-1}$

Option: (4) $14.4\ m\ s^{-1}$

Question 117: The magnetic field at the center of current carrying circular loop is B_1. The magnetic field at a distance of $\sqrt{3}$ times radius of the given circular loop from the center on its axis is B_2. The value of $\frac{B_1}{B_2}$ will be

Option: (1) $9:4$

Option: (2) $12:\sqrt{5}$

Option: (3) $8:1$

Option: (4) $5:\sqrt{3}$

Question 118: The power of a lens (biconvex) is $1.25\ m^{-1}$ in particular medium. Refractive index of the lens is 1.5 and radii of curvature are 20 cm and 40 cm respectively. The refractive index of surrounding medium:

Option: (1) 1.0

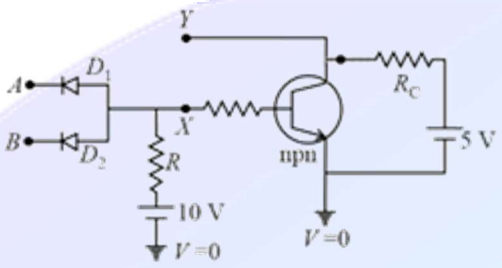
Option: (2) $\frac{9}{7}$

Option: (3) $\frac{3}{2}$

Option: (4) $\frac{4}{3}$

Question 119: A ball is thrown vertically upwards with a velocity of $19.6\ m\ s^{-1}$ from the top of a tower. The ball strikes the ground after 6 s . The height from the ground up to which the ball can rise will be $\left(\frac{k}{5}\right) m$. The value of k is (use $g = 9.8\ m\ s^{-2}$)**Question 120:** In an experiment with a convex lens. The plot of the image distance (v') against the object distance (μ') measured from the focus gives a curve $v'\mu' = 225$. If all the distances are measured in cm . The magnitude of the focal length of the lens is cm .

Question 121: In the following circuit, the correct relation between output (Y) and inputs A and B will be



Option: (1) $Y = A \cdot B$

Option: (2) $Y = A + B$

Option: (3) $Y = \overline{A \cdot B}$

Option: (4) $Y = \overline{A + B}$

Question 122: A pendulum is suspended by a string of length 250 cm . The mass of the bob of the pendulum is 200 g . The bob is pulled aside until the string is at $60°$ with vertical as shown in the figure. After releasing the bob, the maximum velocity attained by the bob will be ms^{-1}. (if $g = 10\ m\ s^{-2}$)

Question 123: A meter bridge setup is shown in the figure. It is used to determine an unknown resistance R using a given resistor of 15Ω. The galvanometer (G) shows null defection when tapping key is at 43 cm mark from end A. If the end correction for end A is 2 cm , then the determined value of R will be Ω.

Question 124: Current measured by the ammeter (A) in the reported circuit when no current flows through 10Ω resistance, will be A.

Question 125: A block of mass 2 kg moving on a horizontal surface with speed of $4\ m\ s^{-1}$ enters a rough surface ranging from $x = 0.5\ m$ to $x = 1.5\ m$. The retarding force in this range of rough surface is related to distance by $F = -kx$ where $k = 12\ N\ m^{-1}$. The speed of the block as it just crosses the rough surface will be

Option: (1) $2\ m\ s^{-1}$

Option: (2) $2.5\ m\ s^{-1}$

Option: (3) $1.5\ m\ s^{-1}$

Option: (4) zero

Question 126: A water drop of radius $1\mu\ m$ falls in a situation where the effect of buoyant force is negligible. Co-efficient of viscosity of air is $1.8 \times 10^{-5}\ N\ s\ m^{-2}$ and its density is negligible as compared to that of water $10^6\ g\ m^{-3}$. Terminal velocity of the water drop is
(Take acceleration due to gravity $= 10\ m\ s^{-2}$)

Option: (1) $145.4 \times 10^{-6}\ m\ s^{-1}$

Option: (2) $123.4 \times 10^{-6}\ m\ s^{-1}$

Option: (3) $118.0 \times 10^{-6}\ m\ s^{-1}$

Option: (4) $132.6 \times 10^{-6}\ m\ s^{-1}$

Question 127: A liquid of density $750\ kg\ m^{-3}$ flows smoothly through a horizontal pipe that tapers in cross-sectional area from $A_1 = 1.2 \times 10^{-2}\ m^2$ to $A_2 = \frac{A_1}{2}$. The pressure difference between the wide and narrow sections of the pipe is 4500 Pa . The rate of flow of liquid is $\times 10^{-3}\ m^3\ s^{-1}$.

Question 128: In a Young's double slit experiment, an angular width of the fringe is $0.35°$ on a screen placed at 2 m away for particular wavelength of 450 nm . The angular width of the

fringe, when whole system is immersed in a medium of refractive index $\frac{7}{5}$, is $\frac{1}{\alpha}$. The value of α is -.

Question 129: A ball is thrown up vertically with a certain velocity so that, it reaches a maximum height h. Find the ratio of the times in which it is at height $\frac{h}{3}$ while going up and coming down respectively.

Option: (1) $\frac{\sqrt{2}-1}{\sqrt{2}+1}$

Option: (2) $\frac{\sqrt{3}-\sqrt{2}}{\sqrt{3}+\sqrt{2}}$

Option: (3) $\frac{\sqrt{3}-1}{\sqrt{3}+1}$

Option: (4) $\frac{1}{3}$

Question 130: The current I flowing through the given circuit will be A.

Question 131: The velocity of a small ball of mass 0.3 g and density $8\ gcc^{-1}$ when dropped in a container filled with glycerine becomes constant after some time. If the density of glycerine is $1.3\ gcc^{-1}$, then the value of viscous force acting on the ball will be $x \times 10^{-4}\ N$, the value of x is .[0pt]

[use $g = 10\ m\ s^{-2}$]

Question 132: A modulating signal $2sin6.28 \times 10^{6}t$ is added to the carrier signal $4sin12.56 \times 10^{9}t$ for amplitude modulation. The combined signal is passed through a non-linear square law device. The output is then passed through a band pass filter. The bandwidth of the output signal of band pass filter will be MHz .

Question 133: Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : The photoelectric effect does not take place, if the energy of the incident radiation is less than the work function of a metal.

Reason R: Kinetic energy of the photoelectrons is zero, if the energy of the incident radiation is equal to the work function of a metal.

Option: (1) Both A and R are correct and R is the correct explanation of A

Option: (3) A is correct but R is not correct

Option: (2) Both A and R are correct but R is not the correct explanation of A

Option: (4) A is not correct but R is correct

Question 134: A parallel beam of light is allowed to fall on a transparent spherical globe of diameter 30 cm and refractive index 1.5. The distance from the centre of the globe at which beam of light can converge is mm .

Question 135: A transistor is used in an amplifier circuit in common emitter mode. If the base current changes by $100\mu\ A$, it brings a change of 10 mA in collector current. If the load resistance is $2k\Omega$ and input resistance is $1k\Omega$, the value of power gain is $x \times 10^{4}$. The value of x is .

Question 136: The motion of a simple pendulum executing S.H.M. is represented by the following equation $y = Asin(\pi t + \varphi)$, where time is measured in second. The length of pendulum is

Option: (1) 97.23 cm

Option: (2) 25.3 cm

Option: (3) 99.4 cm

Option: (4) 406.1 cm

Question 137: A small spherical ball of radius 0.1 mm and density $10^4\ kg\ m^{-3}$ falls freely under gravity through a distance h before entering a tank of water. If, after entering the water the velocity of ball does not change and it
continue to fall with same constant velocity inside water, then the value of h will be m. (Given $g = 10\ m\ s^{-2}$, viscosity of water $= 1.0 \times 10^{-5}\ N - sm^{-2}$).

Question 138: An inductor of 0.5 mH , a capacitor of $200\mu\ F$ and a resistor of 2Ω are connected in series with a 220 V ac source. If the current is in phase with the emf, the frequency of ac source will be $\times 10^2\ Hz$.

Question 139: Given below are two statements :

Statement-I: Acceleration due to gravity is different at different places on the surface of earth.

Statement-II: Acceleration due to gravity increases as we go down below the earth's surface.

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

Option: (1) Both Statement I and Statement II are true

Option: (2) Both Statement I and Statement II are false

Option: (3) Statement I is true but Statement II is false

Option: (4) Statement I is false but Statement II is true

Question 140: A sample of gas at temperature T is adiabatically expanded to double its volume. The work done by the gas in the process is given, (given $\gamma = \frac{3}{2}$) :

Option: (1) $W = TR\sqrt{2} - 2$

Option: (2) $W = \frac{T}{R}\sqrt{2} - 2$

Option: (3) $W = \frac{R}{T}2 - \sqrt{2}$

Option: (4) $W = RT2 - \sqrt{2}$

Question 141: A block is fastened to a horizontal spring. The block is pulled to a distance $x = 10\ cm$ from its equilibrium position (at $x = 0$) on a frictionless surface from rest. The energy of the block at $x = 5\ cm$ is 0.25 J . The spring constant of the spring is Nm^{-1}.

Question 142: For three low density gases A, B, C pressure versus temperature graphs are plotted while keeping them at constant volume, as shown in the figure

The temperature corresponding to the point $/K'$ is:

Option: (1) $-273\ \ ^\circ C$

Option: (2) $-100^\circ C$

Option: (3) $-373^\circ C$

Option: (4) $-40^\circ C$

Question 143: A coil is placed in magnetic field such that plane of coil is perpendicular to the direction of magnetic field. The magnetic flux through a coil can be changed:

A. By changing the magnitude of the magnetic field within the coil.

B. By changing the area of coil within the magnetic field.

C. By changing the angle between the direction of magnetic field and the plane of the coil.

D. By reversing the magnetic field direction abruptly without changing its magnitude.

Choose the most appropriate answer from the options given below:

Option: (1) A and B only

Option: (2) A, B and C only

Option: (3) A, B and D only

Option: (4) A and C only

Question 144: A square shaped coil of area $70\ cm^2$ having 600 turns rotates in a magnetic field of $0.4\ Wb\ m^{-2}$, about an axis which is parallel to one of the side of the coil and perpendicular to the direction of field. If the coil completes 500 revolution in a minute, the instantaneous emf when the plane of the coil is inclined at $60°$ with the field, will be V.

(Take $\pi = \frac{22}{7}$)

Question 145: A small particle of mass m moves in such a way that its potential energy $U = \frac{1}{2}m\omega^2 r^2$ where ω is constant and r is the distance of the particle from origin. Assuming Bohr's quantization of momentum and circular orbit, the radius of n^{th} orbit will be proportional to

Option: (1) $\sqrt{n}$

Option: (2) $\frac{1}{n}$

Option: (3) n^2

Option: (4) n

Question 146: Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R

Assertion A: When you squeeze one end of a tube to get toothpaste out from the other end, Pascal's principle is observed.

Reason R: A change in the pressure applied to an enclosed incompressible fluid is transmitted undiminished to every portion of the fluid and to the walls of its container.

In the light of the above statements, choose the most appropriate answer from the options given below.

Option: (1) Both A and R are correct but R is NOT the correct explanation of A

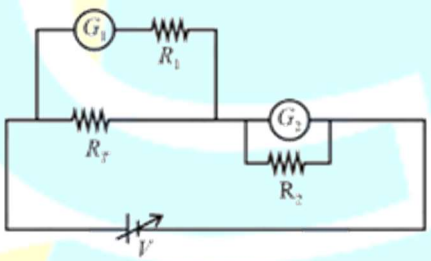
Option: (2) A is not correct but R is correct

Option: (3) A is correct but R is not correct

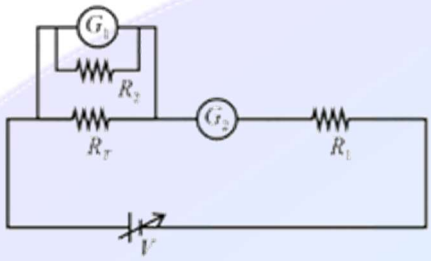
Option: (4) Both A and R is correct and R is the correct explanation of A

Question 147: A student is provided with a variable voltage source V, a test resistor $R_T = 10\Omega$, two identical galvanometers G_1 and G_2 and two additional resistors, $R_1 = 10M\Omega$ and $R_2 = 0.001\Omega$. For conducting an experiment to verify ohm's law, the most suitable circuit is:

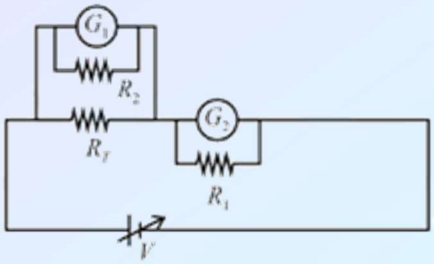
Option: (1)



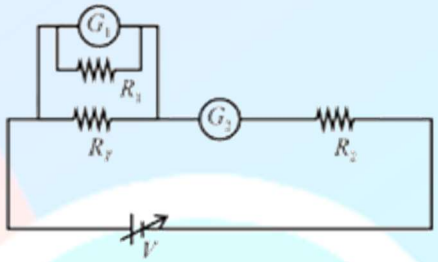
Option: (2)



Option: (3)



Option: (4)



Question 148: Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R

Assertion A: Diffusion current in a $p-n$ junction is greater than the drift current in magnitude if the junction is forward biased.

Reason R: Diffusion current in a $p-n$ junction is form the n-side to the p-side if the junction is forward biased.

In the light of the above statements, choose the most appropriate answer from the options given below.

Option: (1) Both A and R are correct but R is NOT the correct explanation of A

Option: (2) A is correct but R is not correct

Option: (3) A is not correct but R is correct

Option: (4) Both A and R is correct and R is the correct explanation of A

Question 149: At any instant the velocity of a particle of mass 500 g is $(2t\hat{\imath}+3t^2\hat{\jmath})ms^{-1}$. If the force acting on the particle at $t=1\ s$ is $(\hat{\imath}+x\hat{\jmath})N$. Then the value of x will be:

Option: (1) 3

Option: (2) 4

Option: (3) 2

Option: (4) 6

Question 150: An air bubble of volume $1\ cm^3$ rises from the bottom of a lake 40 m deep to the surface at a temperature of $12°C$. The atmospheric pressure is $1\times10^5\ Pa$, the density of water

is $1000\ kg\ m^{-3}$ and $g = 10\ m\ s^{-2}$. There is no difference of the temperature of water at the depth of 40 m and on the surface. The volume of air bubble when it reaches the surface will be

Option: (1) $2\ cm^3$

Option: (2) $3\ cm^3$

Option: (3) $4\ cm^3$

Option: (4) $5\ cm^3$

Question 151: A steel rod of length 1 m and cross-sectional area $10^{-4}\ m^2$ is heated from $0°C$ to $200°C$ without being allowed to extend or bend. The compressive tension produced in the rod is $\times 10^4\ N$. (Given Young's modulus of steel $= 2 \times 10^{11}\ N\ m^{-2}$, coefficient of linear expansion $= 10^{-5}\ K^{-1}$)

Question 152: A transverse harmonic wave on a string is given by $yx, t = 5sin6t + 0.003x$ where x and y are in cm and t in sec. The wave velocity is m s^{-1}.

Question 153: A force of $-P\hat{k}$ acts on the origin of the coordinate system. The torque about the point $(2, -3)$ is $P(a\hat{\imath} + b\hat{\jmath})$, The ratio of $\frac{a}{b}$ is $\frac{x}{2}$. The value of x is

Question 154: An average force of 125 N is applied on a machine gun firing bullets each of mass 10 g at the speed of $250\ m\ s\ s^{-1}$ to keep it in position. The number of bullets fired per second by the machine gun is :

Option: (1) 50

Option: (2) 25

Option: (3) 100

Option: (4) 5

Question 155: A projectile fired at $30°$ to the ground is observed to be at same height at time 3 s and 5 s after projection, during its flight. The speed of projection of the projectile is ms^{-1}. (Given $g = 10\ m\ s^{-2}$)

Question 156: The magnetic field B crossing normally a square metallic plate of area $4\ m^2$ is changing with time as shown in figure. The magnitude of induced emf in the plate during $t = 2\ s$ to $t = 4\ s$, is mV.

Question 157: The energy of He^+ion in its first state is, (The ground state energy for the Hydrogen atom -13.6 eV):

Option: (1) -27.2 eV

Option: (2) -3.4 eV

Option: (3) -13.6 eV

Option: (4) -54.4 eV

Question 158: For a certain organ pipe, the first three resonance frequencies are in the ratio of $1:3:5$ respectively. If the frequency of fifth harmonic is 405 Hz and the speed of sound in air is $324\ m\ s^{-1}$ the length of the organ pipe is
 m .

Question 159: An ice cube has a bubble inside. When viewed from one side the apparent distance of the bubble is 12 cm . When viewed from the opposite side, the apparent distance of the bubble is observed as 4 cm . If the side of the ice cube is 24 cm , the refractive index of the ice cube is

Option: (1) $\frac{3}{2}$

Option: (2) $\frac{2}{3}$

Option: (3) $\frac{6}{5}$

Option: (4) $\frac{4}{3}$

Question 160: A proton and an α-particle are accelerated from rest by 2 V and 4 V potentials, respectively. The ratio of their de-Broglie wavelength is :

Option: (1) $8:1$

Option: (2) $2:1$

Option: (3) $4:1$

Option: (4) $16:1$

Question 161: A body of mass $(5 \pm 0.5)kg$ is moving with a velocity of $(20 \pm 0.4)ms^{-1}$. Its kinetic energy will be

Option: (1) $(1000 \pm 0.14)J$

Option: (2) $(500 \pm 0.14)J$

Option: (3) $(500 \pm 140)J$

Option: (4) $(1000 \pm 140)J$

Question 162: The distance travelled by an object in time t is given by $s = 2.5t^2$. The instantaneous speed of the object at $t = 5\ s$ will be:

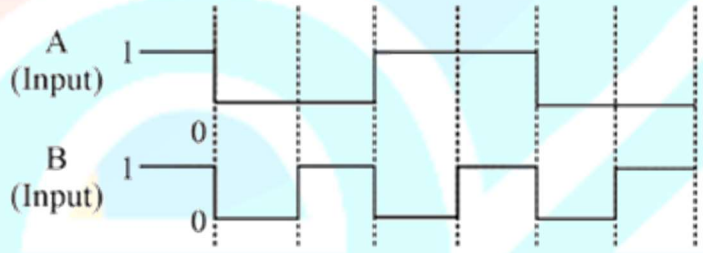
Option: (1) $25\ m\ s^{-1}$

Option: (2) $5\ m\ s^{-1}$

Option: (3) $62.5\ m\ s^{-1}$

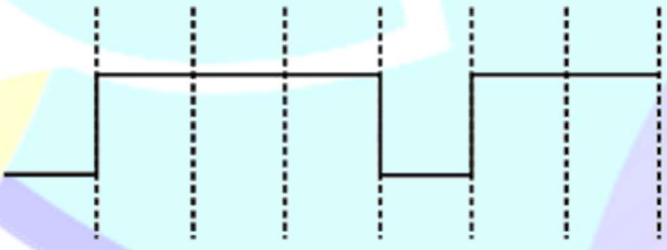
Option: (4) $12.5\ m\ s^{-1}$

Question 163: The output from a NAND gate having inputs A and B given below will be,

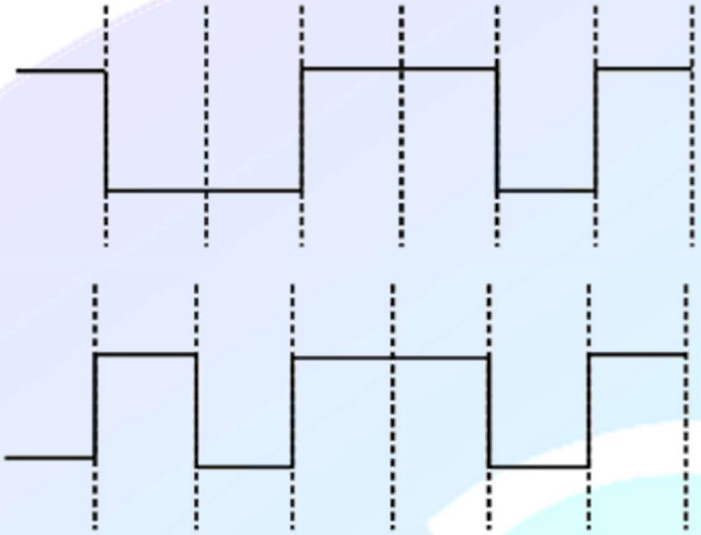


Option: (1)

Option: (2)



Option: (3)



Option: (4)

Question 164: A light rope is wound around a hollow cylinder of mass 5 kg and radius 70 cm . The rope is pulled with a force of 52.5 N . The angular acceleration of the cylinder will be rad s^{-2}.

Question 165: 1 g of a liquid is converted to vapour at 3×10^5 Pa pressure. If 10% of the heat supplied is used for increasing the volume by $1600\ cm^3$ during this phase change, then the increase in internal energy in the process will be :

Option: (1) 4320 J

Option: (2) 432000 J

Option: (3) 4800 J

Option: (4) $4.32 \times 10^8\ J$

Question 166: Given below are two statements:}

Statement I: Acceleration due to earth's gravity decreases as you go 'up' or 'down' from earth's surface.

Statement II: Acceleration due to earth's gravity is same at a height ' h ' and depth ' d ' from earth's surface, if $h = d$.

In the light of above statements, choose the most appropriate answer form the options given below

Option: (1) Statement I is incorrect but statement II is correct

Option: (2) Both Statement I and Statement II are incorrect

Option: (3) Statement I is correct but statement II is incorrect

Option: (4) Both Statement I and II are correct

Question 167: Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R

Assertion (A) : Steel is used in the construction of buildings and bridges.

Reason (R): Steel is more elastic and its elastic limit is high.

In the light of above statements, choose the most appropriate answer from the options given below

Option: (1) Both A and R are correct and R is the correct explanation of A

Option: (3) A is correct but R is not correct

Option: (2) Both A and R are correct but R is NOT the correct explanation of A

Option: (4) A is not correct but R is correct

Question 168: An object of mass 8 kg is hanging from one end of a uniform rod CD of mass 2 kg and length 1 m pivoted at its end C on a vertical wall as shown in figure. It is supported by a cable AB such that the system is in equilibrium. The tension in the cable is:
(Take $g = 10\ m\ s^{-2}$)

Option: (1) 240 N

Option: (2) 90 N

Option: (3) 300 N

Option: (4) 30 N

Question 169: Match List I with List II:

List I	List II
A. Isothermal Process	I. No change in internal energy
B. Adiabatic Process	II. Work done by the gas decreases internal energy
C. Isochoric Process	III. No work is done on or by the gas
D. Isobaric Process	IV. The heat absorbed goes partly to increase internal energy and partly to do work

Choose the correct answer from the options given below:

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

Option: (2) A-II, B-I, C-IV, D-III

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

Option: (4) A-I, B-II, C-III, D-IV

Question 170: For a moving coil galvanometer, the deflection in the coil is 0.05 rad when a current of 10 mA is passed through it. If the torsional constant of suspension wire is $4.0 \times 10^{-5}\ N\ mrad^{-1}$, the magnetic field is 0.01 T and the number of turns in the coil is 200 , the area of each turn (in cm^2) is :

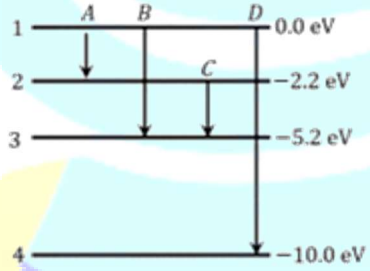
Option: (1) 2.0

Option: (2) 1.0

Option: (3) 1.5

Option: (4) 0.5

Question 171: The energy levels of an atom is shown is figure.
Which one of these transitions will result in the emission of a photon of wavelength 124.1 nm ?
Given ($h = 6.62 \times 10^{-34}\ J$ s)



Option: (1) B

Option: (2) A

Option: (3) C

Option: (4) D

Question 172: A tennis ball is dropped on to the floor from a height of 9.8 m . It rebounds to a height 5.0 m . Ball comes in contact with the floor for 0.2 s . The average acceleration during contact is ms^{-2}. [Given $g = 10\ m\ s^{-2}$]

Question 173: A block of mass m slides down the plane inclined at angle $30°$ with an acceleration $\frac{g}{4}$. The value of coefficient of kinetic friction will be :

Option: (1) $\frac{2\sqrt{3}+1}{2}$

Option: (2) $\frac{1}{2\sqrt{3}}$

Option: (3) $\frac{\sqrt{3}}{2}$

Option: (4) $\frac{2\sqrt{3}-1}{2}$

Question 174: A bicycle tyre is filled with air having pressure of 270 kPa at $27°C$. The approximate pressure of the air in the tyre when the temperature increases to $36°C$ is

Option: (1) 270 kPa

Option: (2) 262 kPa

Option: (3) 278 kPa

Option: (4) 360 kPa

Question 175: A metal block of base area $0.20\ m^2$ is placed on a table, as shown in figure. A liquid film of thickness 0.25 mm is inserted between the block and the table. The block is pushed by a horizontal force of 0.1 N and moves with a constant speed. If the viscosity of the liquid is $5.0 \times 10^{-3} Pl$, the speed of block is $\times 10^{-3}\ m\ s^{-1}$.

Question 176: A square loop of area $25\ cm^2$ has a resistance of 10Ω. The loop is placed in uniform magnetic field of magnitude 40.0 T . The plane of loop is perpendicular to the magnetic field. The work done in pulling the loop out of the magnetic field slowly and uniformly in 1.0 sec , will be

Option: (1) $2.5 \times 10^{-3}\ J$

Option: (2) $1.0 \times 10^{-3}\ J$

Option: (3) $1.0 \times 10^{-4}\ J$

Option: (4) $5 \times 10^{-3}\ J$

Question 177: An inductor of inductance $2\mu H$ is connected in series with a resistance, a variable capacitor and an AC source of frequency 7 kHz . The value of capacitance for which maximum current is drawn into the circuit is $\frac{1}{x}\ F$, where the value of x is .

(Take $\pi = \frac{22}{7}$)

Question 178: The pressure (P) and temperature (T) relationship of an ideal gas obeys the equation $PT^2 =$ constant. The volume expansion coefficient of the gas will be :

Option: (1) $3T^2$

Option: (2) $\frac{3}{T^2}$

Option: (3) $\frac{3}{T^3}$

Option: (4) $\frac{3}{T}$

Question 179: Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : Efficiency of a reversible heat engine will be highest at $-273^{\circ}C$ temperature of cold reservoir.

Reason R : The efficiency of Carnot's engine depends not only on temperature of cold reservoir but it depends on the temperature of hot reservoir too and is given as $\eta = \left(1 - \frac{T_2}{T_1}\right)$

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

Option: (1) A is true but R is false

Option: (2) Both A and R are true but R is NOT the correct explanation of A

Option: (3) A is false but R is true

Option: (4) Both A and R are true and R is the correct explanation of A

Question 180: A flask contains hydrogen and oxygen in the ratio of $2:1$ by mass at temperature $27^{\circ}C$. The ratio of average kinetic energy per molecule of hydrogen and oxygen respectively is :

Option: (1) $2:1$

Option: (2) $1:1$

Option: (3) $1:4$

Option: (4) $4:1$

Question 181: The velocity of a particle executing SHM varies with displacement (x) as $4v^2 = 50 - x^2$. The time period of oscillations is $\frac{x}{7}\ s$. The value of x is .[0pt]

[Take $\pi = \frac{22}{7}$]

Question 182: In the given circuit, rms value of current (I_{rms}) through the resistor R is :

Option: (1) 2 A

Option: (2) $\frac{1}{2}\ A$

Option: (3) 20 A

Option: (4) $2\sqrt{2}\ A$

Question 183: Match List I with List II:

List I	List II
A. Attenuation	IV. Loss of strength of a signal while propagating through a medium
B. Transducer	III. Converts one form of energy into another
C. Demodulation	II. Process of retrieval of information from the carrier wave at receiver
D. Repeater	I. Combination of a receiver and transmitter

Choose the correct answer from the options given below:

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

Option: (2) A-II, B-III, C-IV, D-I

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

Option: (4) A-IV, B-III, C-II, D-I

Question 184: The correct relation between $\gamma = \frac{C_P}{C_V}$ and temperature T is :

Option: (1) $\gamma \propto \frac{1}{\sqrt{T}}$

Option: (2) $\gamma \propto T^0$

Option: (3) $\gamma \propto \frac{1}{T}$

Option: (4) $\gamma \propto T$

Question 185: Expression for an electric field is given by $\vec{E} = 4000x^2\hat{i}Vm^{-1}$. The electric flux through the cube of side 20 cm when placed in electric field (as shown in the figure) is V cm.

Question 186: A body of mass 10 kg is moving with an initial speed of $20\ m\ s^{-1}$. The body stops after 5 s due to friction between body and the floor. The value of the coefficient of friction is: (Take acceleration due to gravity $g = 10\ m\ s^{-2}$)

Option: (1) 0.2

Option: (2) 0.3

Option: (3) 0.5

Option: (4) 0.4

Question 187: The radius of electron's second stationary orbit in Bohr's atom is R. The radius of 3^{rd} orbit will be

Option: (1) $\frac{R}{3}$

Option: (2) $2.25R$

Option: (3) $3R$

Option: (4) $9R$

Question 188: The minimum energy required by a hydrogen atom in ground state to emit radiation in Balmer series is nearly :

Option: (1) 1.5 eV

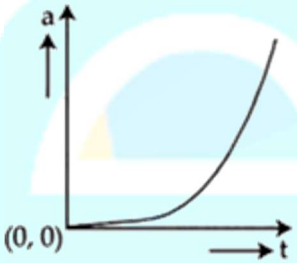
Option: (2) 13.6 eV

Option: (3) 1.9 eV

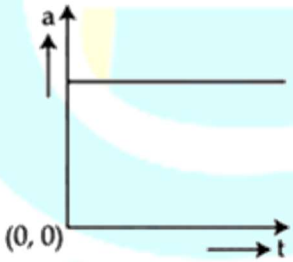
Option: (4) 12.1 eV

Question 189: A wooden block, initially at rest on the ground, is pushed by a force which increases linearly with time t. Which of the following curve best describes acceleration of the block with time:

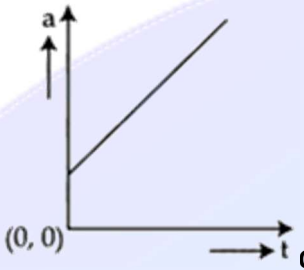
Option: (1)



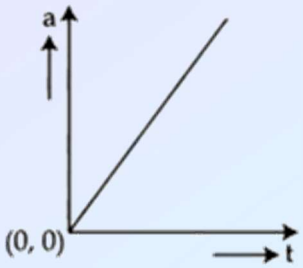
Option: (2)



Option: (3)



Option: (4)



Question 190: Two wires A and B are made up of the same material and have the same mass. Wire A has radius of 2.0 mm and wire B has radius of 4.0 mm . The resistance of wire B is 2Ω. The resistance of wire A is Ω.

Question 191: A wooden block of mass 5 kg rests on a soft horizontal floor. When an iron cylinder of mass 25 kg is placed on the top of the block, the floor yields and the block and the cylinder together go down with an acceleration of $0.1\ ms^{-2}$. The action force of the system on the floor is equal to:

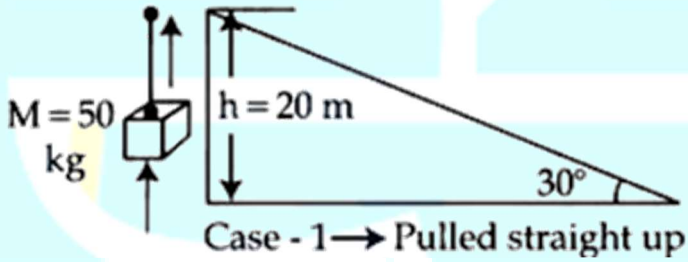
Option: (1) 196 N

Option: (2) 291 N

Option: (3) 294 N

Option: (4) 297 N

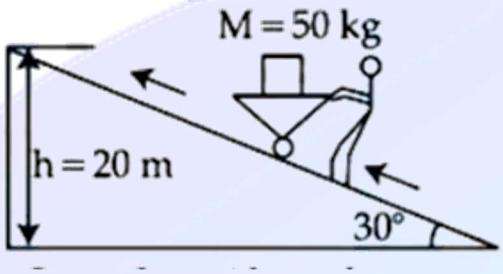
Question 192: A body of mass 50 kg is lifted to a height of 20 m from the ground in the two different ways as shown in the figures. The ratio of work done against the gravity in both the respective cases, will be :



Option: (1) $1:2$

Option: (3) $2:1$

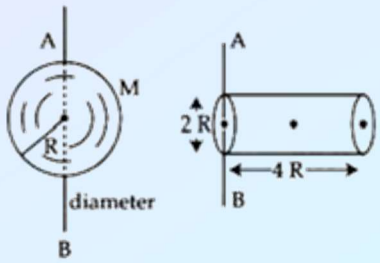
Case -2 → Along the ramp



Option: (2) $\sqrt{3}: 2$

Option: (4) $1: 1$

Question 193: Ratio of radius of gyration of a hollow sphere to that of a solid cylinder of equal mass, for moment of Inertia about their diameter axis AB as shown in figure is $\sqrt{8/x}$. The value of x is :



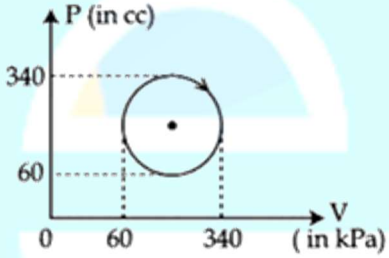
Option: (1) 51

Option: (2) 34

Option: (3) 17

Option: (4) 67

Question 194: The heat absorbed by a system in going through the given cyclic process is :



Option: (1) 19.6 J

Option: (2) 61.6 J

Option: (3) 616 J

Option: (4) 431.2 J

Question 195: A body moves on a frictionless plane starting from rest. If S_n is distance moved between $t = n - 1$ and $t = n$ and S_{n-1} is distance moved between $t = n - 2$ and $t = n - 1$, then the ratio $\frac{S_{n-1}}{S_n}$ is $\left(1 - \frac{2}{x}\right)$ for $n = 10$. The value of x is .

Question 196: In Young's double slit experiment, carried out with light of wavelength $5000\backslash AA$, the distance between the slits is 0.3 mm and the screen is at 200 cm from the slits. The central maximum is at $x = 0\ cm$. The value of x for third maxima is mm .

Question 197: A vernier callipers has 20 divisions on the vernier scale, which coincides with 19^{th} division on the main scale. The least count of the instrument is 0.1 mm . One main scale division is equal to mm .

Option: (1) 0.5

Option: (2) 2

Option: (3) 5

Option: (4) 1

Question 198: A hydraulic press containing water has two arms with diameters as mentioned in the figure. A force of 10 N is applied on the surface of water in the thinner arm. The force required to be applied on the surface of water in the thicker arm to maintain equilibrium of water is

N .

Question 199: The refractive index of prism is $\mu = \sqrt{3}$ and the ratio of the angle of minimum deviation to the angle of prism is one. The value of angle of prism is .

Question 200: A body projected vertically upwards with a certain speed from the top of a tower reaches the ground in t_1. If it is projected vertically downwards from the same point with the same speed, it reaches the ground in t_2. Time required to reach the ground, if it is dropped from the top of the tower, is :

Option: (1) $\sqrt{t_1 t_2}$

Option: (2) $\sqrt{t_1 + t_2}$

Option: (3) $\sqrt{t_1 - t_2}$

Option: (4) $\sqrt{\frac{t_1}{t_2}}$

Question 201: In finding out refractive index of glass slab the following observations were made through travelling microscope 50 vernier scale division $= 49MSD$; 20 divisions on main scale in each cm For mark on paper $MSR = 8.45\ cm, VC = 26$ For mark on paper seen through slab $MSR = 7.12\ cm, VC = 41$ For powder particle on the top surface of the glass slab $MSR = 4.05\ cm, VC = 1 (MSR =$ Main Scale Reading, $VC =$ Vernier Coincidence) Refractive index of the glass slab is :

Option: (1) 1.52

Option: (2) 1.35

Option: (3) 1.42

Option: (4) 1.24

Question 202: In the given figure an ammeter A consists of a 240Ω coil connected in parallel to a 10Ω shunt. The reading of

Question 203: Critical angle of incidence for a pair of optical media is 45°. The refractive indices of first and second media are in the ratio:

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

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

Option: (3) $2:1$

Option: (4) $1:2$

Question 204: A parallel beam of monochromatic light of wavelength 600 nm passes through single slit of 0.4 mm width. Angular divergence corresponding to second order minima would be $\times 10^{-3} rad.$

Question 205: A given object takes n times the time to slide down $45°$ rough inclined plane as it takes the time to slide down an identical perfectly smooth $45°$ inclined plane. The coefficient of kinetic friction between the object and the surface of inclined plane is :

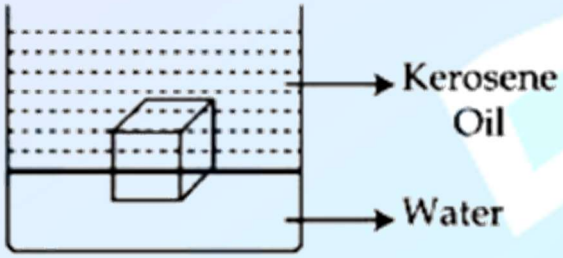
Option: (1) $\sqrt{1-\frac{1}{n^2}}$

Option: (2) $1-n^2$

Option: (3) $1-\frac{1}{n^2}$

Option: (4) $\sqrt{1-n^2}$

Question 206: A cube of ice floats partly in water and partly in kerosene oil. The ratio of volume of ice immersed in water to that in kerosene oil (specific gravity of Kerosene oil $= 0.8$, specific gravity of ice $= 0.9$)



Option: (1) $1:1$

Option: (2) $5:4$

Option: (3) $8:9$

Option: (4) $9:10$

Question 207: If M_o is the mass of isotope $^{12}_{5}B$, M_P and M_n are the masses of proton and neutron, then nuclear binding energy of isotope is :

Option: (1) $(M_o-5M_p)C^2$

Option: (2) $(5M_p+7M_n-M_o)C^2$

Option: (3) $(M_0-12M_n)C^2$

Option: (4) $(M_o-5M_p-7M_n)C^2$

Question 208: Least count of a vernier caliper is $\frac{1}{20\,N}\ cm$. The value of one division on the main scale is 1 mm . Then the number of divisions of main scale that coincide with N divisions of vernier scale is :

Option: (1) $(2\,N-1)$

Option: (2) $\left(\frac{2\,N-1}{2\,N}\right)$

Option: (3) $\left(\frac{2\,N-1}{2}\right)$

Option: (4) $\left(\frac{2N-1}{20}\right)$

Question 209: There are 100 divisions on the circular scale of a screw gauge of pitch 1 mm . With no measuring quantity in between the jaws, the zero of the circular scale lies 5 divisions below the reference line. The diameter of a wire is then measured using this screw gauge. It is found that 4 linear scale divisions are clearly visible while 60 divisions on circular scale coincide with the reference line. The diameter of the wire is :

Option: (1) 3.35 mm

Option: (2) 4.65 mm

Option: (3) 4.55 mm

Option: (4) 4.60 mm

Question 210: A body of mass M thrown horizontally with velocity v from the top of the tower of height H touches the ground at a distance of 100 m from the foot of the tower. A body of mass 2 M thrown at a velocity $\frac{v}{2}$ from the top of the tower of height 4 H will touch the ground at a distance of m.

Question 211: A particle of mass m moves on a straight line with its velocity increasing with distance according to the equation $v = \alpha\sqrt{x}$, where α is a constant. The total work done by all the forces applied on the particle during its displacement from $x = 0$ to $x = d$, will be :

Option: (1) $\frac{m}{2\alpha^2 d}$

Option: (2) $\frac{md}{2\alpha^2}$

Option: (3) $2m\alpha^2 d$

Option: (4) $\frac{m\alpha^2 d}{2}$

Question 212: A heavy iron bar, of weight W is having its one end on the ground and the other on the shoulder of a person. The bar makes an angle θ with the horizontal. The weight experienced by the person is :

Option: (1) $Wcos\theta$

Option: (2) $\frac{W}{2}$

Option: (3) W

Option: (4) $Wsin\theta$

Question 213: An astronaut takes a ball of mass m from earth to space. He throws the ball into a circular orbit about earth at an altitude of 318.5 km . From earth's surface to the orbit, the change in total mechanical energy of the ball is $x\frac{G_e m}{21R_e}$. The value of x is (take $R_e = 6370\ km$) :

Option: (1) 10

Option: (2) 12

Option: (3) 9

Option: (4) 11

Question 214: One main scale division of a vernier caliper is equal to m units. If n^{th} division of main scale coincides with $(n+1)^{th}$ division of vernier scale, the least count of the vernier caliper is :

Option: (1) $\frac{n}{(n+1)}$

Option: (2) $\frac{1}{(n+1)}$

Option: (3) $\frac{m}{(n+1)}$

Option: (4) $\frac{m}{n(n+1)}$

Question 215: Two cars are travelling towards each other at speed of $20\ m\ s^{-1}$ each. When the cars are 300 m apart, both the drivers apply brakes and the cars retard at the rate of $2\ m\ s^{-2}$. The distance between them when they come to rest is :

Option: (1) 200 m

Option: (2) 100 m

Option: (3) 50 m

Option: (4) 25 m

Question 216: A bullet is fired into a fixed target looses one third of its velocity after travelling 4 cm . It penetrates further $D \times 10^{-3}\ m$ before coming to rest. The value of D is :

Option: (1) 32

Option: (2) 5

Option: (3) 3

Option: (4) 4

Question 217: The total kinetic energy of 1 mole of oxygen at $27°C$ is :[0pt]

[Use universal gas constant $(R) = 8.31\ J\ mol^{-1}\ K^{-1}$]

Option: (1) 6845.5 J

Option: (2) 5942.0 J

Option: (3) 6232.5 J

Option: (4) 5670.5 J

Question 218: An object is placed in a medium of refractive index 3. An electromagnetic wave of intensity $6 \times 10^8\ W\ m\ m^{-2}$ falls normally on the object and it is absorbed completely. The radiation pressure on the object would be (speed of light in free space $= 3 \times 10^8\ m\ s^{-1}$):

Option: (1) $36\ N\ m^{-2}$

Option: (2) $18\ N\ m^{-2}$

Option: (3) $6\ N\ m^{-2}$

Option: (4) $2\ N\ m^{-2}$

Question 219: The temperature of a gas having 2.0×10^{25} molecules per cubic meter at 1.38 atm (Given, $k = 1.38 \times 10^{-23}\ J\ K^{-1}$) is :

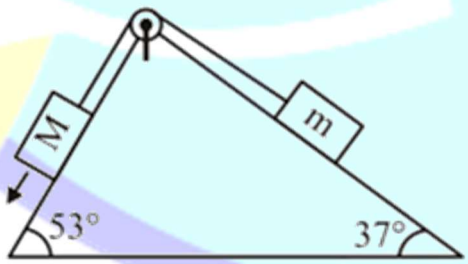
Option: (1) 500 K

Option: (2) 200 K

Option: (3) 100 K

Option: (4) 300 K

Question 220: Two resistance of 100Ω and 200Ω are connected in series with a battery of 4 V and negligible internal resistance. A voltmeter is used to measure voltage across 100Ω resistance, which gives reading as 1 V . The resistance of voltmeter must be Ω.**Question 221:** In an experiment to measure the focal length (f) of a convex lens, the magnitude of object distance (x) and the image distance (y) are measured with reference to the focal point of the lens. The $y - x$ plot is shown in figure. The focal length of the lens is cm .**Question 222:** In the given arrangement of a doubly inclined plane two blocks of masses M and m are placed. The blocks are connected by a light string passing over an ideal pulley as shown. The coefficient of friction between the surface of the plane and the blocks is 0.25 . The value of m, for which $M = 10\ kg$ will move down with an acceleration of $2\ m\ s^{-2}$, is: (take $g = 10\ m\ s^{-2}$ and $tan37° = \frac{3}{4}$)



Option: (1) 9 kg

Option: (2) 4.5 kg

Option: (3) 6.5 kg

Option: (4) 2.25 kg

Question 223: A coil is placed perpendicular to a magnetic field of 5000 T . When the field is changed to 3000 T in 2 s , an induced emf of 22 V is produced in the coil. If the diameter of the coil is 0.02 m , then the number of turns in the coil is:

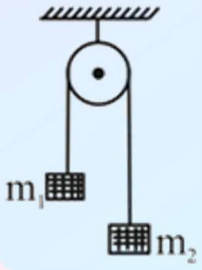
Option: (1) 7

Option: (2) 70

Option: (3) 35

Option: (4) 140

Question 224: A light string passing over a smooth light fixed pulley connects two blocks of masses m_1 and m_2. If the acceleration of the system is $\frac{g}{8}$, then the ratio of masses is



Option: (1) $\frac{9}{7}$

Option: (2) $\frac{8}{1}$

Option: (3) $\frac{4}{3}$

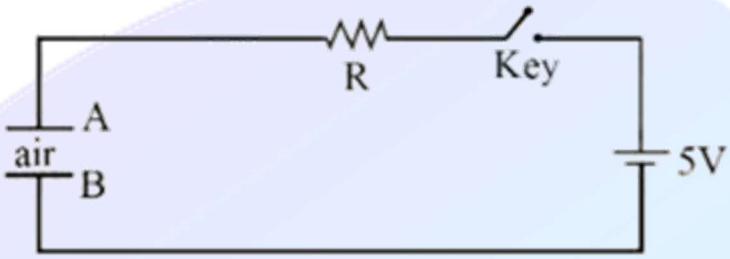
Option: (4) $\frac{5}{3}$

Question 225: Two identical spheres each of mass 2 kg and radius 50 cm are fixed at the ends of a light rod so that the separation between the centers is 150 cm . Then, moment of inertia of the system about an axis perpendicular to the rod and passing through its middle point is $\frac{x}{20}\ kg\ m^2$, where the value of x is

Question 226: Two soap bubbles of radius 2 cm and 4 cm , respectively, are in contact with each other. The radius of curvature of the common surface, in cm , is .

Question 227: Identify the valid statements relevant to the given circuit at the instant when the key is closed.

A. There will be no current through resistor R. B. There will be maximum current in the connecting wires. C. Potential difference between the capacitor plates A and B is minimum. D. Charge on the capacitor plates is minimum. Choose the correct answer from the options given below:



Option: (1) A, C Only

Option: (2) A, B, D Only

Option: (3) C, D Only

Option: (4) B, C, D Only

Question 228: Two point charges $-4\mu c$ and $4\mu c$, constituting an electric dipole, are placed at $(-9,0,0)cm$ and $(9,0,0)cm$ in a uniform electric field of strength $10^4 NC^{-1}$. The work done on the dipole in rotating it from the equilibrium through $180°$ is :

Option: (1) 18.4 mJ

Option: (2) 14.4 mJ

Option: (3) 12.4 mJ

Option: (4) 16.4 mJ

Question 229: A uniform solid cylinder of mass ' m ' and radius ' r ' rolls along an inclined rough plane of inclination $45°$. If it starts to roll from rest from the top of the plane then the linear acceleration of the cylinder's axis will be

Option: (1) $\frac{1}{\sqrt{2}}\ g$

Option: (2) $\frac{1}{3\sqrt{2}}\ g$

Option: (3) $\frac{\sqrt{2}g}{3}$

Option: (4) $\sqrt{2}g$

Question 230: The ratio of the power of a light source S_1 to that the light source S_2 is 2. S_1 is emitting 2×10^{15} photons per second at 600 nm . If the wavelength of the source S_2 is 300 nm , then the number of photons per second emitted by S_2 is $\ldots\ldots \times 10^{14}$.

Question 231: A thin prism P_1 with angle $4°$ made of glass having refractive index 1.54 , is combined with another thin prism P_2 made of glass having refractive index 1.72 to get dispersion without deviation. The angle of the prism P_2 in degrees is

Option: (1) 3

Option: (2) $16/3$

Option: (3) 4

Option: (4) 1.5

Question 232:

A conducting bar moves on two conducting rails as shown in the figure. A constant magnetic field B exists into the page. The bar starts to move from the vertex at time $t = 0$ with a constant velocity. If the induced EMF is $E \propto t^n$, then value of n is

Question 233: The workdone in an adiabatic change in an ideal gas depends upon only:

Option: (1) change in its temperature

Option: (2) change in its volume

Option: (3) change in its pressure

Option: (4) change in its specific heat

Question 234: The number of spectral lines emitted by atomic hydrogen that is in the 4^{th} energy level, is

Option: (1) 3

Option: (2) 1

Option: (3) 6

Option: (4) 0