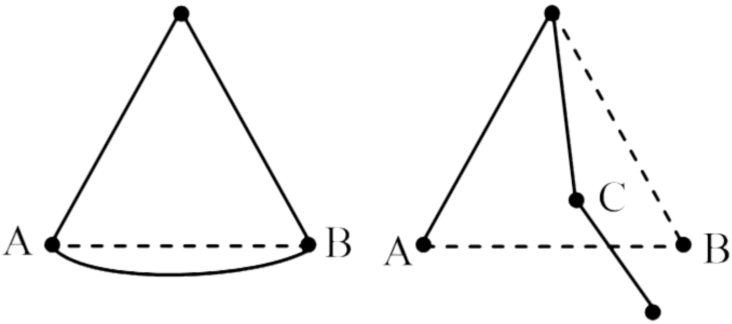
PHYSICS

BOOKS - KVPY PREVIOUS YEAR

KVPY

Physics

1. A simple pendulum oscillates freely between points A and B. We now put a peg (nail) at some point C as shown. As the pendulum moves from A to the right, the string will bend at C and the pendulum will go to its extreme points D. Ignoring friction, the point D



A. will lie on the line AB

B. will lie above the line AB

C. will lie below the line AB

D. will coincide with B

Answer: A

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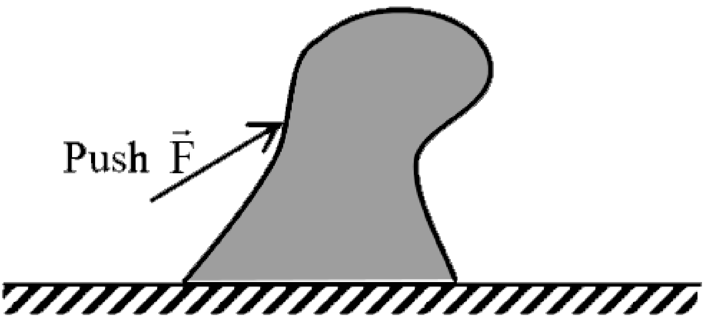
2. A small child tries to moves a large rubber toy placed on the ground. The toy does not move but gets deformed under her pushing force $\left(\overrightarrow{F}\right)$ which is obliquely upward as shown. Then



A. the resultant of the pushing force $\left(\overrightarrow{F}\right)$, weight of the toy, normal force by the ground on the toy and the frictional force is zero

B. the normal force by the ground is equal and opposite to the weight of the toy

C. the pushing force $\left(\vec{F}\right)$ of the child is balanced by the equal and opposite frictional force

D. the pushing force $(vacF)$ of the child is balanced by the total internal force in the toy generated due to deformation

Answer: A

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3. A juggler tosses a ball up in the air with initial speed u. At the instant it reaches its maximum height H, he tosses up a second ball with the same initial speed. The two balls will collide at a height

A. $\frac{H}{4}$

B. $\frac{H}{2}$

C. $\frac{3H}{2}$

D. $\sqrt{\frac{3}{4}}H$

Answer: C

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4. On a horizontal frictionless frozen lake, a girl (36 kg) and a box (9 kg) are connected to each other by means of a rope. Initially they are 20 m apart. The girl exerts a horizontal force on the box, pulling it towards her. How far has the girl traveled when she meets the box $>$

A. 10 m

B. Since there is no friction, the girl will not move

C. 16 m

D. 4m

Answer: D

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5. The following three objects (1) a metal tray, (2) a block of wood, and (3) a woolen cap are left in a closed room overnight. Next day the temperature of each is recorded as T_1, T_2 and T_3 respectively. The likely situation is

A. $T_1 = T_2 = T_3$

B. $T_3 > T_2 > T_1$

C. $T_3 = T_2 > T_1$

D. $T_3 > T_2 = T_1$

Answer: A

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6. We sit in the room with windows open. Then

A. air pressure on the floor of the room equals the atmospheric pressure but the air pressure on the ceiling is negligible

B. air pressure is nearly the same on the floor, the walls and the ceiling

C. air pressure on the floor equals the weight of the air column inside the room (from floor to ceiling) per unit area

D. air pressure on the walls is zero since the weight of air acts downward

Answer: B

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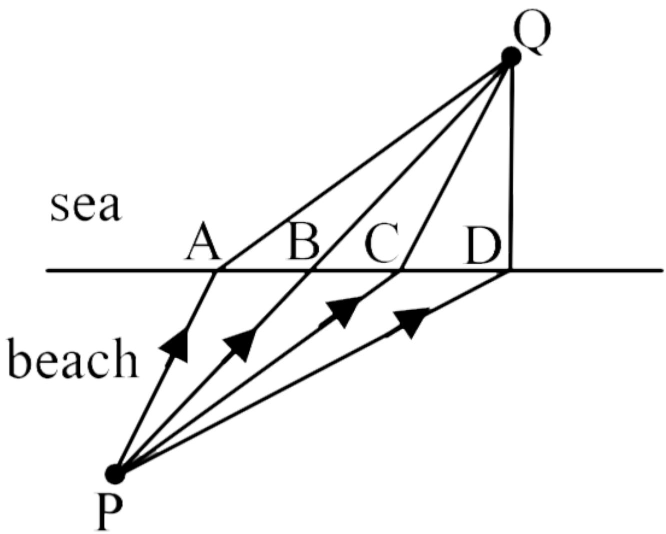
7. A girl standing at point P on a beach wishes to reach a point Q in the sea as quickly as possible. She can run at $6kmh^{-1}$ on the beach and swim at $4kmh^{-1}$ in the sea. She should take the path



A. PAQ

B. PBQ

C. PCQ

D. PDQ

Answer: C

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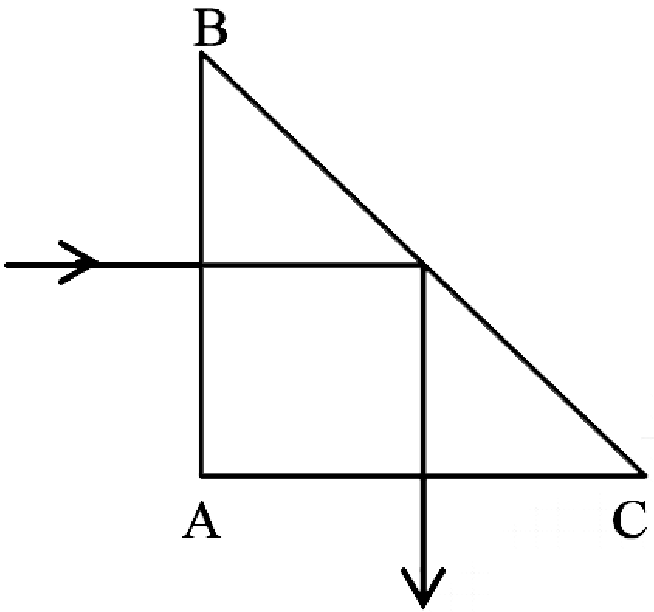
8. Light enters an isosceles right triangular prism at normal incidence through face AB and undergoes total internal reflection at face BC as shown below.

The minimum value of the refractive index of the prism is close to



A. 1.10

B. 1.55

C. 1.42

D. 1.72

Answer: C

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9. A convex lens is used to form an image of an object on a screen. If the upper half of the lens is blackened so that it becomes opaque, then

A. only half of the image will be visible

B. the image position shifts towards the lens

C. the image position shifts away from the lens

D. the brightness of the image reduces

Answer: D

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10. A cylindrical copper rod has length L and resistance R. If it is melted and formed into another rod of length 2L, the resistance will be

A. R

B. 2R

C. 4R

D. 8R

Answer: C

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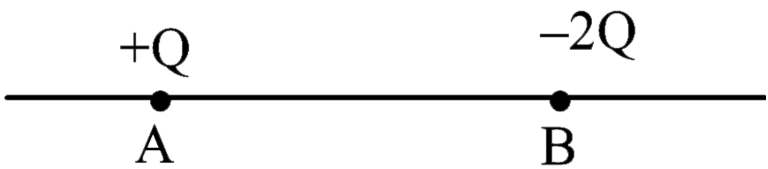
11. Two charges $+Q$ and $-2Q$ are located at points A and B on a horizontal line as shown below

The electric field is zero at a point which is located at a finite distance



A. on the perpendicular bisector of AB

B. left of A on the line

C. between A and B on the line

D. right of B on the line

Answer: B

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12. A 750 W motor drivers a pump which lifts 300 litres of water per minute to a height of 6 meters. The efficiency of the motor is nearly (take acceleration due to gravity to be $10m/s^2$)

A. 0.3

B. 0.4

C. 0.5

D. 0.2

Answer: B

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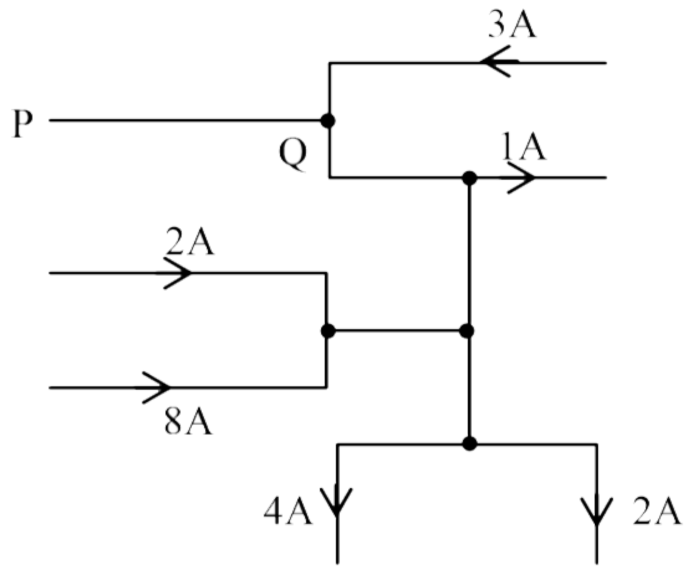
13. Figure below shows a portion of an electric circuit with the currents in amperes and their directions. The magnitude and direction of the current in the portion PQ is



A. 0A

B. 3 A from P to Q

C. 4 A from Q to P

D. 6A from Q to P

Answer: D

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14. A nucleus of lead Pb_{82}^{214} emits two electrons followed by an alpha particle. The resulting nucleus will have

A. 82 protons and 128 neutrons

B. 80 protons and 130 neutrons

C. 82 protons and 130 neutrons

D. 78 protons and 134 neutrons

Answer: A

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15. The number of air molecules in a $(5m \times 5m \times 4m)$ room at standard temperature and pressure is of the order of

A. 6×10^{23}

B. 3×10^{24}

C. 3×10^{27}

D. 6×10^{30}

Answer: C

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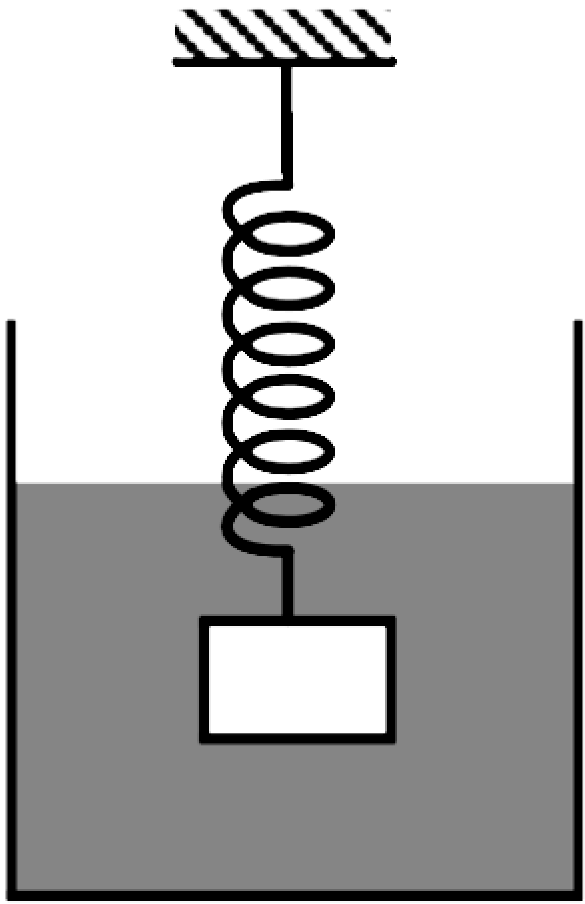
16. An object with uniform density ρ is attached to a spring that is known to stretch linearly with applied force as shown below.

When the spring-object system is immersed in a liquid of density ρ_1 as shown in the figure, the spring stretches by an amount $x_1(\rho > \rho_1)$. When the experiment is repeated in a liquid of density $\rho_2 > \rho_1$, the spring stretches by an amount x_2. Neglecting any buoyant force on the spring, the density of the object is



A. $\rho = \dfrac{\rho_1 x_1 - \rho_2 x_2}{x_1 - x_2}$

B. $\rho = \dfrac{\rho_1 x_2 - \rho_2 x_1}{x_2 - x_1}$

C. $\rho = \dfrac{\rho_1 x_2 + \rho_2 x_1}{x_2 + x_1}$

D. $\rho = \dfrac{\rho_1 x_2 + \rho_2 x_1}{x_1 + x_2}$

Answer: B

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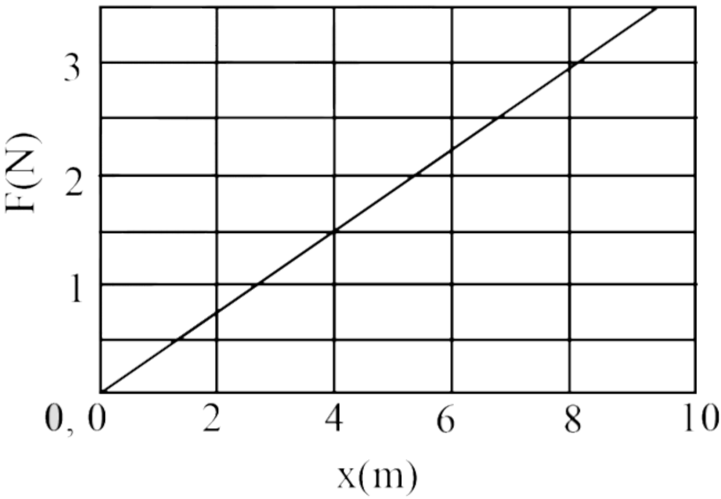
17. A body of 0.5 kg moves along the positive x-axis under the influence of a varying force F (in Newtons) as shown below.

If the speed of the object at x = 4m in 3.16 ms^{-1} then its speed at x = 8m is



A. $3.16ms^{-1}$

B. $9.3ms^{-1}$

C. $8ms^{-1}$

D. $6.8ms^{-1}$

Answer: D

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18. In a thermally isolated system, two boxes filled with an ideal gas are connected by a valve. When the valve is in closed position, states of the box 1 and 2, respectively, are (1 atm, V, T) and (0.5 atm, 4V, T). When the valve is opened, the final pressure of the system is approximately

A. 0.5 atm

B. 0.6 atm

C. 0.75 atm

D. 1.0 atm

Answer: B

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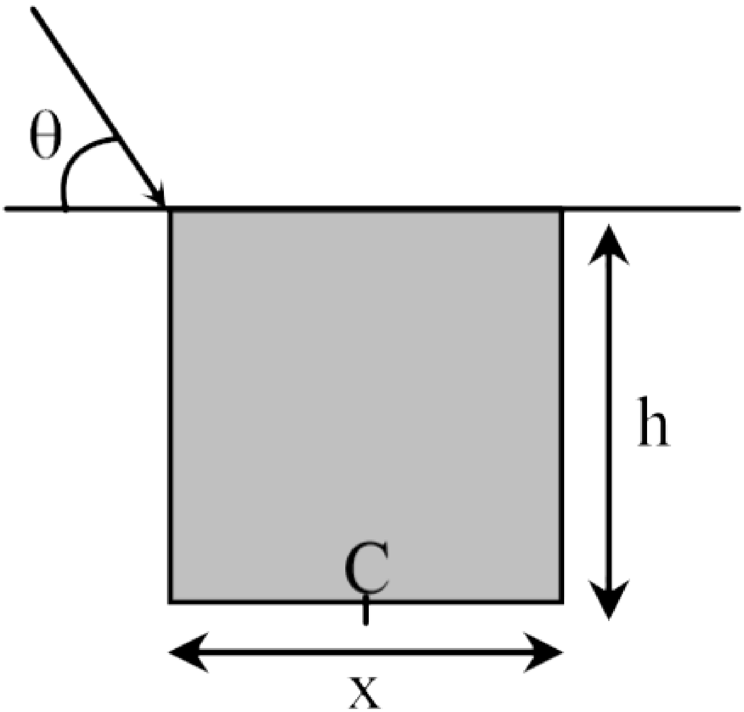
19. A student sees the top edge and the bottom center C of a pool simultaneously from an angle θ above the horizontal as shown in the figure. The refraction index of water which fills up to the top edge of the pool is 4/3. If h/x = 7/4 then $\cos\theta$ is



A. $\frac{2}{7}$

B. $\frac{8}{3\sqrt{45}}$

C. $\frac{8}{3\sqrt{53}}$

D. $\frac{8}{21}$

Answer: C

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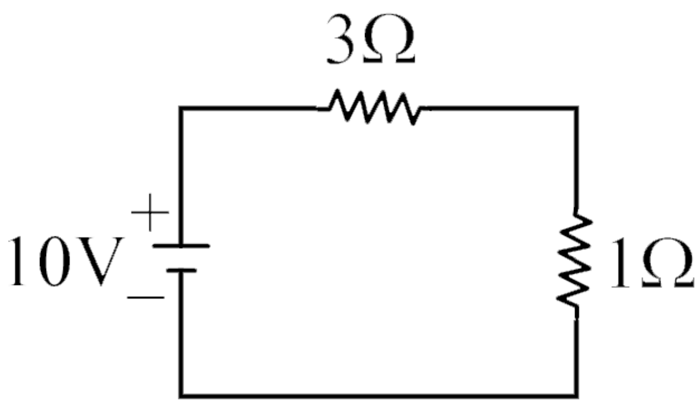
20. In the following circuit, the 1Ω resistor dissipates power P.

If the resistor is replaced by 9Ω, the power dissipated in it is



A. P

B. 3P

C. 9P

D. $P/3$

Answer: A

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21. An ideal monatomic gas expands to twice its volume. If the process is isothermal, the magnitude of work done by the gas is W_1. If the process is adiabatic, the magnitude of work done by the gas is W_a . Which of the following is true ?

A. $W_i = W_a > 0$

B. $W_i > W_a = 0$

C. $W_i > W_a > 0$

D. $W_i > W_a > 0$

Answer: B

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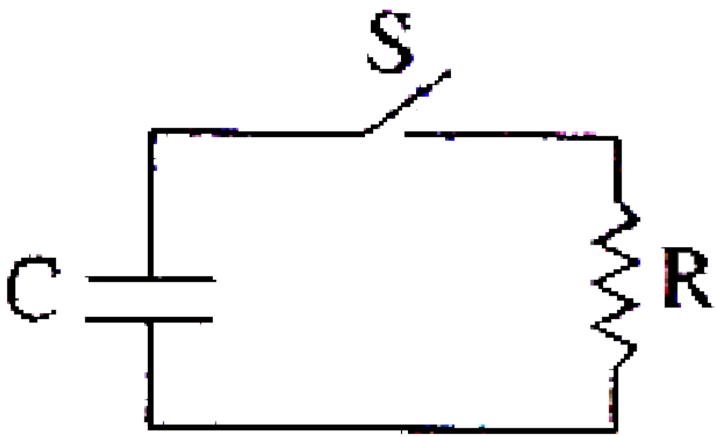
22. The capacitor of capacitance C in the circuit shown in fully charged initially. Resistance is R.–



After the switch S is closed, the time taken to reduce the stored energy in the capacitor to half its initial value is

A. $RC/2$

B. $2RC$ in 2

C. RC ln 2

D. $\frac{RC\ln 2}{2}$

Answer: D

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23. A liquid drop placed on a horizontal plane has a near spherical shape (slightly flattened due to gravity). Let R be the radius of its largest horizontal section. A small disturbance causes the drop to vibrate with frequency v about its equilibrium shape. By dimensional analysis the ratio $\frac{v}{\sqrt{\sigma/\rho R^3}}$ can be (Here σ is surface tension, ρ is density, g is acceleration due to gravity, and k is arbitrary dimensionless constant)–

A. $k\rho g R^2 / \sigma$

B. $k\rho R^2 / g\sigma$

C. $k\rho R^3 / g\sigma$

D. $k\rho / g\sigma$

Answer: A

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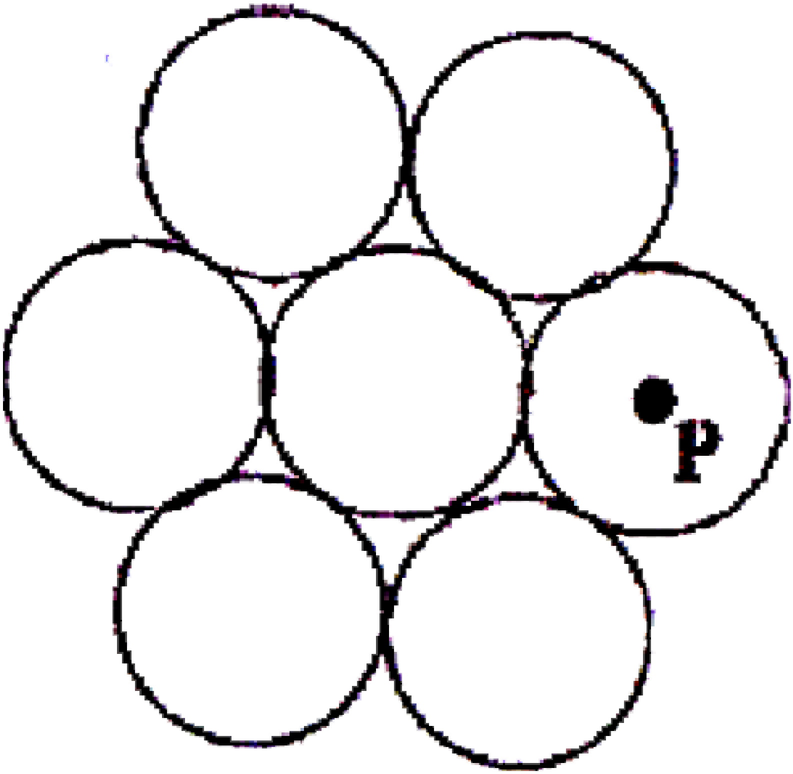
24. Seven identical coins are rigidly arranged on a flat table in the pattern shown below so that each coin touches its neighbors. Each coin is a thin disc of mass m and radius r. Note that the moment of inertia of an individual coin about an axis passing through centre and perpendicular to the plane of the coin is $m^2/2$



The moment of inertia of the system of seven coins about an axis that passes through the point P (the centre of the coin positioned directly to the right of the central coin) and perpendicular to the plane of the coins is–

A. $\frac{55}{2}mr^2$

B. $\frac{127}{2}mr^2$

C. $\frac{111}{2}mr^2$

D. $55mr^2$

Answer: C

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25. A planet orbits in an elliptical path of eccentricity e around a massive star considered fixed at one of the foci. The point in space where it is closest to the star is denoted by P and the point where it is farthest is denoted by A. Let v_p and v_a be the respective speeds at P and A. Then–

A. $\frac{v_P}{v_A} = \frac{1+e}{1-e}$

B. $\frac{v_P}{v_A} = \frac{1+e^2}{1-e}$

C. $\frac{v_P}{v_A} = 1$

D. $\frac{v_P}{v_A} = \frac{1+e^2}{1-e^2}$

Answer: A

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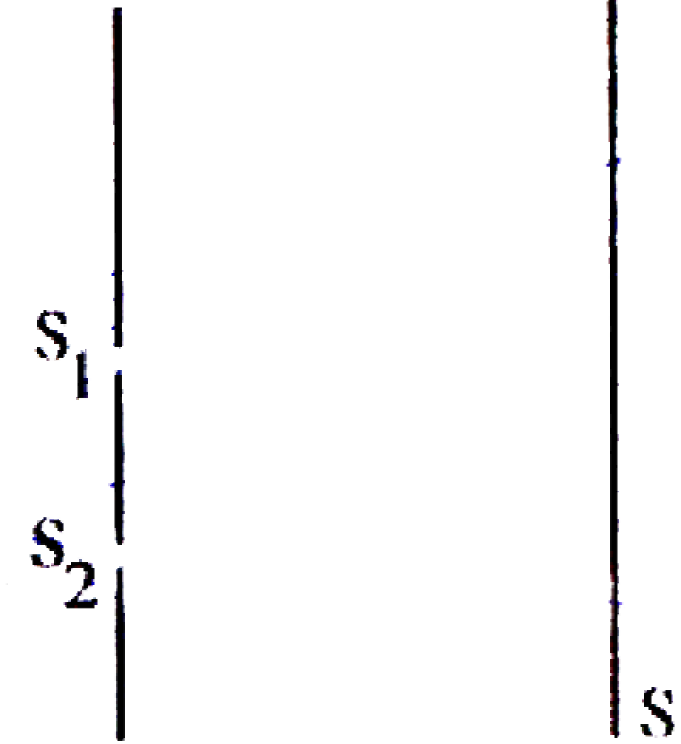
26. In a Young's double slit experiment the intensity of light at each slit is I_0. Interference pattern in observed along a direction parallel to the line S_1S_2, on screen S.–



The minimum, maximum, and the intensity averaged over the entire screen are respectively

A. $0,\ 4I_0,\ 2I_0$

B. $0,\ 4I_0,\ I_0$

C. $I_0,\ 2I_0,\ 3I_0\,/\,2$

D. $0,\ 2_0,\ I_0$

Answer: A

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27. A loop carrying current I has the shape of a regular polygon of n sides. If R is the distance from the centre to any vertex, then the magnitude of the magnetic induction vector $\overrightarrow{B}$ at the centre of the loop is –

A. $n\frac{\mu_0 I}{2\pi R}\tan.\ \frac{\pi}{n}$

B. $\frac{\mu_0 I}{2R}$

C. $n\frac{\mu_0 I}{2\pi R}\tan.\ \frac{2\pi}{n}$

D. $\frac{\mu_0 I}{\pi R}\tan.\ \frac{\pi}{n}$

Answer: A

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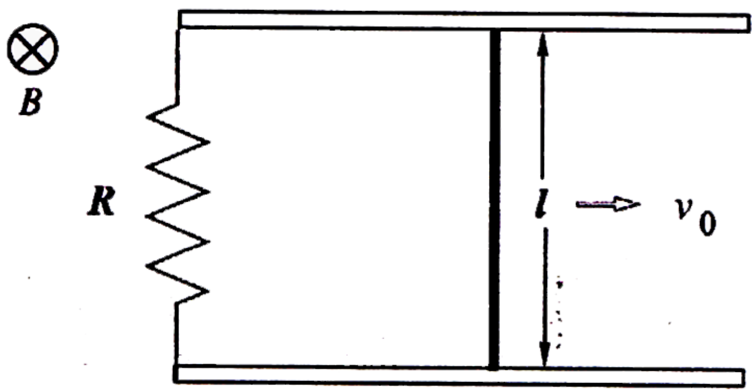
28. A conducting rod of mass m and length l is free to move without friction on two parallel long conducting rails, as shown below. There is a resistance R across the rails. In the entire space around, there is a uniform magnetic field B normal to the plane of the rod and rails. The rod is given an impulsive velocity v_0-



Finally, the initial energy $\frac{1}{2}mv_0^2$

A. Will be converted fully into heat energy in the resistor

B. Will enable rod to continue to move with velocity v_0 since the rails are frictionless

C. Will be converted fully into magnetic energy due to induced current

D. Will be converted into the work done against the magnetic field

Answer: A

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29. A steady current I flows through a wire of radius r, length L and resistivity ρ. The current produced heat in the wire. The rate of heat loss in a wire is proportional to its surface area. The steady temperature of the wire is independent of–

A. L

B. r

C. l

D. ρ

Answer: A

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30. The ratio of the speed of sound to the average speed of an air molecule at 300 K and 1 atmospheric pressure is close to–

A. 1

B. $\sqrt{1/300}$

C. $\sqrt{300}$

D. 300

Answer: A

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31. In one model of the electron, the electron of mass me is thought to be a uniformly charged shell of radius R and total charge e, whose electrostatic energy E is equivalent to its mass me via Einstein's mass energy relation $E = m_e c^2$. In this model, R is approximately ($m_e = 9.1 \times 10^{-31} kg, c = 3 \times 10^8, 1/4\pi\varepsilon_0 = 9 \times 10^9 \text{Farad} m^{-1}$, magnitude of the electron charge $= 1.6 \times 10^{-19} C$) -

A. $1.4 \times 10^{-15} m$

B. $5.3 \times 10^{-11} m$

C. $2 \times 10^{-13} m$

D. $2.8 \times 10^{-35} m$

Answer: A

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32. A body is executing simple harmonic motion of amplitude a and period T about the equilibrium position x = 0. large numbers of snapshots are taken at random of this body in motion. The probability of the body being found in a very small interval x to $x + |dx|$ is highest at –

A. $x = \pm a$

B. $x = \pm a/2$

C. $x = 0$

D. $x = \pm / \sqrt{2}$

Answer: A

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33. Two identical bodies are made of a material for which the heat capacity increases with temperature. One of these is at $100^\circ C$. While the other one is at $0^\circ C$. If the two bodies are brought into contact, then assuming no heat loss, the final common temperature is

A. $50^\circ C$

B. Less than $50^\circ C$

C. More than $50^\circ C$

D. $0^\circ C$

Answer: C

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34. A particle is acted upon by a force given by $F = -\alpha x^3 - \beta x^4$ where α and β are positive constants. At the point x = 0, the particle is –

A. In stable equilibrium

B. In unstable equilibrium

C. In neutral equilibrium

D. Not in equilibrium

Answer: C

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35. The potential energy of a point particle is given by the expression $V(x) = -\alpha x + \beta \sin(x/\gamma)$. A dimensionless combination of the constant α, β and γ is–

A. $\alpha / \beta\gamma$

B. $\alpha^2 / \beta\gamma$

C. $\gamma / \alpha\beta$

D. $\alpha\gamma / \beta$

Answer: D

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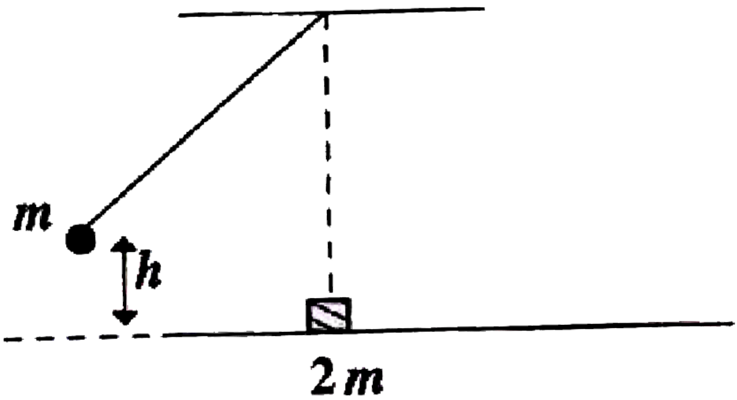
36. A ball of mass m suspended from a rigid support by an inextensible massless string is released from a height h above

its lowest point. At its lowest point it collides elastically with a block of mass 2m at rest on a frictionless surface. Neglect the dimensions of the ball and the block. After the collision the ball rises to a maximum height of–



A. $h/3$

B. $h/2$

C. $h/8$

D. $h/9$

Answer: D

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37. A particle released from rest is falling through a thick fluid under gravity. The fluid exerts a resistive force on the particle proportional to the square of its speed. Which one of the following graphs best depicts the variation of its speed v with time t –

A.

B.

C.

D.

Answer: A

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38. A cylindrical steel rod of length 0.10 m and thermal conductivity $50W.m^{-1}K^{-1}$ is welded end to end to copper rod of thermal conductivity $400W.m^{-1}.K^{-1}$ and of the same area of cross section but 0.20 m long. The free end of the steel rod is maintained at $100^{\circ}C$ and that of the copper and at $0^{\circ}C$. Assuming that the rods are perfectly insulated from the surrounding, the temperature at the junction of the two rods–

A. $20^{\circ}C$

B. $30^{\circ}C$

C. $40^{\circ}C$

D. $50^{\circ}C$

Answer: A

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39. A parent nucleus X is decaying into daughter nucleus Y which in turn decays to Z. The half lives of X and Y are 40000 years and 20 years respectively. In a certain sample, it is found that the number of Y nuclei hardly changes with time. If the number of X nuclei in the sample is 4×10^{20}, the number of Y nuclei present in its is–

A. 2×10^{17}

B. 2×10^{20}

C. 4×10^{23}

D. 4×10^{20}

Answer: A

40. An unpolarized beam of light of intensity I_0 passes through two linear polarizers making an angle of 30° with respect to each other. The emergent beam will have an intensity –

A. $\frac{3I_0}{4}$

B. $\frac{\sqrt{3}I_0}{4}$

C. $\frac{3I_0}{8}$

D. $\frac{I_0}{8}$

Answer: C

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41. The total energy of a black body radiation source is collected for five minutes and used to heat water. The temperature of the water increases from 10.0° to 11.0°. The absolute temperature of the black body is doubled and its surface area halved and the experiment repeated for the same time. Which of the following statements would be most nearly correct ?

A. The temperature of the water would increase from $10.0^{\circ} C$ to a final temperature of $12^{\circ} C$

B. The temperature of the water would increase from $10.0^{\circ} C$ to a final temperature of $18^{\circ} C$

C. The temperature of the water would increase from $10.0^{\circ} C$ to a final temperature of $14^{\circ} C$

D. The temperature of the water would increases from $10.0^{\circ} C$ to a final temperature of $11^{\circ} C$

Answer: B

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42. A small asteroid is orbiting around the sun in a circular orbit of radius r_0 with speed V_0. A rocket is launched from the asteroid with speed $V = \alpha V_0$, where V is the speed relative to the sun. The highest value of α for which the rocket will remain bound to the solar system is (ignoring gravity due to the asteroid and effects of other planets) –

A. $\sqrt{2}$

B. 2

C. $\sqrt{3}$

D. 1

Answer: D

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43. A radioactive nucleus A has a single decay mode with half life τ_A. Another radioactive nucleus B has two decay modes 1 and 2. If decay mode 2 were absent, the half life of B would have been $\tau_A / 2$. If decay mode 1 were absent, the half life of B would have been $3\tau_A$, then the ratio τ_B / τ_A is–

A. $3/7$

B. $7/2$

C. $7/3$

D. 1

Answer: A

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44. A stream of photons having energy 3 eV each impinges on a potassium surface. The work function of potassium is 2.3 eV. The emerging photo-electrons are slowed down by a copper plate placed 5 mm away. If the potential difference between the two metal plates is 1 V, the maximum distance the electrons can move away from the potassium surface before being turned back is–

A. $3.5mm$

B. $1.5mm$

C. $2.5mm$

D. $5.0mm$

Answer: A

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45. Consider three concentric metallic spheres A, B and C of radii a, b, c respectively where $a < b < c$, A and B are connected whereas C is grounded. The potential of the middle sphere B is raised to V then the charge on the sphere C is–

A. $-4\pi\varepsilon_0 V\frac{bc}{c-b}$

B. $-4\pi\varepsilon_0 V\frac{ac}{c-b}$

C. $+4\pi\varepsilon_0 V\frac{bc}{c-b}$

D. Zero

Answer: A

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46. On a bright sunny day a diver of height h stands at the bottom of a lake of depth H. Looking upward, he can see objects outside the lake in a circular region of radius R. Beyond this circle he sees the image of objects lying on the floor of the lake. If refractive index of water is 4/3, then the value of R is–

A. $3(H-h)/\sqrt{7}$

B. $(H-h)/\sqrt{7/3}$

C. $3h\sqrt{7}$

D. $(H-h)/\sqrt{5/3}$

Answer: A

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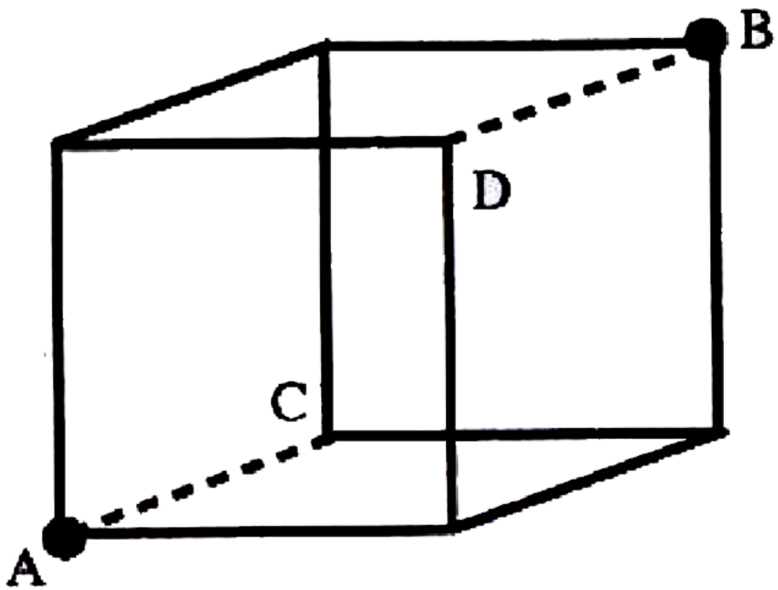
47. As shown in the figure below, a cube is formed with ten identical resistance R (thick lines) and two shorteing wires (dotted lines) along the arms AC and BD



Resistance between point A and B is–

A. $R/2$

B. $5R/6$

C. $3R/4$

D. R

Answer: A

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48. A standing wave in a pipe with a length $L = 1.2m$ is described by

$y(x,t) = y_0 \sin[(2\pi/L)x]\sin[(2\pi/L)x + \pi/4]$

Based on above information, which one of the following statements is incorrect. (Speed of sound in air is $300ms^{-1}$)–

A. The pipe is closed at both ends

B. The wavelength of the wave could be 1.2 m

C. There could be a node at x = 0 and antinode at $x = L/2$

D. The frequency of the fundamental mode of vibrations is

137.5 Hz

Answer: D

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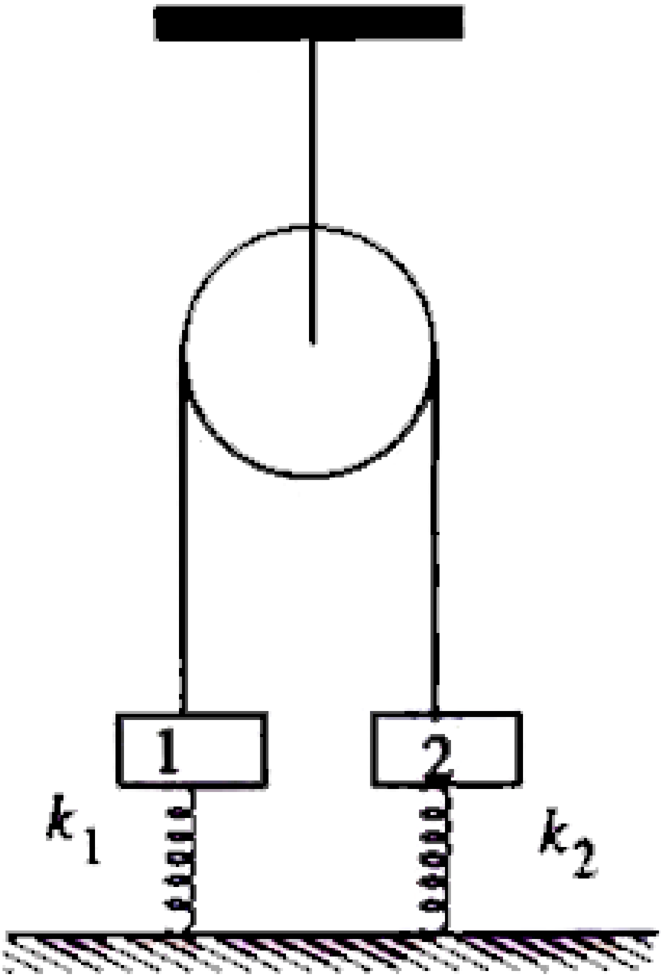
49. Two blocks (1 and 2) of equal mass m are connected by an ideal string (see figure shown) over a frictionless pulley. The blocks are attached to the ground by springs having spring constants k_1 and k_2 such that $k_1 > k_2$



Initially, both springs are unstretched. The block 1 is slowly pulled down a distance x and released. Just after the release the possible values of the magnitude of the acceleration of the blocks a_1 and a_2 can be–

A. Either $\left(a_1 = a_2 = \frac{(k_1 + k_2)x}{2m}\right)$ or $\left(a_1 \frac{k_1 x}{m} - g \text{ and } a_2 = \frac{k_2 x}{m} + g\right)$

B. $\left(a_1 = a_2 = \frac{(k_1 + k_2)x}{2m}\right)$ only

C. $\left(a_1 = a_2 = \frac{(k_1 - k_2)x}{2m}\right)$ only

D. $\left(a_1 = a_2 = \frac{(k_1 - k_2)x}{2m}\right)$ or $\left(a_1 = a_2 = \frac{(k_1 k_2)x}{(k_1 + k_2)m} - g\right)$

Answer: B

Watch Video Solution

50. A simple pendulum is released from rest at the horizontally stretched position. When the string makes an angle θ with the vertical, the angle θ which the acceleration vector of the bob makes with the string is given by–

A. $\phi = 0$

B. $\varphi = \tan^{-1}\left(\frac{\tan\theta}{2}\right)$

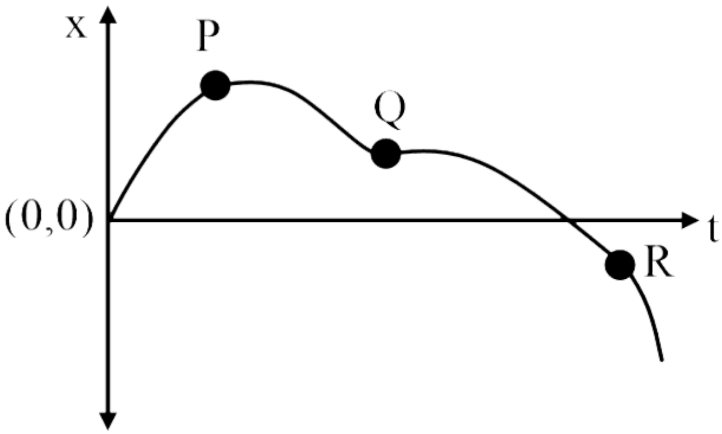
C. $\varphi = \tan^{-1}(2\tan\theta)$

D. $\varphi = \pi/2$

Answer: B

Watch Video Solution

51. In following displacement (x) vs time (t) graph at which among the P,Q and R is the object's speed increasing ?



A. R only

B. P only

C. Q and R only

D. P, Q, R

Answer: A

Watch Video Solution

52. A box, when hung from a spring balance shows a reading of 50 kg. If the same box is hung from the same spring balance inside an evacuated chamber, the reading on the scale will be

A. 50 kg because the mass of the box remains unchanged.

B. 50 kg because the effect of the absence of the atmosphere will be identical on the box and the spring balance.

C. less than 50 kg because the weight of the column of air on the box will be absent.

D. more than 50 kg because the atmosphere buoyancy force will be absent.

Answer: D

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53. Two positively charged spheres of masses $m_1,$ and m_2 are suspended from a common point at the ceiling by identical insulating massless strings of length l. Charged on the two spheres are q_1 and q_2, respectively. At equilibrium both strings make the same angle θ with the vertical. Then

A. $q_1 m_1 = q_2 m_2$

B. $m_1 = m_2$

C. $m_1 = m_2 \sin \theta$

D. $q_2 m_1 = q_1 m_2$

Answer: B

Watch Video Solution

54. A box when dropped from a certain height reaches the ground with a speed ν. When it slides from rest from the same height down a rough inclined plane inclined at an angle 45° to the horizontal, it reaches the ground with a speed $\nu/3$. The coefficient of sliding friction between the box and the plane is (acceleration due to gravity is $10ms^{-2}$)

A. $\frac{8}{9}$

B. $\frac{1}{9}$

C. $\frac{2}{3}$

D. $\frac{1}{3}$

Answer: A

Watch Video Solution

55. A thin paper cup filled with water does not catch fire when placed over a flame. This is because

A. the water cuts off oxygen supply to the paper cup.

B. water is an excellent conductor of heat.

C. the paper cup does not become appreciably hotter than the water it contains.

D. paper is a poor conductor of heat.

Answer: C

Watch Video Solution

56. Ice is used in a cooler in order to cool its contents. Which of the following will speed up the cooling process ?

A. Wrap the ice in a metal foil.

B. Drain the water from the cooler periodically.

C. Put the ice as single block.

D. Crush the ice.

Answer: D

Watch Video Solution

57. The angle of a prism is 60°. When light is incident at an angle of 60° on the prism, the angle of emergence is 40°. The angle of incidence i for which the light ray will deviate the least is such that

A. $I < 40^{\circ}$

B. $40^{\circ} < I < 50^{\circ}$

C. $50^\circ < I < 60^\circ$

D. $I > 60^\circ$

Answer: B

View Text Solution

58. A concave lens made of material of refractive index 1.6 is immersed in a medium of refractive index 2.0 The two surfaces of the concave lens have the same radius of curvature 0.2 m. The lens will behave as a

A. divergent lens of focal length 0.4 m.

B. divergent lens of focal length 0.5 m.

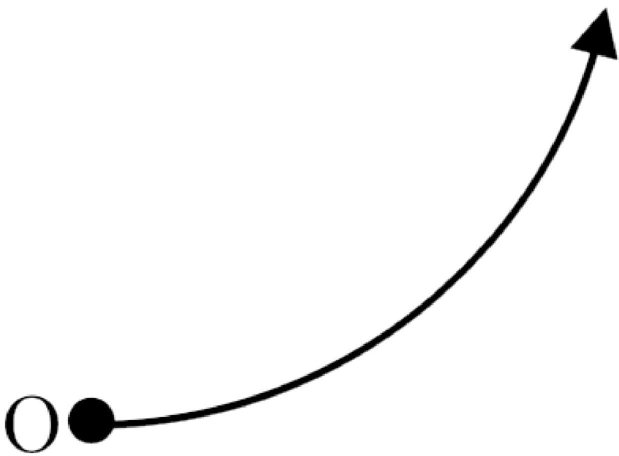
C. convergent lens of focal length 0.4 m.

D. convergent lens of focal length 0.5 m.

Answer: D

Watch Video Solution

59. A charged particle initially at rest at O, when released follows a trajectory as shown. Such a trajectory is possible in the presence of



A. electric field of constant magnitude and varying direction.

B. magnetic field of constant magnitude and varying direction

C. electric field of constant magnitude and constant direction

D. electric and magnetic fields of constant magnitudes and constant directions which are parallel to each other

Answer: A

Watch Video Solution

60. Two equal charges of magnitude Q each are placed at a distance d apart. Their electrostatic energy is E. A third charge $-Q/2$ is brought midway between these two charges. The electrostatic energy of the system is now

A. $-2E$

B. $-E$

C. 0

D. E

Answer: B

Watch Video Solution

61. A bar magnet falls with its north pole pointing down through the axis of a copper ring. When viewed from above, the current in the ring will be

A. clockwise while the magnet is above the plane of the ring, and counter clockwise while below the plane of the ring.

B. counter clockwise throughout.

C. counter clockwise while the magnet is above the plane of the ring, and clockwise while below the plane of the ring.

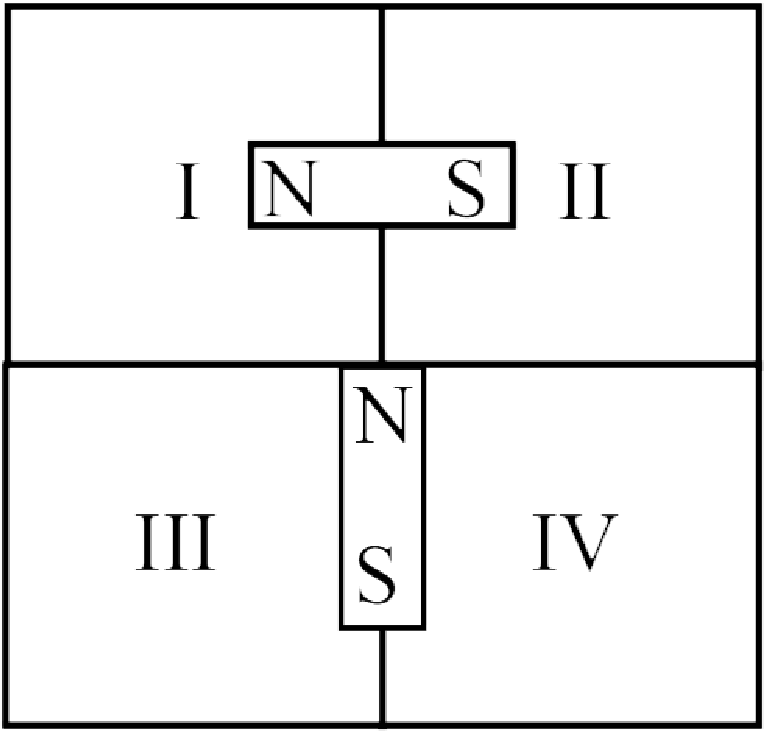
D. clockwise throughout.

Answer: C

Watch Video Solution

62. Two identical bar magnets are held perpendicular to each other with a certain separation, as shown below. The area around the magnets is divided into four zones.

Given that there is a neutral point it is located in



A. Zone I

B. Zone II

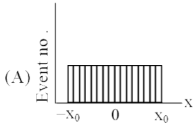
C. Zone III

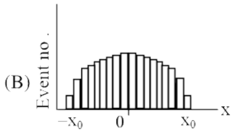
D. Zone IV

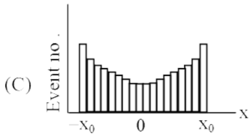
Answer: A

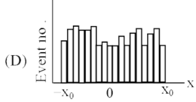
Watch Video Solution

63. A large number of random snap shots using a camera are taken of a particle in simple harmonic motion between $x = -x_0$ and $x = +x_0$ with origin x = 0 as the mean position . A histogram of the total number of times the particle is recorded about a given position (Event no.) would most closely resemble

A. 

B. 

C. 

D. 

Answer: C

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64. In 1911, the physical Ernest Rutherford discovered that atoms have a tiny , dense nucleus by shooting positively charged particles at a very thin gold foil. A key physical property which led Rutherford to use gold was that it was

A. electrically conducting

B. highly malleable

C. shiny

D. non-reactive

Answer: B

Watch Video Solution

65. A uniform thin rod of length 2L and mass m lies on a horizontal table. A horizontal impulse J is given to the rod at one red. There is no friction. The total kinetic energy of the rod just after the impulse will be

A. $\frac{J^2}{2m}$

B. $\frac{J^2}{m}$

C. $\frac{2J^2}{m}$

D. $\frac{6J^2}{m}$

Answer: C

Watch Video Solution

Watch Video Solution

66. A solid sphere spinning about a horizontal axis with an angular velocity ω is placed on a horizontal surface. Subsequently it rolls without slipping with an angular velocity of :

A. $2\omega/5$

B. $7\omega/5$

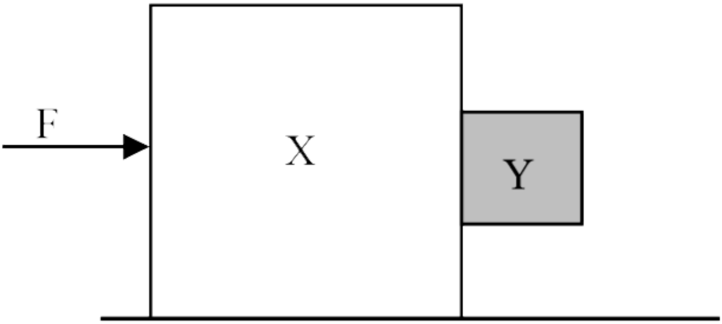
C. $2\omega/7$

D. ω

Answer: C

Watch Video Solution

67. Consider the system shown below



A horizontal force F is applied to a block X of mass 8 kg such that the block Y of mass 2 kg adjacent to it does not slip downwards under gravity. There is no friction between the horizontal plane and the base of the block X. The coefficient of friction between the surfaces of blocks X and Y is 0.5. Take acceleration due to gravity to be $10ms^{-2}$. The minimum value of F is

A. 200 N

B. 160 N

C. 40 N

D. 240 N

Answer: A

Watch Video Solution

68. The maximum value attained by the tension in the string of a swinging pendulum is four times the minimum value it attains. There is no slack in the string. The angular amplitude of the pendulum is

A. 90°

B. 60°

C. 45°

D. 30°

Answer: B

Watch Video Solution

69. One mole of a monoatomic ideal gas is expanded by a process described by PV^3 = C where C is a constant. The heat capacity of the gas during the process is given by (R is the gas constant)

A. 2 R

B. $\frac{5}{2}R$

C. $\frac{3}{2}R$

D. R

Answer: D

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70. A concave mirror of radius of curvature R has a circular outline of radius r. A circular disc is to be placed normal to the axis at the focus so that it collects all the light that is reflected from the mirror from a beam parallel to the axis. For r $> > R$, the area of this disc has to be at least

A. $\frac{\pi r^6}{4R^4}$

B. $\frac{\pi r^4}{4R^2}$

C. $\frac{\pi r^5}{4R^3}$

D. $\frac{\pi r^4}{R^2}$

Answer: A

Watch Video Solution

71. The angles of incidence and refraction of a monochromatic ray of light of wavelength λ at an air-glass interface are i and r, respectively. A parallel beam of light with a small spread $\delta\lambda$ in wavelength about a mean wavelength λ is refracted at the same air-glass interface. The refractive index μ of glass depends on the wavelength λ as $\mu(\lambda) = a + b / \lambda 2$ where a and b are constants. Then the angular spread in the angle of refraction of the beam is

A. $\left|\frac{\sin i}{\lambda^3 \cos r}\delta\lambda\right|$

B. $\left|\frac{2b}{\lambda^3}\delta\lambda\right|$

C. $\left|\frac{2b \tan r}{a\lambda^3 + b\lambda}\delta\lambda\right|$

D. $\left|\frac{2b\left(a + b / \lambda^2\right)\sin i}{\lambda^3}\delta\lambda\right|$

Answer: C

Watch Video Solution

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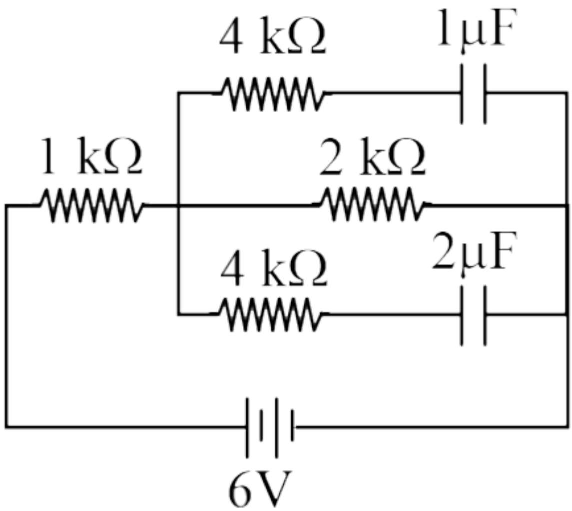
72. What are the charges stored in the $1\mu F$ and $2\mu F$ capacitors in the circuit below, once the currents become steady ?



A. $8\mu C$ and $4\mu C$ respectively

B. $4\mu C$ and $8\mu C$ respectively

C. $3\mu C$ and $6\mu C$ respectively

D. $6\mu C$ and $3\mu C$ respectively

Answer: B

Watch Video Solution

73. A 1.5 kW (kilo-watt) laser beam of wavelength 6400 Å is used to levitate a thin aluminium disc of same area as the cross section of the beam. The laser light is reflected by the aluminium disc without any absorption. The mass of the foil is close to

A. $10^{-9} kg$

B. $10^{-3} kg$

C. $10^{-4} kg$

D. $10^{-6} kg$

Answer: D

Watch Video Solution

74. When ultraviolet radiation of a certain frequency falls on a potassium target, the photoelectrons released can be stopped completely by a retarding potential of 0.6 V. If the frequency of the radiation is increased by 10%, this stopping potential rises to 0.9 V. The work function of potassium is

A. 2.0 eV

B. 2.4 eV

C. 3.0 eV

D. 2.8 eV

Answer: B

Watch Video Solution

75. The dimensions of Stefan-Boltzmann constant σ can be written in terms of Planck's constant h, Boltzmann constant k_B and the speed of light c as $\sigma = h^{\alpha} k_B^{\beta} c^{\gamma}$. Here

A. $\alpha = 3, \beta = 4 \text{ and } \gamma = -3$

B. $\alpha = 3, \beta = -4 \text{ and } \gamma = 2$

C. $\alpha = -3, \beta = 4 \text{ and } \gamma = -2$

D. $\alpha = 2, \beta = -3 \text{ and } \gamma = -1$

Answer: C

Watch Video Solution

76. In an experiment, mass of an object is measured by applying a known force on it, and then measuring its acceleration. If, in the experiment, the measured values of applied force and the measured acceleration are $F = 10.0 \pm 0.2N$ and $a = 1.00 \pm 0.01m/s^2$, respectively, the mass of the object is -

A. $10.0kg$

B. $10.0 \pm 0.1kg$

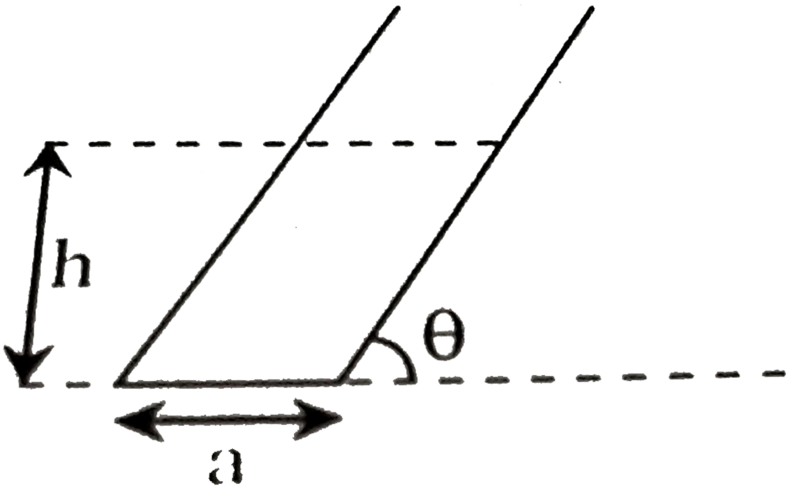
C. $10.0 \pm 0.3kg$

D. $10.0 \pm 0.4kg$

Answer: C

Watch Video Solution

77. A hollow tilted cylindrical vessel of negligible mass rest on a horizontal plane as shown. The diameter of the base is a and the side of the cylinder makes an angle θ with the horizontal. Water is then slowly poured into the cylinder. The cylinder topples over when the water reaches a certain height h, given by



A. $h = 2a \tan\theta$

B. $h = a \tan^2\theta$

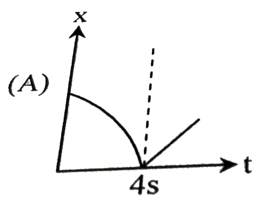
C. $h = a \tan\theta$

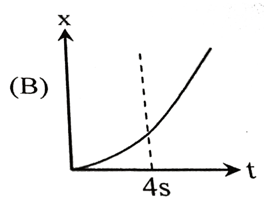
D. $h = \frac{a}{2} \tan \theta$

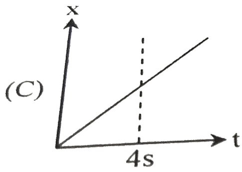
Answer: C

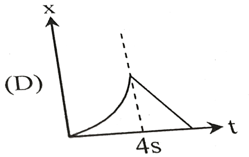
Watch Video Solution

78. An object at rest at the origin begins to move in the $+x$ direction with a uniform acceleration of $1 m / s^2$ for 4s and then it continues moving with a uniform velocity of 4 m/s in the same direction. The x-t graph for object's motion will be -

A. 

B. 

C. 

D. 

Answer: B

Watch Video Solution

79. If the axis of rotation of the earth were extended into space then it would pass close to -

A. the moon

B. the sun

C. the pole star

D. the centre of mass of all the planets in the solar system

Answer: C

Watch Video Solution

80. Methane is greenhouse gas because -

A. it absorbs longer wavelengths of the electromagnetic spectrum while transmitting shorter wavelengths.

B. it absorbs shorter wavelengths of the electromagnetic spectrum while transmitting longer wavelengths

C. it absorbs all wavelengths of the electromagnetic spectrum

D. it transmits all wavelengths of the electromagnetic spectrum

Answer: A

Watch Video Solution

81. A parachutist with total weight 75 kg drops vertically onto a sandy ground with a speed of $2ms^{-1}$ and comes to a halt over a distance of $0.25m$. The average force from the ground on her is close to -

A. 600 N

B. 1200 N

C. 1350 N

D. 1950 N

Answer: C

Watch Video Solution

82. The beta particles of a radioactive metal originate from -

A. the free electrons in the metal

B. the orbiting electrons of the metal atoms

C. the photons released from the nucleus

D. the nucleus of the metal atoms

Answer: D

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83. An optical device is constructed by fixing three identical convex lenses of focal lengths 10 cm each inside a hollow tube at equal spacing of 30 cm each. One end of the device is placed 10 cm away from a point source. How much does the image shift when the device is moved away from the source by another 10 cm ?

A. 0

B. 5 cm

C. 15 cm

D. 45 cm

Answer: A

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84. An isosceles glass prism with base angles 40° is champed over a tray of water in a position such that the base is just dipped in water. A ray of light incident normally on the inclined face suffers total internal reflection at the base. If the refractive index of water is 1.33 then the condition imposed on the refractive index μ of the glass is -

A. $\mu < 2.07$

B. $\mu > 2.07$

C. $\mu < 1.74$

D. $\mu > 1.74$

Answer: B

Watch Video Solution

85. A point source of light is moving at a rate of $2cm - s^{-1}$ towards a thin convex lens of focal length 10 cm along its optical axis. When the source is 15 cm away from the lens the image is moving at -

A. $4cm - s^{-1}$ towards the lens

B. $8cm - s^{-1}$ towards the lens

C. $4cm - s^{-1}$ away from the lens

D. $8cm - s^{-1}$ away from the lens

Answer: D

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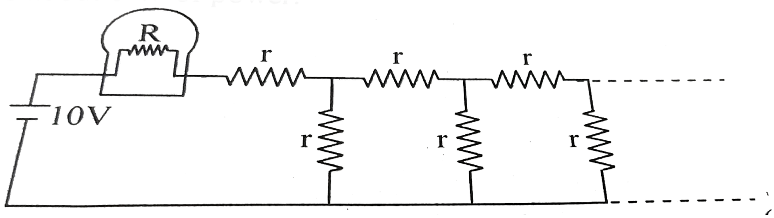
86. A light bulb of resistance $R = 16\Omega$ is attached in series with an infinite resistor network with identical resistances r as shown below. A 10 V battery drives current in the circuit. What should be the value of r such that the bulb dissipates about 1 W of power.



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87. A ball is launched from the top of Mt. Everest which is at elevation of 9000 m. The ball moves in circular orbit around earth. Acceleration due to gravity near the earth's surface is g. The magnitude of the ball's acceleration while in orbit is -

A. close to g/2

B. Zero

C. much greater than g

D. nearly equal to g

Answer: D

Watch Video Solution

88. A planet is orbiting the sun is an elliptical orbit. Let U denote the potential energy and K denote the kinetic energy of the planet at an arbitrary point on the orbit. Choose the correct statement -

A. $K < |U|$ always

B. $K > |U|$ always

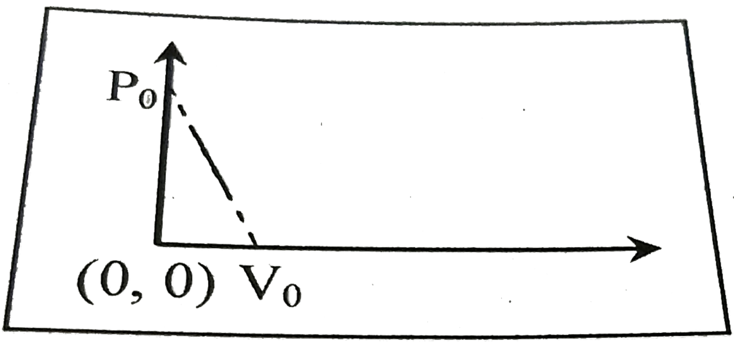
C. $K = |U|$ always

D. $K = |U|$ for two positions of the planet in the orbit

Answer: A

Watch Video Solution

89. One mole of ideal gas undergoes a linear process as shown in figure below. Its temperature expressed as function of volume V is -



A. $\frac{P_0 V_0}{R}$

B. $\dfrac{P_0 V}{R}$

C. $\dfrac{P_0 V}{R}\left(1-\dfrac{V}{V_0}\right)$

D. $\dfrac{P_0 V_0}{R}\left(1-\left(\dfrac{V}{V_0}\right)^2\right)$

Answer: C

Watch Video Solution

90. The international space station is maintained in a nearly circular orbit with a mean altitude of 330 km and a maximum of 410 km. An astronaut is floating in the space station's cabin. The acceleration of astronaut as measured from the earth is -

A. Zero

B. nearly zero and directed towards the earth

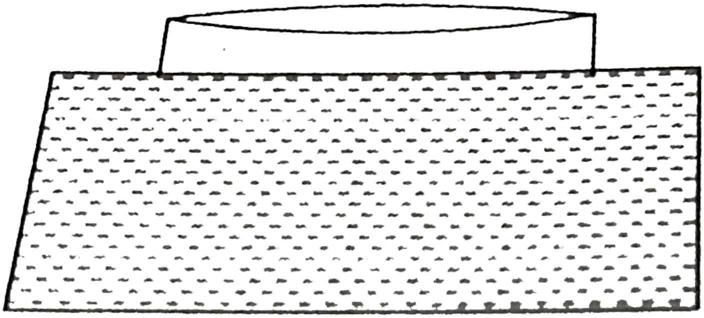
C. nearly g and directed along the line of travel of the station

D. nearly g and directed towards the earth

Answer: D

Watch Video Solution

91. A girl sees through a circular glass slab (refractive index 1.5) of thickness 20 mm and diameter 60 cm to the bottom of a swimming pool. Refractive index of water is 1.33. The bottom surface of the slab is in contact with the water surface.



The depth of swimming pool is 6m. The area of bottom of swimming pool that can be seen through the slab is approximately -

A. $100m^2$

B. $160m^2$

C. $190m^2$

D. $220m^2$

Answer: B

Watch Video Solution

92. 1 Kg of ice at $-20^{\circ} C$ is mixed with 2 Kg of water at $90^{\circ} C$. Assuming that there is no loss of energy to the environment, what will be the final temperature of the mixture ? (Assume latent heat of ice = 334.4 KJ/Kg, specific heat of water and ice are $4.18 kJ / (kg.\ K)$ and $2.09 kJ / (kg.\ K)$, respectively.)

A. $30^{\circ} C$

B. $0^{\circ} C$

C. $80^{\circ} C$

D. $45^{\circ} C$

Answer: A

Watch Video Solution

93. A rigid body in the shape of a "V" has two equal arms made of uniform rods. What must the angle between the two rods be so that when the body is suspended from one end, the other arm is horizontal ?

A. $\cos^{-1}\left(\frac{1}{3}\right)$

B. $\cos^{-1}\left(\frac{1}{2}\right)$

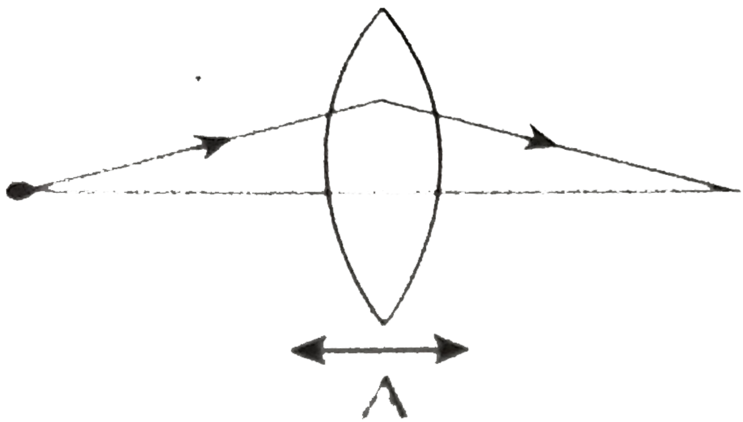
C. $\cos^{-1}\left(\frac{1}{4}\right)$

D. $\cos^{-1}\left(\frac{1}{6}\right)$

Answer: A

Watch Video Solution

94. A point object is placed 20 cm left of a convex lens of focal length f = 5 cm (see the figure). The lens is made to oscillate with small amplitude A along the horizontal axis. The image of the object will also oscillate along the axis with



A. amplitude A/9, out of phase with the oscillation of the lens.

B. amplitude A/3, out of phase with the oscillations of the lens.

C. amplitude A/3, in phase with the oscillations of the lens

D. amplitude A/9, in phase with the oscillations of the lens

Answer: A

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95. Stoke's law states that the viscous drag force F experienced by a sphere of radius a, moving with a speed v through a fluid with coefficient of viscosity η, is given by $F = 6\pi\eta$ If this fluid is flowing through a cylindrical pipe of radius r, length l and a pressure difference of P across its two ends, then the volume of water V which flows through the pipe in time t can be written as

$$\frac{V}{t} = K\left(\frac{p}{l}\right)^{a}\eta^{b}r^{c}$$

where k is a dimensionless constant. Correct values of a, b and c are -

A. $a = 1, b = -1, c = 4$

B. $a = -1, b = 1, c = 4$

C. $a = 2, b = -1, c = 3$

D. $a = 1, b = -2, c = -4$

Answer: A

Watch Video Solution

96. A small box resting on one edge of the table is struck in such a way that it slides off the other edge, 1 m away, after 2 seconds. The coefficient of kinetic friction between the box and the table -

A. must be less than 0.05

B. must be exactly zero

C. must be more than 0.05

D. must be exactly 0.05

Answer: A

Watch Video Solution

97. Carbon-II decays to boron-II according to the following formula.

$._{6}^{11}C \rightarrow ._{5}^{11}B + e^{+} + v_{e} + 0.96 MeV$

Assume that positrons (e^{+}) produced in the decay combine with free electrons in the atmosphere and annihilate each other almost immediately. Also assume that the neutrinos (v_{e}) are massless and do not interact with the environment. At t = 0 we have $1\mu g$ of $._{6}^{12}C$. If the half-life of the decay process is t_0, the net energy produced between time t = 0 and $t = 2t_0$ will be nearly -

A. $8 \times 10^{18} MeV$

B. $8 \times 10^{16} MeV$

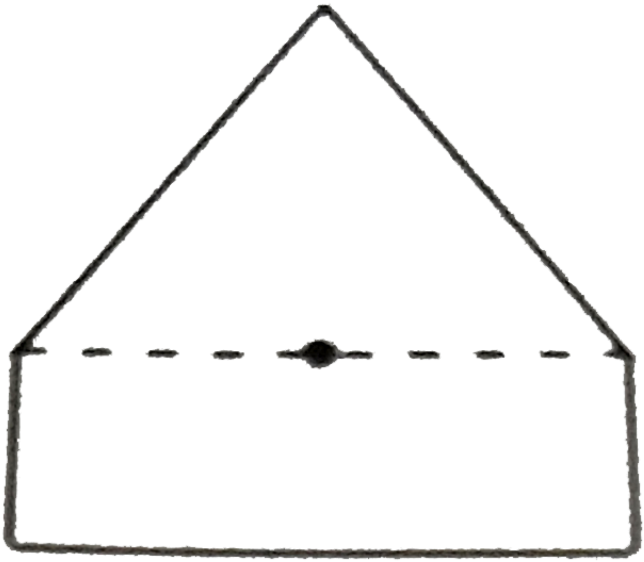
C. $4 \times 10^{18} MeV$

D. $4 \times 10^{16} MeV$

Answer: B

Watch Video Solution

98. Two uniform plates of the same thickness and area but of different materials, one shaped like an isosceles triangle and the other shaped like a rectangle are joined together to form a composite body as shown in the figure. If the centre of mass of the composite body is located at the midpoint of their common side, the ratio between masses of the triangle to that of the rectangle is -



A. $1:1$

B. $4:3$

C. $3:4$

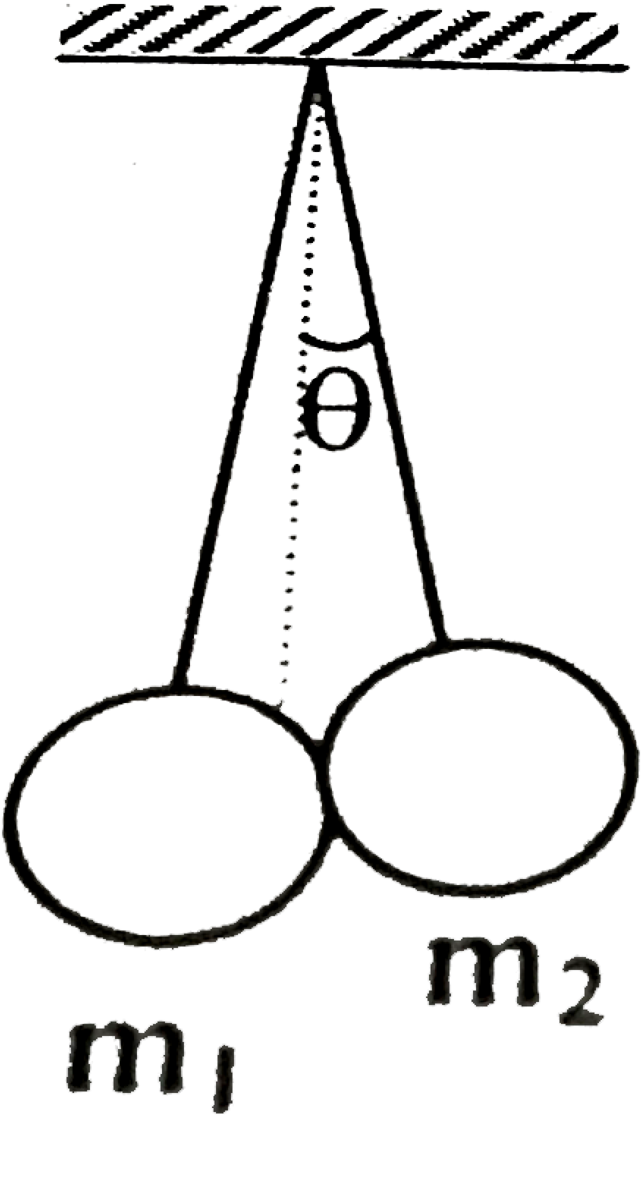
D. $2:1$

Answer: C

Watch Video Solution

99. Two spherical objects each of radii R and masses m1 and m2 are suspended using two strings of equal length L as shown in the figure $(R < < L)$. The angle, θ which mass m_2

makes with the vertical is approximately -



A. $\dfrac{m_1 R}{(m_1 + m_2)L}$

B. $\dfrac{2m_1R}{(m_1+m_2)L}$

C. $\dfrac{2m_2R}{(m_1+m_2)L}$

D. $\dfrac{m_2R}{(m_1+m_2)L}$

Answer: B

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100. A horizontal disk of moment of inertia $4.25kg-m^2$ with respect to its axis of symmetry is spinning counter clockwise at 15 revolutions per second about its axis, as viewed from above. A second disk of moment of inertia $1.80kg-m^2$ with respect to its axis of symmetry is spinning clockwise at 25 revolutions per second as viewed from above about the same axis and is dropped on top of the first disk. The two disks stick together and rotate as one about their axis of symmetry. The new angular velocity of the system as viewed from above is close to -

A. 18 revolutions/second and clockwise

B. 18 revolutions/second and counter clockwise

C. 3 revolutions/second and clockwise

D. 3 revolutions/second and counter clockwise

Answer: D

Watch Video Solution

101. A boy is standing on top of a tower of height 85 m and throws a ball in the vertically upward direction with a certain speed. If 5.25 seconds later he hears the ball hitting the ground, then the speed with which the boy threw the ball is (take $g = 10\frac{m}{s^2}$, speed of sound in air = 340 m/s)

A. 6 m/s

B. 8 m/s

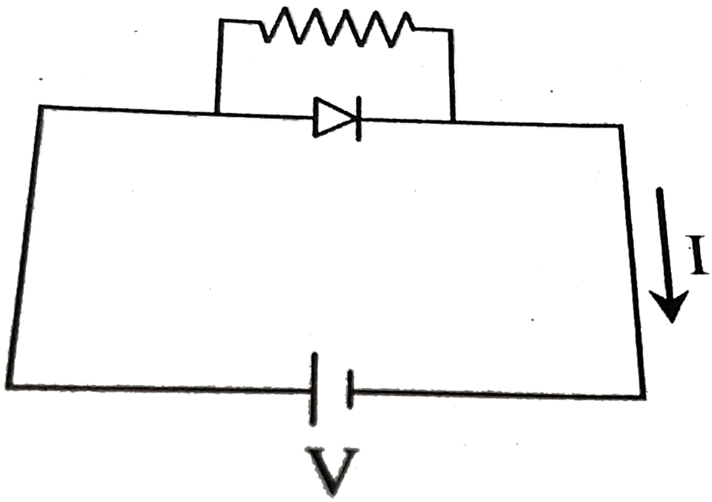
C. 10 m/s

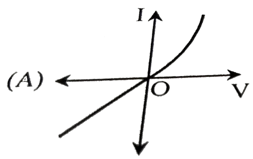
D. 12 m/s

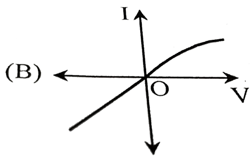
Answer: B

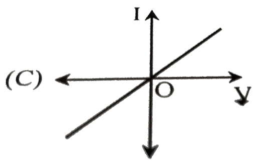
Watch Video Solution

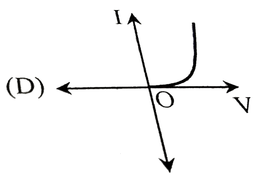
102. For a diode connected in parallel with a resistor, which is the most likely current (I) – voltage (V) characteristic ?



A. 

B. 

C. 

D. 

Answer: A

Watch Video Solution

103. A beam of monoenergetic electrons, which have been accelerated from rest by a potential U, is used to form an interference pattern in a Young's Double slit experiment. The electrons are now accelerated by potential 4U. The fringe width -

A. remains the same

B. is half the original fringe width

C. is twice the original fringe width

D. is one-fourth the original fringe width

Answer: B

Watch Video Solution

104. A point charge $Q(= 3 \times 10^{-12} C)$ rotates uniformly in a vertical circle of radius R =1 mm. The axis of the circle is aligned along the magnetic axis of the earth. At what value of the angular speed ω, the effective magnetic field at the center of the circle will be reduced to zero ? (Horizontal component of Earth's magnetic field is 30 micro Tesla)

A. 10^{11} rad/s

B. 10^{9} rad/s

C. 10^{13} rad/s

D. 10^{7} rad/s

Answer: A

Watch Video Solution

105. A closed bottle containing water at $30^\circ C$ is open on the surface of the moon. Then -

A. the water will boil

B. the water will come as a spherical ball

C. the water will freeze

D. the water will decompose into hydrogen and oxygen

Answer: A

Watch Video Solution

106. A simple pendulum of length l is made to oscillate with an amplitude of 45 degrees. The acceleration due to gravity is g.

Let $T_0 = 2\pi\sqrt{l/g}$. The time period of oscillation of this pendulum will be -

A. T_0 irrespective of the amplitude

B. slightly less than T_0

C. slightly more than T_0

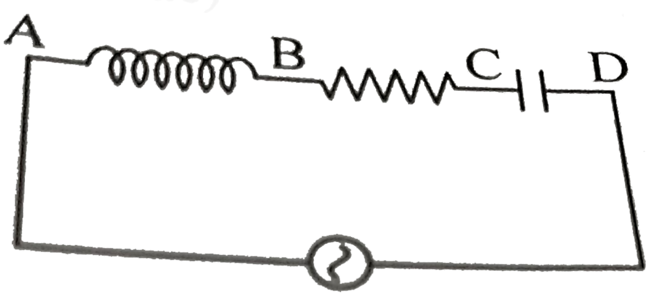
D. dependent on whether it swings in a plane aligned with the north-south or east-west directions

Answer: C

Watch Video Solution

107. An ac voltmeter connected between points A and B in the circuit below reads 36 V. If it is connected between A and C, the reading is 39 V. The reading when it is connected between

B and D is 25 V. What will the voltmeter read when it is connected between A and D ? (Assume that the voltmeter reads true rms voltage values and that the source generates a pure ac)



A. $\sqrt{481}V$

B. 31 V

C. 61 V

D. $\sqrt{3361}V$

Answer: A

Watch Video Solution

108. A donor atom in a semiconductor has a loosely bound electron. The orbit of this electron is considerably affected by the semiconductor material but behaves in many ways like an electron orbiting a hydrogen nucleus. Given that the electron has an effective mass of $0.07m_e$, (where me is mass of the free electron) and the space in which it moves has a permittivity $13\varepsilon_0$, then the radius of the electron's lowermost energy orbit will be close to (The Bohr radius of the hydrogen atom is 0.53Å)

A. 0.53Å

B. 243Å

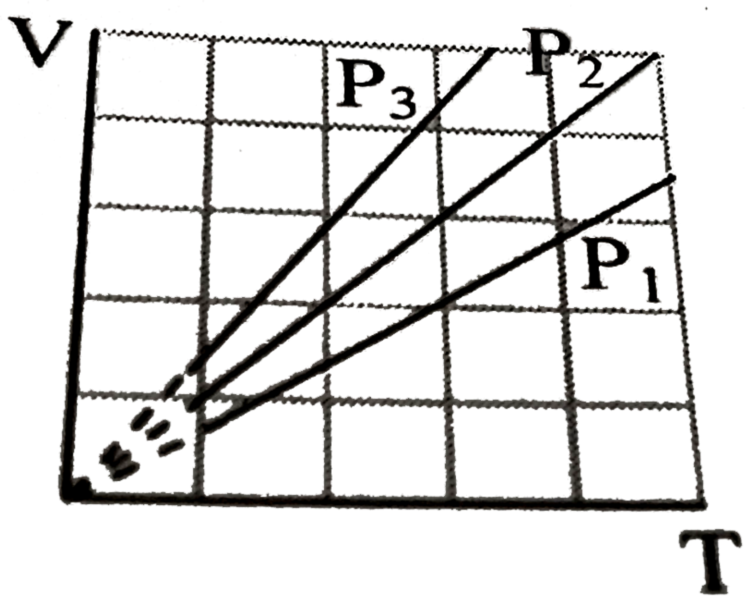
C. 10Å

D. 100Å

Answer: D

Watch Video Solution

109. The state of an ideal gas was changed isobarically. The graph depicts three such isobaric lines. Which of the following is true about the pressures of the gas ?



A. $P_1 = P_2 = P_3$

B. $P_1 > P_2 > P_3$

C. $P_1 < P_2 < P_3$

D. $P_1 / P_2 = P_3 / P_1$

Answer: B

Watch Video Solution

110. A metallic ring of radius a and resistance R is held fixed with its axis along a spatially uniform magnetic field whose magnitude is B_0 sin (ωt). Neglect gravity. Then,

A. the current in the ring oscillates with a frequency of 2ω .

B. the joule hearting loss in the ring is proportional to a^2,

C. the force per unit length on the ring will be proportional to B_0^2.

D. the net force on the ring is non-zero

Answer: C

Watch Video Solution

111. The dimensions of the area A of a black hole can be written in terms of the universal gravitational constant G, its mass M and the speed of light c as $A = G^{\alpha} M^{\beta} c^{\gamma}$. Here -

A. $\alpha = -2, \beta = -2$, and $\gamma = 4$

B. $\alpha = 2, \beta = 2$ and $\gamma = -4$

C. $\alpha = 3, \beta = 3$, and $\gamma = -2$

D. $\alpha = -3, \beta = -3$ and $\gamma = 2$

Answer: B

Watch Video Solution

112. A 160 watt infrared source is radiating light of wavelength 50000Å uniformly in all directions. The photon flux at a distance of $1.18m$ is of the order of -

A. $10m^{-2}s^{-1}$

B. $10^{10}m^{-2}s^{-1}$

C. $10^{15}m^{-2}s^{-1}$

D. $10^{20}m^{-2}s^{-1}$

Answer: D

Watch Video Solution

113. A wire bent in the shape of a regular n-polygonal loop carries a steady current I. Let l be the perpendicular distance of a given segment and R be the distance of vertex both from the centre of the loop. The magnitude of the magnetic field at the centre of the loop is given by -

A. $\frac{n\mu_0 I}{2\pi l}\sin(\pi/n)$

B. $\frac{n\mu_0 I}{2\pi R}\sin(\pi/n)$

C. $\frac{n\mu_0 I}{2\pi l}\cos(\pi/n)$

D. $\frac{n\mu_0 I}{2\pi R}\cos(\pi/n)$

Answer: A

Watch Video Solution

114. The intensity of sound during the festival season increased by 100 times. This could imply a decibel level rise from -

A. 20 to 120 dB

B. 70 to 72 dB

C. 100 to 10000 dB

D. 80 to 100 dB

Answer: D

Watch Video Solution

115. One end of a slack wire (Young's modulus Y, length L and cross-section area A) is clamped to rigid wall and the other end to a block (mass m) which rests on a smooth horizontal plane. The block is set in motion with a speed v. What is the maximum distance the block will travel after the wire becomes taut ?

A. $v\sqrt{\frac{mL}{AY}}$

B. $v\sqrt{\frac{2mL}{AY}}$

C. $v\sqrt{\frac{mL}{AY}}$

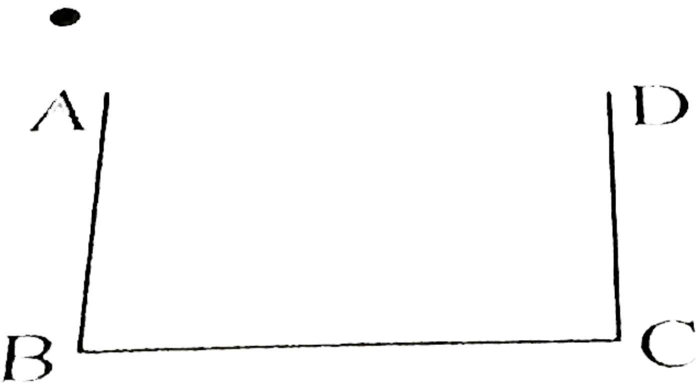
D. $L\sqrt{\frac{mv}{AY}}$

Answer: A

Watch Video Solution

116. A cubical vessel has opaque walls. An observer (dark circle in figure below) is located such that she can see only the wall

CD but not the bottom. Nearly to what height should water be poured so that she can see an object placed at the bottom at a distance of 10 cm from the corner C ? Refractive index of water is 1.33.



A. 10 cm

B. 16 cm

C. 27 cm

D. 45 cm

Answer: C

Watch Video Solution

117. The moments of inertia of a non-uniform circular disc (of mass M and radius R) about four mutually perpendicular tangents AB, BC, CD, DA are I_1, I_2, I_3 and I_4, respectively (the square ABCD circumscribes the circle). The distance of the center of mass of the disc from its geometrical center is given by -

A. $\frac{1}{4MR}\sqrt{(I_1 - I_3)^2 + (I_2 - I_4)^2}$

B. $\frac{1}{12MR}\sqrt{(I_1 - I_3)^2 + (I_2 - I_4)^2}$

C. $\frac{1}{3MR}\sqrt{(I_1 - I_2)^2 + (I_3 - I_4)^2}$

D. $\frac{1}{2MR}\sqrt{(I_1 + I_3)^2 + (I_2 + I_4)^2}$

Answer: A

Watch Video Solution

118. A horizontal steel railroad track has a length of 100 m when the temperature is $25^\circ C$. The track is constrained from expanding or bending. The stress on the strack on a hot summer day, when the temperature is $40^\circ C$, is (Note : the linear coefficient of thermal expansion for steel is $1.1 \times 10^{-5} / .^\circ C$ and the Young's modulus of steel is 2×10^{11} Pa)

A. $6.6 \times 10^7 Pa$

B. $8.8 \times 10^7 Pa$

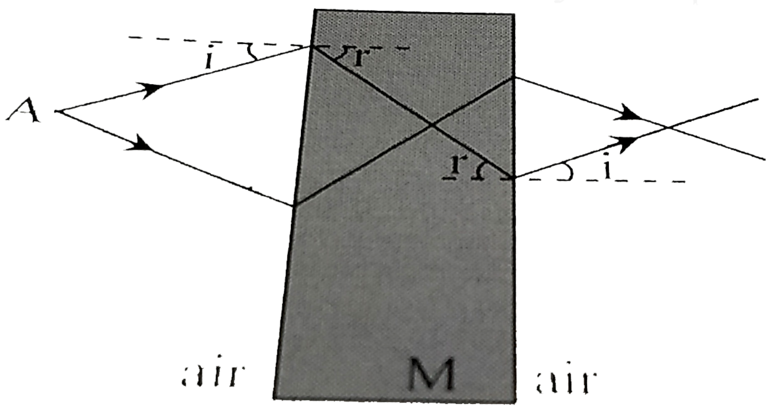
C. $3.3 \times 10^7 Pa$

D. $5.5 \times 10^7 Pa$

Answer: C

Watch Video Solution

119. Electromagnetic waves emanating from a point A (in air) are incident on a rectangular block of material M and emerge from the other side as shown. The angles i and r are angles of incidence and refraction when the wave travels from air to the medium. Such paths for the rays are possible



A. if the material has a refractive index very nearly equal to zero.

B. only with gamma rays with a wavelength smaller than the atomic nuclei of the material

C. if the material has a refractive index less than zero.

D. only if the wave travels in M with a speed faster than the speed of light in vacuum.

Answer: C

Watch Video Solution

120. Two small metal balls of different mass m_1 and m_2 are connected by strings of equal length to a fixed point. When the balls are given equal charges, the angles that the two strings make with the vertical are 30° and 60°, respectively. The ratio m_1 / m_2 is close to -

A. 1.7

B. 3.0

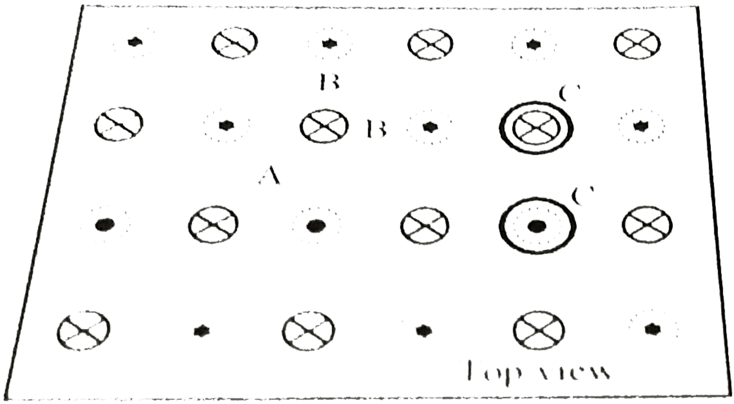
C. 0.58

D. 2.0

Answer: A

Watch Video Solution

121. Consider the regular array of vertical identical current carrying wires (with direction of current flow as indicated in the figure below) protruding through a horizontal table. If we scatter some diamagnetic particles on the table, they are likely to accumulate -



A. around regions such as A

B. around regions such as B

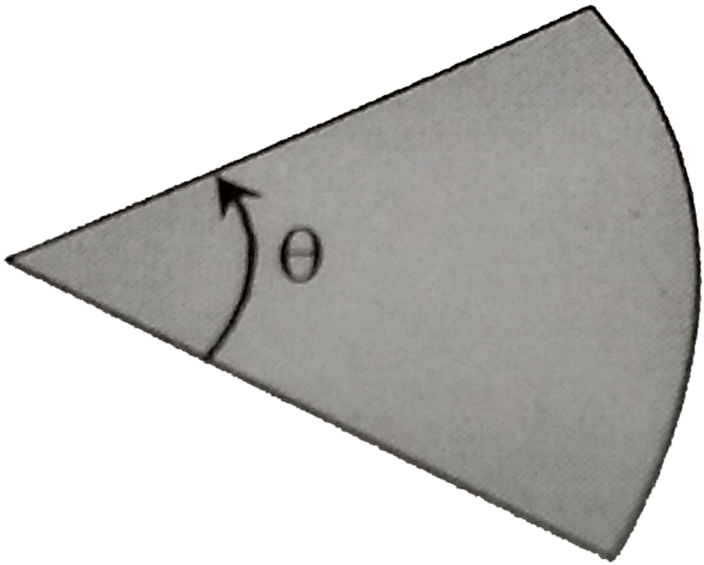
C. in circular regions around individual wires such as C

D. uniformly everywhere

Answer: A

Watch Video Solution

122. The distance between the vertex and the center of mass of a uniform solid planar circular segment of angular size θ and radius R is given by -



A. $\frac{4}{3}R\frac{\sin(\theta/2)}{\theta}$

B. $R\frac{\sin(\theta/2)}{\theta}$

C. $\frac{4}{3}R\cos\left(\left(\frac{\theta}{2}\right)\right)$

D. $\frac{2}{3}R\cos(\theta)$

Answer: A

Watch Video Solution

123. An object is propelled vertically to a maximum height of 4R from the surface of a planet of radius R and mass M. The speed of object when it returns to the surface of the planet is -

A. $2\sqrt{\frac{2GM}{5R}}$

B. $\sqrt{\frac{GM}{2R}}$

C. $\sqrt{\frac{3GM}{2R}}$

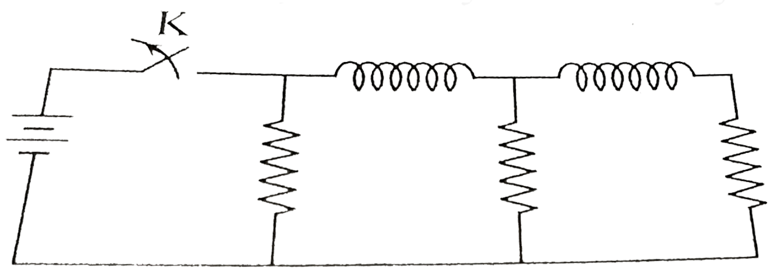
D. $\sqrt{\frac{GM}{5R}}$

Answer: A

Watch Video Solution

Watch Video Solution

124. In the circuit shown below, all the inductors (assumed ideal) and resistors are identical. The current through the resistance on the right is I after the key K has been switched on for along time. The currents through the three resistors (in order, from left to right) immediately after the key is switched off are -



A. 2I upwards, I downwards and I downwards

B. 2I downwards, I downwards and I downwards

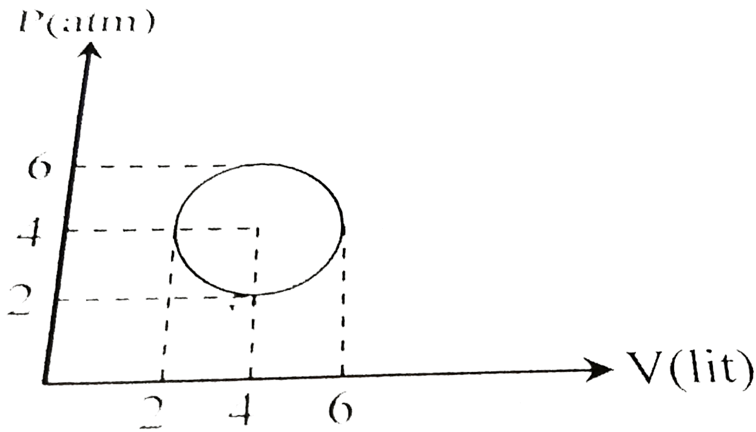
C. I downwards, I downwards and I downwards

D. 0, I downwards and I downwards

Answer: A

Watch Video Solution

125. An ideal gas undergoes a circular cycle centered at 4 atm, 4 lit as shown in the diagram. The maximum temperature attained in this process is closed to -



A. 30/R

B. 36/R

C. 24/R

D. 16/R

Answer: A

Watch Video Solution

126. A person walks 25.0° north of east for 3.18 km. How far would she have to walk due north and then due east to arrive at the same location?

A. towards north 2.88 km and towards east 1.34 km

B. towards north 2.11 km and towards east 2.11 km

C. towards north 1.25 km and towards east 1.93 km

D. towards north 1.34 km and towards east 2.88 km

Answer: D

Watch Video Solution

127. The length and width of a rectangular room are measured to be 3.95 ± 0.05 m and 3.05 ± 0.05 m, respectively, the area of the floor is

A. $12.05 \pm 0.01 m^2$

B. $12.05 \pm 0.005 m^5$

C. $12.05 \pm 0.34 m^2$

D. $12.05 \pm 0.40 m^2$

Answer: C

Watch Video Solution

128. A car goes around uniform circular track of radius R at a uniform speed v once in every T seconds. The magnitude of the centripetal acceleration is a_c. If the car now goes uniformly around a larger circular track of radius 2R and experiences a centripetal acceleration of magnitude $8a_c$, then its time period is

A. 2T

B. 3T

C. T/2

D. 3/2 T

Answer: C

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129. The primary and the secondary coils of a transformer contain 10 and 100 turns, respectively. The primary coil is connected to a battery that supplies a constant voltage of 1.5 volts. the voltage across the secondary coil is

A. 1.5 V

B. 0.15 V

C. 0.0 V

D. 15 V

Answer: C

Watch Video Solution

130. Water falls down a 500.0 m shaft to reach a turbine which generates electricity. How much water must fall per second in order to generate 1.00×10^9 Watts of power? (Assume 50% efficiency of conversion and $g = 10m/s^2$)

A. $250m^3$

B. $400m^3$

C. $500m^3$

D. $200m^3$

Answer: B

Watch Video Solution

131. The diagram below shows two circle loops of wire (A and B) centred on and perpendicular to the x-axis, and oriented with their planes parallel to each other. The y-axis passes vertically through loop A (dashed line). There is a current I_B in loop B as shown. Possible actions which we might perform on loop A are:

ltbegt (i) Move A to the right along x axis closer to B

(ii) Move A to the left along x axis away from B

(iii) As viewed from above, rotate A clockwise about y axis

(iv) As viewed from above, rotate A anticlockwise about y axis

Which of these actions will induce a current in A only in the direction shown.

A. Only (i)

B. Only (ii)

C. Only (i) and (iv)

D. Only (ii) and (iii)

Answer: A

Watch Video Solution

132. A rigid ball rolls without slipping on a surface shown below.

Which one of the following is the most likely representation of the distance traveled by the ball vs time graph?

A.

B.

C.

D.

Answer: D

Watch Video Solution

133. In an experiment , setup A consists of two parallel wires which carry currents in opposite directions as shown in the figure. A second setup B is identical to setup A, except that there is a metal plate between the wires

Let F_A and F_B be the magnitude of the force between the two wires in setup A and setup B, respectively.

A. $F_A > F_B \neq 0$

B. $F_A < F_B$

C. $F_A = F_B \neq 0$

D. $F_A > F_B = 0$

Answer: C

Watch Video Solution

134. In the circuit, wire 1 is of negligible resistance, Then

A. Current will flow through wire 1 if $\varepsilon_1 \neq \varepsilon_2$

B. Current will flow through wire 1 if $\varepsilon_1 / R_1 \neq \varepsilon_2 / R_2$

C. Current will flow through wire 1 if $(\varepsilon_1 + \varepsilon_2) / (R_1 + R_2) \neq (\varepsilon_1 - \varepsilon_2) / (R_1 - R_2)$

D. No current will flow through wire 1.

Answer: D

Watch Video Solution

135. The radius of a nucleus is given by $r_0 A^{1/3}$ where $r_0 = 1.3 \times 10^{-15}$ m and A is the mass number of the nucleus, the Lead nucleus has A = 206. the electrostatic force between two protons in this nucleus is approximately

A. 10^2 N

B. 10^7 N

C. 10^{12} N

D. 10^{17} N

Answer: A

Watch Video Solution

136. A hollow lens is made of thin glass and in the shape of a double concave lens. It can be filled with air, water of refractive index 1.33 or CS_2 of refractive index 1.6. It will act as a diverging lens if it is

A. filled with air and immersed in water.

B. filled with water and immersed in CS_2.

C. filled with air and immersed in CS_2.

D. filled with CS_2 and immersed in water.

Answer: D

Watch Video Solution

137. A stone thrown down with a seed u takes a time t_1 to reach the ground , while another stone, thrown upwards from the same point with the same speed, takes time t_2. The maximum height the second stone reaches from the ground is

A. $.^{1/2}\, g t_1 t_2$

B. $g/8(t_1 + t_2)^2$

C. $g/8(t_1 - t_2)^2$

D. $.^{1/2}\, g t_2^2$

Answer: B

Watch Video Solution

138. An electric field due to a positively charged long straight wire at a distance r from it is proportional to r_{-1} in magnitude. Two electrons are orbiting such a long straight wire in circular orbits of radii 1Å and 2Å. The ratio of their respective time periods is

A. $1:1$

B. $1:2$

C. $2:1$

D. $4:1$

Answer: B

Watch Video Solution

139. Two particles of identical mass are moving in circular orbits under a potential given by $V(r) = Kr^{-n}$, where K is a constant. If the radii of their orbits are r_1, r_2 and their speeds are v_1, v_2, respectively, then

A. $v_1^2 r_1^n = v_2^2 r_2^n$

B. $v_1^2 r_1^{-n} = v_2^2 r_2^{-2}$

C. $v_1^2 r_1 = v_2^2 r_2$

D. $v_1^2 r_1^{2-n} = v_2^2 r_2^{2-n}$

Answer: A

Watch Video Solution

140. Mercury is often used in clinical thermometers. Which one of the following properties of mercury is not a reason for this?

A. The coefficient of the thermal expansion is large.

B. It is shiny.

C. It is a liquid at room temperature.

D. It has high density.

Answer: D

Watch Video Solution

141. Which one of the following four graphs best depict the variation with x of the moment of inertia I of a uniform triangular lamina about an axis parallel to its base at a distance x from it

A.

B.

C.

D.

Answer: A

Watch Video Solution

142. A rectangular block is composed of three different glass prisms (with refractive indices μ_1, μ_2 and μ_3) as shown in the figure below. A ray of light incident normal to the left face emerges normal to the right face. Then the refractive indices are related by

A. $\mu_1^2 + \mu_2^2 = 2\mu_3^2$

B. $\mu_1^2 + \mu_2^2 = \mu_3^2$

C. $\mu_1^2 + \mu_3^2 = 2\mu_2^2$

D. $\mu_2^2 + \mu_3^2 = 2\mu_1^2$

Answer: C

Watch Video Solution

143. A uniform metal plate shaped like a triangle ABC has a mass of 540 gm. the length of the sides AB, BC and CA are 3 cm, 5 cm and 4 cm, respectively. The plate is pivoted freely about the point A . What mass must be added to a vertex , so that the plate can hang with the long edge horizontal ?

A. 140 gm at C

B. 540 gm at C

C. 140 gm at B

D. 540 gm at B

Answer: A

Watch Video Solution

144. A 20gm bullet whose specific heat is 5000 J / $(kg - .^{\circ} C)$ and moving at 2000 m/s plunges into a 1.0 kg block of wax whose specific heat is 3000 J $/(kg - .^{\circ} C)$. Both bullet and wax are at $25^{\circ} C$ and assume that (i) the bullet comes to rest in the wax and (ii) all its kinetic energy goes into heating the wax. Thermal temperature of the wax in $.^{\circ} C$ is close to

A. 28.1

B. 31.5

C. 37.9

D. 42.1

Answer: C

Watch Video Solution

145. A"V" shaped rigid body has two identical uniform arms. What must be the angle between the two arms so that when the body is hung from one end, the other arm is horizontal ?

A. $\cos^{-1}(1/3)$

B. $\cos^{-1}(1/2)$

C. $\cos^{-1}(1/4)$

D. $\cos^{-1}(1/6)$

Answer: A

Watch Video Solution

146. Physical processes are sometimes described visually by lines. Only the following can cross -

A. Streamlines in fluid flow

B. Lines of forces in electrostatics

C. Rays in geometrical optics

D. Lines of force in magnetism

Answer: C

Watch Video Solution

147. Uniform ring of radius R is moving on a horizontal surface with speed v and then climbs up a ramp of inclination 30° to a height h. There is no slipping in the entire motion. Then h is

A. $v^2 / 2g$

B. v^2 / g

C. $3v^2 / 2g$

D. $2v^2 / g$

Answer: B

Watch Video Solution

148. A gas at initial temperature T undergoes sudden expansion from volume V to 2V. Then -

A. The process is adiabatic

B. The process is isothermal

C. The work done in this process is nRT $\ln_e(2)$ where n is the number of moles of the gas.

D. The entropy in the process does not change

Answer: A

Watch Video Solution

149. Photons of wavelength λ are incident on a metal. The most energetic electrons ejected from the metal are bent into a circular arc of radius R by a perpendicular magnetic field having a magnitude B. The work function of the metal is (Where symbols have their usual meanings) -

A. $\dfrac{hc}{\lambda} - m_e + \dfrac{e^2B^2R^2}{2m_e}$

B. $\dfrac{hc}{\lambda} + 2m_e\left(\dfrac{eBR}{2m_e}\right)^2$

C. $\dfrac{hc}{\lambda} - m_e C^2 - \dfrac{e^2 B^2 R^2}{2m_e}$

D. $\dfrac{hc}{\lambda} - 2m_e \left(\dfrac{eBR}{2m_e}\right)^2$

Answer: D

Watch Video Solution

150. A container is divided into two equal part I and II by a partition with a small hole of diameter d. The two partitions are filled with same ideal gas, but held at temperature $T_I = 150K$ and $T_{II} = 300K$ by connecting to heat reservoirs. Let λ_I and λ_{II} be the mean free paths of the gas particles in the two parts such that $d > > \lambda_I$ and $d > > \lambda_{II}$. Then λ_I / λ_{II} is close to -

A. 0.25

B. 0.5

C. 0.7

D. 1.0

Answer: C

Watch Video Solution

151. A conducting bar of mass m and length l moves on two frictionless parallel rails in the presence of a constant uniform magnetic field of magnitude B directed into the page as shown in the figure . The bar is given an initial velocity v_0 towards the right at t = 0. Then the

A. Induced current in the circuit is in the clockwise direction

B. Velocity of the bar decreases linearly with time

C. Distance the bar travels before it comes to a complete stop is proportional to R

D. Power generated across the resistance is proportional to l.

Answer: C

Watch Video Solution

152. A particle with total mechanical energy, which is small and negative, is under the influence of a one dimensional potential

$U(x) = x^4/4 - x^2/2J$ Where x is in meters. At time $t = 0s$, it is at $x = -0.5$ m. Then at a later time it can be found

A. Anywhere on the x axis

B. Between x $= -1.0$ m to x $= 1.0$ m

C. Between x = $-1.0m$ to x = 0.0 m

D. Between $x = 0.0$ m to $x = 1.0$ m

Answer: C

Watch Video Solution

153. A nurse measures the blood pressure of a seated patient to be 190 mm of Hg -

A. The blood pressure at the patient's feet is less than 190 mm of Hg

B. The actual pressure is about 0.25 times the atmospheric pressure

C. The blood pressure at the patient's neck is more than 190 mm of Hg

D. The actual pressure is about 1.25 times the atmospheric pressure

Answer: D

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154. A particle at a distance of 1 m from the origin starts moving such that $dr / d\theta = r$, where (r, θ) are polar coordinates. Then the angle between resultant velocity and tangential velocity component is

A. 30 degrees

B. 45 degrees

C. 60 degrees

D. Dependent on where the particle is

Answer: B

Watch Video Solution

155. Electrons accelerated from rest by an electrostatic potential are collimated and sent through a Young's double slit setup. The fringe width is w. If the accelerating potential is doubled then the width is now close to -

A. 0.5 w

B. 0.7 w

C. 1.0 w

D. 2.0 w

Answer: B

Watch Video Solution

156. A metallic sphere is kept in between two oppositely charged plates. The most appropriate representation of the field lines is -

A.

B.

C.

D.

Answer: B

157. An electron with kinetic energy =E eV collides with a hydrogen atom in the ground state. The collision will be elastic

A. For all values of E

B. For $E < 10.2$ eV

C. For $10.2eV < E < 13.6$ eV only

D. For $0 < E < 3.4$ eV only

Answer: B

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158. The continuous part of X-ray spectrum is a result of the

A. Photoelectric effect

B. Raman effect

C. Compton effect

D. Inverse photoelectric effect

Answer: D

Watch Video Solution

159. Thermal expansion of a solid is due to the

A. symmetric characteristic of the inter atomic potential energy curve of the solid

B. asymmetric characteristic of the inter atomic potential energy curve of the solid

C. double well nature of the inter-atomic potential energy curve of the solid

D. Rotational motion of the atoms of the solid

Answer: B

Watch Video Solution

160. An electron and a photon have same wavelength of 10^{-9} m. If E is the energy of the photon and p is the momentum of the electron, the magnitude of E/p in SI units is

A. 1.00×10^{-9}

B. 1.50×10^{8}

C. 3.00×10^{8}

D. 1.20×10^{7}

Answer: C

Watch Video Solution

161. If one takes into account finite mass of the proton, the correction to the binding energy of the hydrogen atom is approximately (mass of proton = 1.60×10^{-27}kg, mass of electron =9.10×10^{-31} kg)-

A. 0.06%

B. 0.0006%

C. 0.02%

D. 0.00%

Answer: A

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162. A monochromatic light source S of wavelength 440 nm is placed slightly above a plane mirror M as shown . Image of S in M can be used as a virtual source to produce interference fringes on the screen. The distance of source S from O is 20.0 cm, and the distance of screen from O is 100.0 cm (figure is not to scale). If the angle $\theta = 0.50 \times 10^{-3}$ radians, the width of the interference fringes observed on the screen is –

A. 2.20 mm

B. 2.64 mm

C. 1.10 mm

D. 0.55 mm

Answer: B

Watch Video Solution

163. A nuclear fuel rod generates energy at a rate of $5 \times 10^{8} \mathrm{Watt} / m^{3}$. It is in the shape of a cylinder of radius 4.0 mm and length 0.20 m . A coolant of specific heat $4 \times 10^{3} J / (kg - K)$ flows past it at a rate of 0.2 kg/s. The temperature rise in this coolant is approximately -

A. 2° C

B. 6° C

C. 12° C

D. 30° C

Answer: B

Watch Video Solution

164. A hearing test is conducted on an aged person. It is found that her threshold of hearing is 20 decibels at 1 kHz and it rises linearly with frequency to 60 decibels at 9 kHz. The minimum intensity of sound that the person can hear at 5 kHz is-

A. 10 times than that at 1 kHz

B. 100 times than that at 1 kHz

C. 0.5 times than that at 9 kHz

D. 0.05 times than that at 9 kHz

Answer: B

Watch Video Solution

165. Two infinitely long parallel wires carry currents of magnitude I_1 and I_2 and are at a distance 4 cm apart. The magnitude of the net magnetic field is found to reach a non-zero minimum values between the two wires and 1 cm away from the first wire. The ratio of the two currents and their mutual direction is

A. $\frac{I_2}{I_1} = 9$, antiparallel

B. $\frac{I_2}{I_1} = 9$, parallel

C. $\frac{I_2}{I_1} = 3$, antiparallel

D. $\frac{I_2}{I_1} = 3$, parallel

Answer: A

Watch Video Solution

166. A light balloon filled with helium of density ρ_{He} is tied to a long light string of length and the string is attached to the ground. If the balloon is displaced slightly in the horizontal direction from the equilibrium and released then .

A. The ballon undergoes simple harmonic motion with period $2\pi\sqrt{\left(\frac{\rho_{air}}{\rho_{air}-\rho_{He}}\right)\frac{l}{g}}$

B. The ballon undergoes simple harmonic motion with period $2\pi\sqrt{\left(\frac{\rho_{air}-\rho_{He}}{\rho_{air}}\right)\frac{l}{g}}$

C. The ballon undergoes simple harmonic motion with period $2\pi\sqrt{\left(\frac{\rho_{He}}{\rho_{air}-\rho_{He}}\right)\frac{l}{g}}$

D. The ballon undergoes conical oscillations with period $2\pi\sqrt{\left(\frac{\rho_{air}+\rho_{He}}{\rho_{air}-\rho_{He}}\right)\frac{l}{g}}$

Answer: C

Watch Video Solution

167. Consider a cube having a uniform volume charge density. Find the ratio of electrostatic potential at the centre to the potential at a corner of the cube

A. 2

B. $\sqrt{3}/2$

C. $\sqrt{2}$

D. 1

Answer: A

Watch Video Solution

168. Two infinitely long wires each carrying current I along the same direction are made into the geometry as shown in the figure. The magnetic field at the point P is

A. $\frac{\mu_0 I}{\pi r}$

B. $\frac{\mu_0 I}{r}\left(\frac{1}{\pi}+\frac{1}{4}\right)$

C. Zero

D. $\frac{\mu_0 I}{2\pi r}$

Answer: D

169. A photon of wavelength λ is absorbed by an electron confined to a box of length $\sqrt{35h\lambda / 8mc.}$. As a result, the electron makes a transition from state k = 1 to the state n. Subsequently the electron transits from the state n to the state m by emitting a photon of wavelength $\lambda' = 1.85\lambda$. Then

A. n = 4, m = 2

B. n = 5, m =3

C. n = 6, m = 4

D. n = 3, m = 1

Answer: C

Watch Video Solution

170. Consider two masses with $m_1 > m_2$ connected by a light inextensible string that passes over a pulley of radius R and moment of inertia I about its axis of rotation. The string does not slip on the pulley and the pulley turns without friction. The two masses are released from rest separated by a vertical distance 2h. When the two masses pass each other, the speed of the masses is proportional to

A. $\sqrt{\dfrac{m_1 - m_2}{m_1 + m_2 + \frac{1}{R^2}}}$

B. $\sqrt{\dfrac{(m_1 - m_2)(m_1 - m_2)}{m_1 + m_2 + \frac{1}{R^2}}}$

C. $\sqrt{\dfrac{m_1 + m_2 + \frac{1}{R^2}}{m_1 - m_2}}$

D. $\sqrt{\dfrac{\frac{1}{R^2}}{m_1 + m_2}}$

Answer: C

Watch Video Solution

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171. An ideal gas is taken reversibly around the cycle a-b-c-d-a as shown on the T (temperature) – S (entrophy) diagram

The most appropriate representation of above cycle on a U (internal energy) – V (volume) diagrame is

A.

B.

C.

D.

Answer: A

Watch Video Solution

172. The heat capacity of one mole an ideal is found to be CV = 3R (1 + aRT)/2 where a is a constant. The equation obeyed by this gas during a reversible adiabatic expansion is -

A. $TV^{3/2}e^{aRT}$=constant

B. $TV^{3/2}e^{3aRT}$=constant

C. $TV^{3/2}$=constant

D. $TV^{3/2}e^{2aRT/3}$=constant

Answer: A

Watch Video Solution

173. If the input voltage V_i to the circuit below is given by $V_i(t) = A\cos(2\pi ft)$, the output voltage is given by

$V_o(t) = B\cos(2\pi ft + \phi)$-

Which one of the following four graphs best depict the variation of ϕ vs f ?

A.

B.

C.

D.

Answer: C

174. A glass prism has a right-triangular cross section ABC, with $\angle A = 90^\circ$. A ray of light parallel to the hypotenuse BC and incident on the side AB emerges grazing the side AC. Another ray, again parallel to the hypotenuse BC, incident on the side AC suffers total internal reflection at the side AB. Which one of the following must be true about the refractive index μ of the material of the prism ?

A. $\sqrt{\frac{3}{2}} < \mu < \sqrt{2}$

B. $\mu > \sqrt{3}$

C. $\mu < \sqrt{\frac{3}{2}}$

D. $\sqrt{2} < \mu < \sqrt{3}$

Answer: A

Watch Video Solution

175. A smaller cube with side b (depicted by dashed lines) is excised from a bigger uniform cube with side a as shown below such that both cubes have a common vertex P. Let X = a/b. If the centre of mass of the remaining solid is at the vertex O of smaller cube then X satisfies.

A. $X^3 - X^2 - X - 1 = 0$

B. $x^2 - X - 1 = 0$

C. $X^3 + X^2 - X - 1 = 0$

D. $X^2 - X - 1 = 0$

Answer: A

Watch Video Solution

176. Particles used in the Rutherford's scattering experiment to deduce the structure of atoms

A. had atomic number 2 and were fully ionised.

B. had atomic number 2 and were neutral.

C. had atomic number 4 and were fully ionised.

D. had atomic number 4 and were neutral.

Answer: A

Watch Video Solution

177. The number of completely filled shells for the element $\cdot_{16}S^{32}$ is

A. 1

B. 2

C. 3

D. 4

Answer: B

Watch Video Solution

178. In an experiment on simple pendulum to determine the acceleration due to gravity, a student measures the elngth of the thread as 632 cm and diameter of the pendulum bob as 2.256 cm. The student should take the lenght of the pendulum to be

A. 64.328cm

B. 64.36 cm

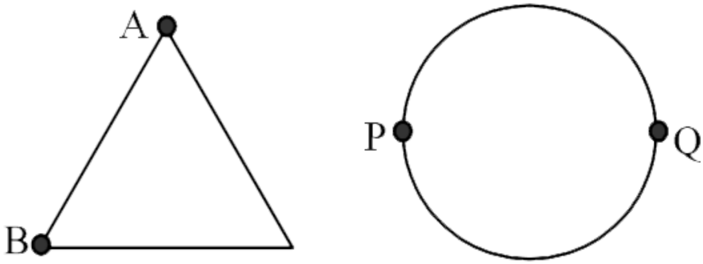
C. 65.456 cm

D. 65.5 cm

Answer: B

Watch Video Solution

179. A uniform metallic wire of lenght L is mounted in two configurations. In configuration I (triangle), it is an equilateral triangle and a voltage V is applied to corners A and B. In configuration 2 (circle), it is bent in the form of a circle, and the potential v is applied at diameterically opposite points P and Q. The ratio of the power dissipated in configuration 1 to configuration 2 is.



A. $2/3$

B. $9/8$

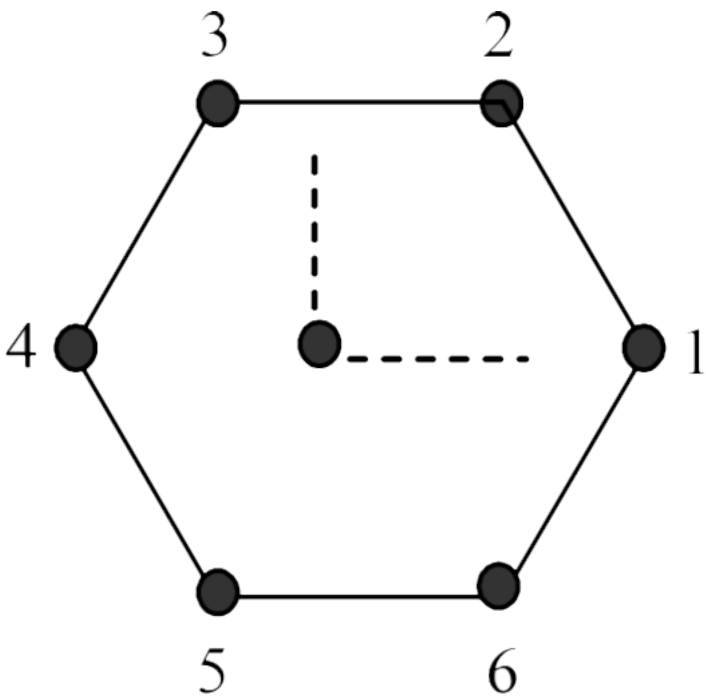
C. $5/4$

D. $7/8$

Answer: B

Watch Video Solution

180. Six objects are placed at the vertices of a regular hexagon. The geometric center of the hexagon is at the origin with objects 1 and 4 on the x-axis (see figure). The mass of the k^{th} object is $mk = \mathrm{k\ M} \quad |\cos q_k|$ where i is an integer, M is a constant with dimension of mass, and q_k is the angular position of the kth verted measured from the positive x-axis in the counter-clockwise sense. If the net gravitational force on a body at the centroid vanishes, the value of i is



A. 0

B. 1

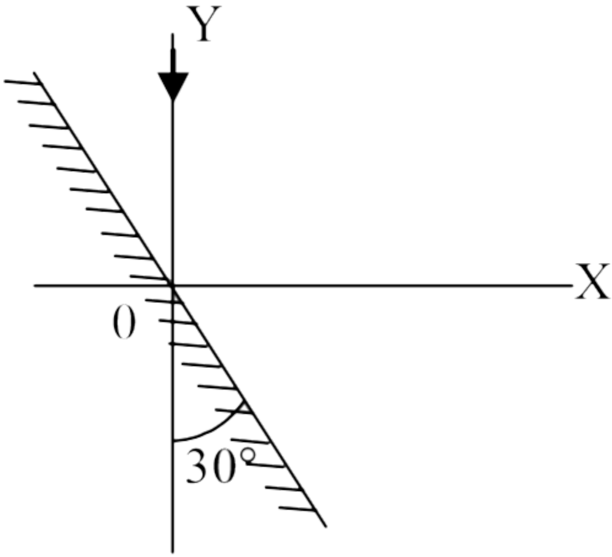
C. 2

D. 3

Answer: A

Watch Video Solution

181. A mirror is placed at an angle of 30° with respect to y-axis (see figure). A light ray travelling in the negative y-direction strikes the mirror. The direction of the reflected ray is given by the vector



A. $\hat{i}$

B. $\hat{i} - \sqrt{3}\hat{j}$

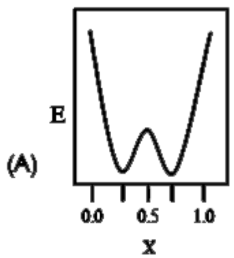
C. $\sqrt{3}\hat{i} - \hat{j}$

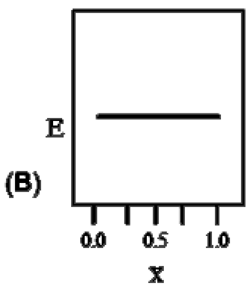
D. $\hat{i} - 2\hat{j}$

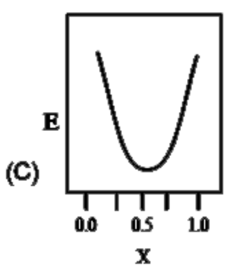
Answer: C

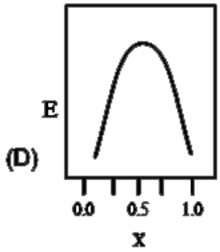
Watch Video Solution

182. A total charge q is divided as q_1 and q_2 which are kept at two of the vertices of an equilateral triangle of side a. The magnitude of the electric field E at the third vertex of the triangle is to be depicted schematically as a function of $x = q_1 / q$. Choose the correct figure.

A. 

B. 

C. 

D. 

Answer: C

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183. The refractive index of water in a biology laboratory tank veries as $1.33 + 0.002 / \lambda^2$, where λ is the wavelength of light. Small pieces of organic matter of different colours are seen at the bottom of the tank using a travelling microscope. Then the image of the orgainc matter appears

A. deeper for the violet pieces than the green ones.

B. shallower for the blue pieces than the orange ones.

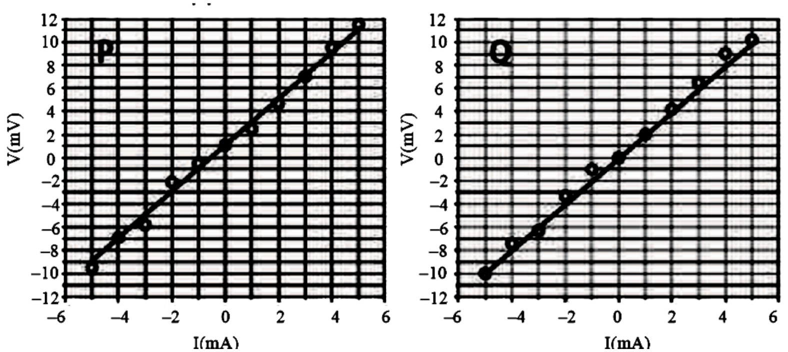
C. at the same depth for both the blue and orange pieces.

D. deeper for the green pieces than the red ones.

Answer: B

View Text Solution

184. Two students P and Q perform an experiment to verify Ohm's law for a conductor with resistance R. They use a current source and a voltmeter with least counts of 0.1 mA and 0.1 mV, respectively. The plots of the variation of voltage drop (V) across R with current (I) for both are shown below



The statement which is most likely to be correct is:

A. P has only random error (s).

B. Q has only systematic error (s).

C. Q has both random and systematic errors.

D. P has both random and systematic errors.

Answer: D

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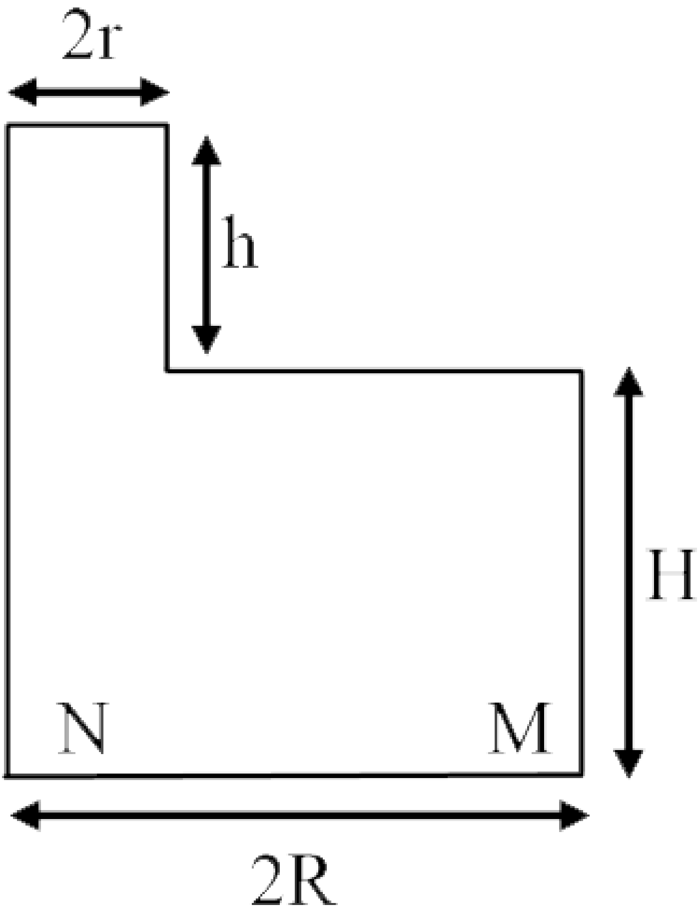
185. A cylindrical vessel of base radius R and height H has a narrow neck of height h and radius r at one end (see figure). The vessel is filled with water (densityρ_w) and its neck is filled with immiscible oil (density ρ_O). Then the pressure at



A. M is $g(h\rho_0 + H\rho_w)$

B. N is $g(h\rho_0 + H\rho_w)\frac{r^2}{R^2}$

C. M is g $H\rho_w$

D. N is g$\frac{\rho_w HR^2 + \rho_0 hr^2}{R^2 + r^2}$

Answer: A

Watch Video Solution

186. Two cars S_1 and S_2 are moving in coplanar concentric circular tracks in the opposite sense with the periods of revolution 3 min and 24 min, respectively. At time t = 0, the cars are farthest apart. Then, the two cars will be

A. closest to each other at t = 12 min and farthest at t = 18 min.

B. closest to each other at t = 3 min and farthest at t = 24 min

C. closest to each other at t = 6 min and farthest at t = 12 min

D. colsest to each other at t = 12 min and farthest at t = 24 min

Answer: D

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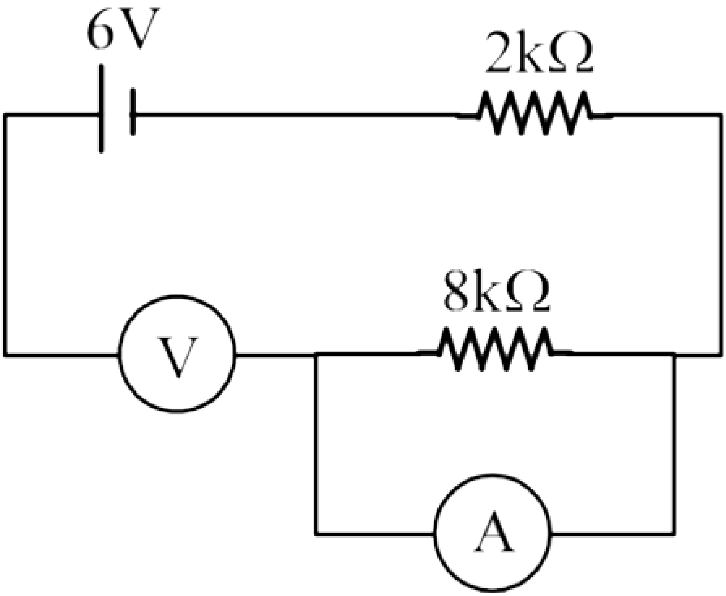
187. In the circuit shown below, a student performing Ohm's law experiment accidently puts the voltmeter and the ammeter as shown in the circuit below, the reading in the voltmeter will be close to



A. 0V

B. 4.8 V

C. 6.0 V

D. 1.2 V

Answer: C

Watch Video Solution

188. The bhagirathi and the Alaknanda merge at Deoprayag to form the Ganga with their speeds in the ratio $1:1.5$. The cross-sectional areas of the Bhagirathi, the Alaknanda and the Ganga are in the ratio $1:2:3$. Assuming stremline flow, the ratio of the speed of Ganga to that of the Alaknands is

A. $7:9$

B. $4:3$

C. $8:9$

D. $5:3$

Answer: C

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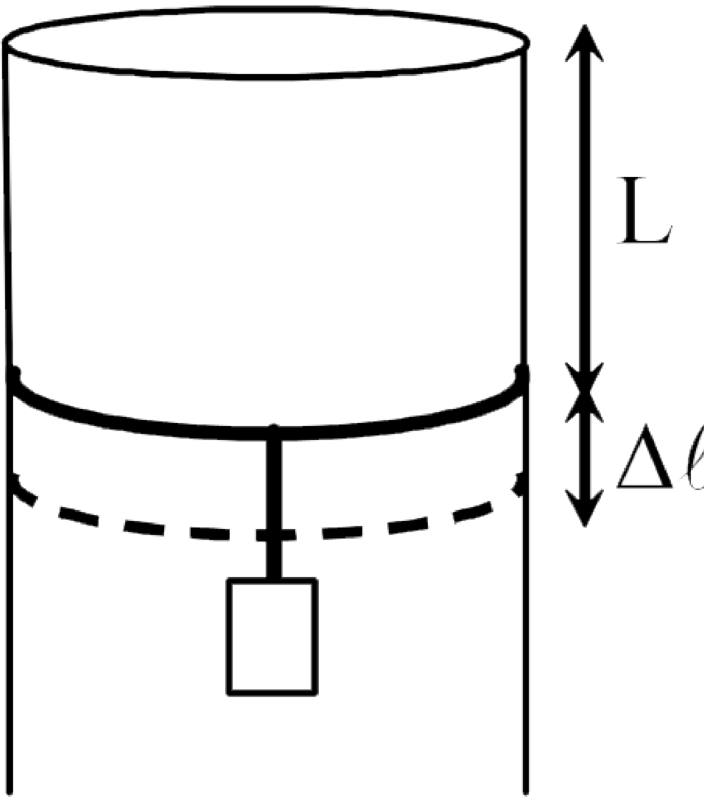
189. A long cylindrical pipe of radius 20 cm is closed at its upper end and has an airtight piston of negligible mass as shown. When a 50 Kg mass is attached to the other end of the pistion, it moves down by a distanceΔl before coming to equilibrium. Assuming air to be an ideal gas, $\Delta l / L$ (see figure) is close to (g = 10 ms^2 , atmospheric pressure is 10^5 Pascal),



A. 0.01

B. 0.02

C. 0.04

D. 0.09

Answer: C

Watch Video Solution

190. The word "KVPY" is written on a board and viewed through different lense such that board is at a distance beyond the focal length of the lens.

(i) (ii)

Ignorging magnification effects, consider the following statements

(I) Image (i) has been viewed from the planar side of a plano-convex lens and image (ii) from the planar side of a plano-convex lens.

(II) Image (i) has been viewed from the concave side of a plano-concave lens and image (ii) from the convex side of a plano-convex lens.

(iii) Image (i) has been viewed from the cocave side of a plano-concave lens and image (ii) from the planar side of a plano-convex lens.

(iv) Image (i) has been viewed from the planar side of a plano-concave lens and image (ii) from the convex side of a plano-convex lens.

Which of the above statements are correct ?

A. Only (III)

B. Only (IV)

C. Only (III) and (IV).

D. All four.

Answer: D

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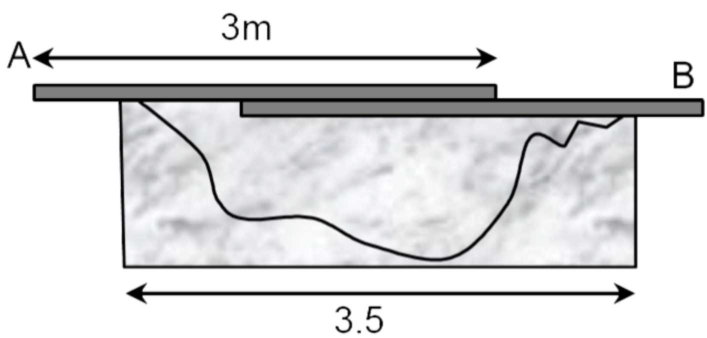
191. Persons A and B are standing on the opposite sides of a 3.5 m wide water stream which they wish to cross. Each one of them has a rigid wooden plank whose mass can be neglected. However, each plank is only slightly longer than 3 m. So they decide to arrange them together as shown in the figure schematically. With B (mass 17 kg) standing, the maximum mass of A, who can walk over the plank is close to



A. 17 kg

B. 65 kg

C. 80 kg

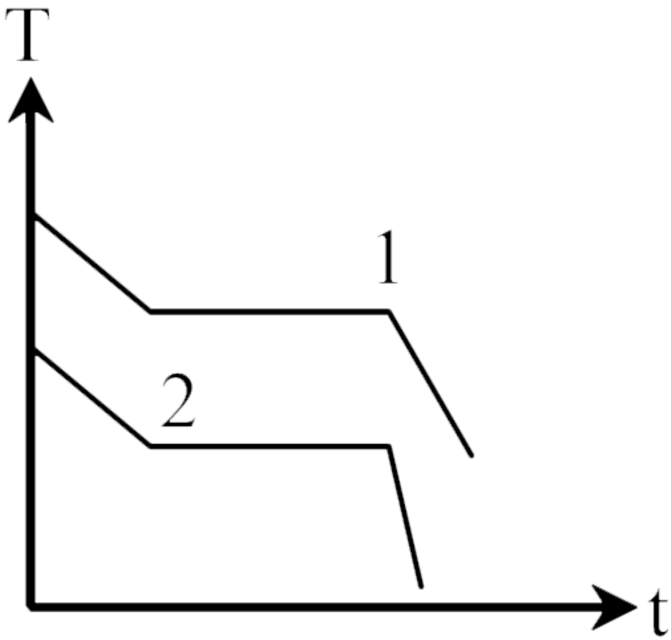
D. 105 kg

Answer: C

Watch Video Solution

192. Two different liquids of same mass are kept in two identical vessels, which are placed in a freezer that extracts heat from them at the same rate causing each liquid to transform into a solid. The schematic figure below shows the temperature T vs time t plot for the two materials. We denote the specific heat of metrials in the liquid (solid) states to be

$C_{L1}(C_{S1})$ and $C_{L2}(C_{S2})$ respectively



A. $C_{L1} < C_{L2}$ and $C_{S1} < C_{S2}$

B. $C_{L1} > C_{L2}$ and $C_{S1} > C_{S2}$

C. $C_{L1} > C_{L2}$ and $C_{S1} > C_{S2}$

D. $C_{L1} < C_{L2}$ and $C_{S1} > C_{S2}$

Answer: B

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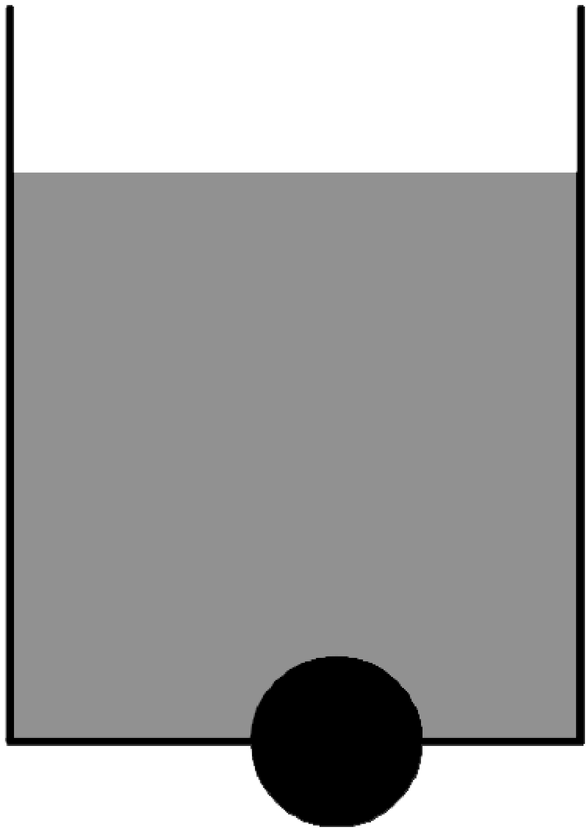
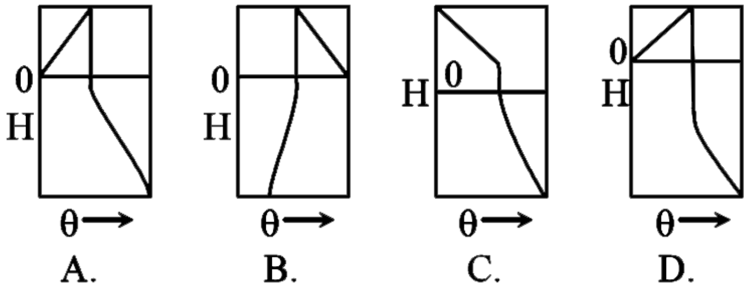
193. A ray of light originates from inside a glass slab and is incident on its inner surface at an angle θ as shown,



In this experiment the location x of the spot where the ray hits the screen is recorded. Which of the following correctly shows the plot of variation of x with the angle θ?



A. A

B. B

C. C

D. D

Answer: A

Watch Video Solution

194. Four identical pendulums are made by made by attaching a small ball of mass 100 g on a 20 cm long thread and suspended from the same point. Now each ball is given charge Q so that balls move away from each other with each thread making an angle of 45° from the vertical. The value of Q is close to $\left(\frac{1}{4\pi \in_0} = 9 \times 10^9 \text{ in SI units}\right)$

A. $1\mu C$

B. $1.5\mu C$

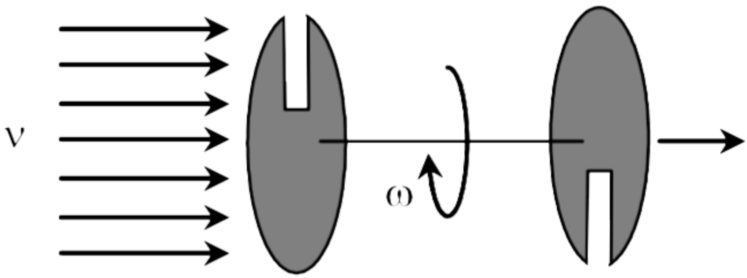
C. $2\mu C$

D. $2.5\mu C$

Answer: B

Watch Video Solution

195. Two parallel discs are connected by a rigid rod of length L =0.5 m centrally. Each disc has a slit oppositely placed as shown in the figure. A beam of neutral atoms are incident on one of the discs axially at different velocities v, while the system is rotated at angular speed of 600 rev/second so that atoms only with a specific velocity emerge at the other end. Calculate the two largest speeds (in meter/second) of the atoms that will emerge at the other end.



A. 75, 25

B. 100,50

C. 300, 100

D. $600, 200$

Answer: D

Watch Video Solution

196. The magnitude of acceleration of the electron in the n^{th} orbit of hydrogen atom is a_H and that of singly ionized helium atom is a_{He}. The ratio $a_H : a_{He}$ is

A. $1:8$

B. $1:4$

C. $1:2$

D. dependent on n

Answer: A

Watch Video Solution

197. A carrot looks orange in colour because of the β carotene molecule in it. This means that the β carotene molecule absorbs light of wavelengths

A. longer than 550 nm.

B. shorter than 550 nm.

C. longer than 700 nm.

D. shorter than 700 nm.

Answer: B

Watch Video Solution

198. If some charge is given to a solid metallic sphere, the field inside remains zero and by Gauss's law all the charge resides on the surface. Suppose now that Colomb's force between two charges varies as $1/r^3$. Then, for a charged solid metallic sphere

A. field inside will be zero and charge density inside will be zero.

B. field inside will not be zero and charge density inside will not be zero.

C. field inside will not be zero and charge density inside will be zero.

D. field inside will be zero and charge density inside will not be zero.

Answer: D

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199. Using dimensional analysis the resistivity in terms of fundamental constants $h, m_e, c, e, \varepsilon_0$ can be expressed as

A. $\dfrac{h}{\varepsilon_0 m_e c e^2}$

B. $\dfrac{\varepsilon_0 m_e c e^2}{h}$

C. $\dfrac{h^2}{m_e c e^2}$

D. $\dfrac{m_e \varepsilon_0}{c e^2}$

Answer: C

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200. Consider a bowl filled with water on which some black pepper powder have been sprinkled uniformly. Now a drop of liquid soap is added at the centre of the surface of water. The picture of the surface immediately after this will look like

A.

B.

C.

D.

Answer: C

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201. It was found that the refractive index of material of a certain prism varied as $1.5 + 0.004/\lambda^2$, where λ is the wavelength of light used to measure the refractive index. The same material was then used to construct a thin prism of apex angle 10°. Angles of minimum deviation (δm) of the prism were recorded for the sources with wavelengths λ_1 and λ_2 respectively. Then

A. $\delta_m(\lambda_1) < \delta_m(\lambda_2) \ \text{ if } \ \lambda_1 < \lambda_2.$

B. $\delta_m(\lambda_1) > \delta_m(\lambda_2) \ \text{ if } \ \lambda_1 > \lambda_2.$

C. $\delta_m(\lambda_1) > \delta_m(\lambda_2) \ \text{ if } \ \lambda_1 < \lambda_2.$

D. δm is the same in both the cases.

Answer: C

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202. Two circularly shaped linear polarisers are placed coaxially. The transmission axis of the first polarizer is at 30° from the vertical while the second one is at 60°, both in the clockwise sense. If an unpolarised beam of light of intensity $I = 20W/m^2$ is incident on this pair of polarisers, then the intensities I_1 and I_2 transmitted by the first and the second polarisers, respectively, will be close to

A. $I_1 = 10.0W/m^2$ and $I_2 = 7.5W/m^2$

B. $I_1 = 20.0W/m^2$ and $I_2 = 15W/m^2$

C. $I_1 = 10.0W/m^2$ and $I_2 = 8.6W/m^2$

D. $I_1 = 15.0W/m^2$ and $I_2 = 0.0W/m^2$

Answer: A

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203. An electron in an electron microscope with initial velocity $v_0\hat{i}$ enters a region of a stray transverse electric field $E_0\hat{j}$. The time taken for the change in its de-Broglie wavelength from the initial value of λ to $\lambda/3$ is proportional to

A. E_0

B. $\frac{1}{E_0}$

C. $\frac{1}{\sqrt{E_0}}$

D. $\sqrt{E_0}$

Answer: B

Watch Video Solution

204. A bird sitting on a single high tension wire does not get electrocuted because

A. the circuit is not complete.

B. the bird feet has an insulating covering.

C. capacitance of the bird is too small and the line frequency is too small.

D. resistance of the bird is too high

Answer: C

Watch Video Solution

205. A positive charge q is placed at the center of a neutral hollow cylindrical conducting shell with its cross section as shown in the figure below.

Which one of the following figures correctly indicates the induced charge distribution on the conductor (ignore edge effects).

A.

B.

C.

D.

Answer: A

Watch Video Solution

206. A transverse wave of frequency 500 Hz and speed 100 m/s is traveling in the positive x direction on a long string. At time t = 0 s the displacements at $x = 0.0$ m and at $x = 0.25$ m are 0.0 m and 0.02 m, respectively. The displacement at $x = 0.2$ m at $t = 5 \times 10^{-4} s$ is

A. -0.04 m

B. -0.02 m

C. 0.04 m

D. 0.02 m

Answer: D

Watch Video Solution

207. A thin piece of thermal conductor of constant thermal conductivity insulated on the lateral sides connects two reservoirs which are maintained at temperatures T_1 and T_2 as shown. Assuming that the system is in steady state, which of the following plots best represents the dependence of the rate of change of entropy of the ratio of temperatures T_1/T_2

A.

B.

C.

D.

Answer: B

208. Which of the following plots represents schematically the dependence of the time period of a pendulum if measured and plotted as a function of its oscillations? (Note : amplitude need not be small)

A.

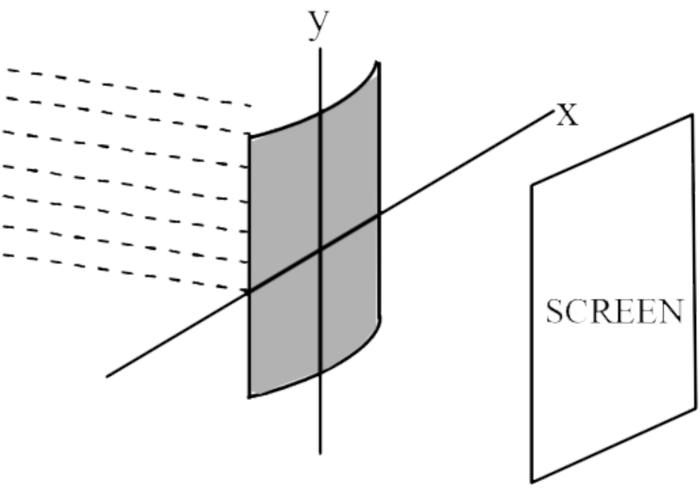
B.

C.

D.

Answer: A

209. On a pulley of mass M hangs a rope with two masses m_1 and $m_2 (m_1 > m_2)$ tied at the ends as shown in the figure. The pulley rotates without any friction, whereas the friction between the rope and the pulley is large enough to prevent any slipping. Which of the following plots best represents the difference between the tensions in the rope on the two sides of the pulley as a function of the mass of the pulley ?



A.

B.

C.

D.

Answer: C

Watch Video Solution

210. Two satellites S_1 and S_2 are revolving around a planet in the opposite sense in coplanar circular concentric orbits. At time t = 0, the satellites are farthest apart. The periods of revolution of S_1 and S_2 are 3 h and 24 h respectively. The radius of the orbit of S_1 is 3×10^4 km. Then the orbital speed ofS_2 as observed from

A. the planet is $4\pi \times 10^4$ km h^{-1} when S_2 is closest from S_1.

B. the planet is $2\pi \times 10^4$ km h^{-1} when S_2 is closest from S_1.

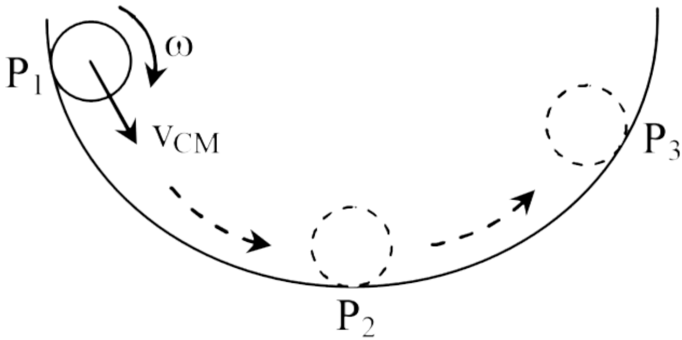
C. S_1 is $\pi \times 10^4$ km h^{-1} when S_2 is closest from S_1

D. S_1 is $3\pi \times 10^4$ km h^{-1} when S_2 is closest from S_1

Answer: D

Watch Video Solution

211. A rectangular region of dimensions $w \times l(w < < l)$ has a constant magnetic field into the plane of the paper as shown. On one side the region is bounded by a screen. On the other side positive ions of mass m and charge q are accelerated from rest and towards the screen by a parallel plate capacitor at constant potential difference $V < 0$, and come out through a small hole in the upper plate. Which one of the following statements is correct regarding the charge on the ions that hit the screen ?



A. Ions with $q > \frac{2|v|m}{B^2w^2}$ will hit the screen.

B. Ions with $q < \frac{2|v|m}{B^2w^2}$ will hit the screen.

C. Only ions with $q = \frac{2|v|m}{B^2w^2}$ will hit the screen.

D. All ions will hit the screen.

Answer: B

Watch Video Solution

212. Force $\vec{F}$ applied on a body is written as $\vec{F} = (\hat{n}.\,\vec{F})\ \hat{n} + \vec{G}$, where $\hat{n}$ is a unit vector. The vector $\vec{G}$ is equal to

A. $\hat{n} \times \vec{F}$

B. $\hat{n} \times \left(\hat{n} \times \vec{F}\right)$

C. $\left(\hat{n} \times \vec{F}\right) \times \vec{F} / \left|\vec{F}\right|$

D. $\left(\hat{n} \times \vec{F}\right) \times \hat{n}$

Answer: D

Watch Video Solution

213. A particle of mass m moves around the origin in a potential $\frac{1}{2}m\omega^2 r^2$, where r is the distance from the origin.

Applying the Bohr model in this case, the radius of the particle in its n^{th} orbit in terms of $a = \sqrt{h/2\pi m\omega}$ is

A. $a\sqrt{n}$

B. an

C. an^2

D. $an\sqrt{n}$

Answer: A

Watch Video Solution

214. Two bottles A and B have radii R_A and R_B and heights h_A and h_B respectively with $R_B = 2R_A$ and $h_B = 2h_A$. These are filled with hot water at $60^\circ C$. Consider that heat loss for the bottles takes place only from side surfaces. If the time the water to cool down to $50^{\circ} C$ is t_A and t_B for the bottles A and B, respectively, then t_A and t_B are best related as

A. $t_A = t_B$

B. $t_B = 2t_A$

C. $t_B = 4t_A$

D. $t_A = t_A / 2$

Answer: B

Watch Video Solution

215. The number of gas molecules striking per second per square meter of the top surface of a table placed in a room at $20^{\circ} C$ and 1 atmospheric pressure is of the order of

$(k_B = 1.4 \times 10^{-23}$ J/K, and the average mass of an air molecules is 5×10^{-27}kg)

A. 10^{27}

B. 10^{23}

C. 10^{25}

D. 10^{29}

Answer: A

Watch Video Solution

216. One end of a rod of length L=1 m is fixed to a point on the circumference of a wheel of radius $R = 1/\sqrt{3}$ m. The other end is sliding freely along a straight channel passing through the center O of the wheel as shown in the figure below. The wheel is rotating with a constant angular velocity ω about O.

The speed of the sliding end P when $\theta = 60^\circ$ is

A. $\frac{2\omega}{3}$

B. $\frac{\omega}{3}$

C. $\frac{2\omega}{\sqrt{3}}$

D. $\frac{\omega}{\sqrt{3}}$

Answer: A

Watch Video Solution

217. One mole of an ideal monatomic gas undergoes the following four reversible processes :

Step1 : It is first compressed adiabatically from volume V_1 to

$1m^3$.

Step 2 : then expanded isothermally to volume 10 m^3.

Step 3 : then expanded adiabatically to volume V^3.

Step 4 : then compressed isothermally to volume V_1.

If the efficiency of the above cycle is 3/4 then V_1 is,

A. $2m^3$

B. $4m^3$

C. $6m^3$

D. $8m^3$

Answer: D

Watch Video Solution

218. A neutron star with magnetic moment of magnitude m is spinning with angular velocity ω about its magnetic axis. The electromagnetic power P radiated by it is given by $\mu_0^x m^y \omega^z c^u$ where μ_0 and c are the permeability and speed of light in free space, respectively. Then

A. x = 1, y = 2, z = 4 and u = -3

B. x = 1, y = 2, z = 4 and u = 3

C. x = -1, y = 2, z = 4 and u = -3

D. x = -1, y = 2, z = 4 and u = 3

Answer: A

Watch Video Solution

219. A solid cube of wood of side 2a and mass M is resting on a horizontal surface as shown in the figure. The cube is free to rotate about a fixed axis AB. A bullet of mass m $(< < M)$ and speed v is shot horizontally at the face opposite to ABCD at a height 4a/3 from the surface to impart the cube an angular speed ω. It strike the face and embeds in the cube. Then ω_c is close to (note : the moment of inertia of the cube about an axis perpendicular to the face and passing through the center of mass is $2Ma^2/3)$

A. Mv/ma

B. Mv/2ma

C. mv/Ma

D. mv/2Ma

Answer: D

Watch Video Solution

220. A gas obeying the equation of state PV = RT undergoes a hypothetical reversible process described by the equation, $PV^{5/3}\exp\left(-\frac{PV}{E_0}\right) = c_1$ where c_1 and E_0 are dimensioned constants. Then, for this process, the thermal compressibility at high temperature

A. approaches a constant value.

B. is proportional to T.

C. is proportional to $T^{1/2}$

D. is proportional to T^2.

Answer: A

Watch Video Solution

221. To calculate the size of a hydrogen anion using the Bohr model, we assume that its two electrons move in an orbit such that they are always on diametrically opposite sides of the nucleus. With each electron having the angular momentum $h = h/2\pi$, and taking electron interaction into account the radius of the orbit in terms of the Bohr radius of hydrogen atom $a_B = \frac{4\pi\varepsilon_0 h^2}{me^2}$ is

A. a_B

B. $\frac{4}{3}a_B$

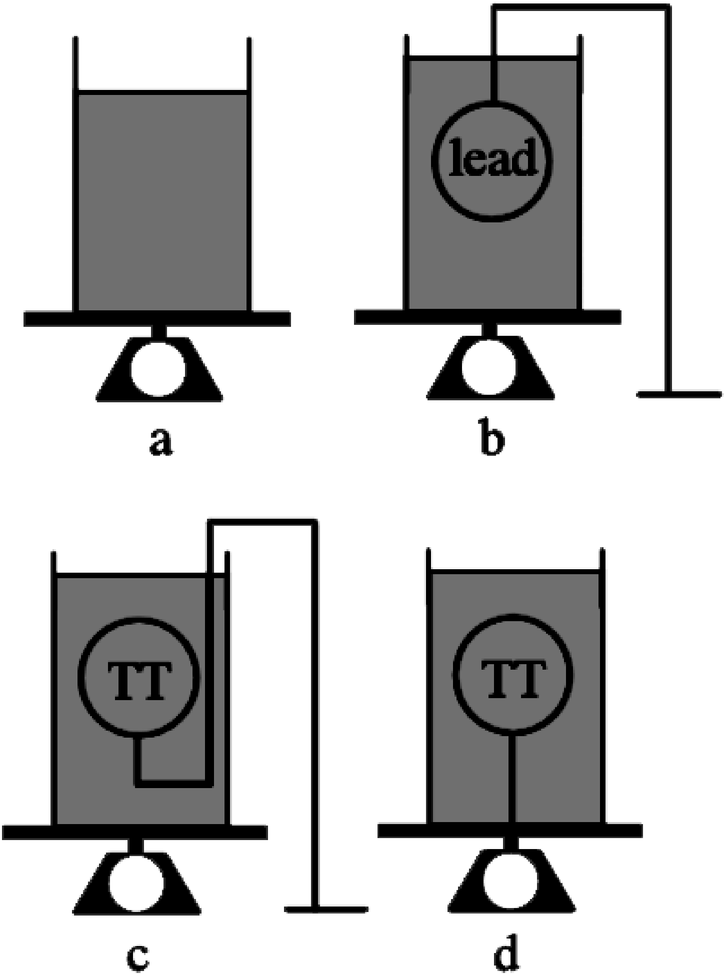
C. $\frac{2}{3}a_B$

D. $\frac{3}{2}a_B$

Answer: B

Watch Video Solution

222. A square-shaped conducting wire loop of dimension a moving parallel to the x-axis approaches a square region of size b $(a < b)$ where a uniform magnetic field B exists pointing into the plane of the paper (see figure). As the loop passes through this region, the plot correctly depicting its speed (v) as a function of x is



A.

B.

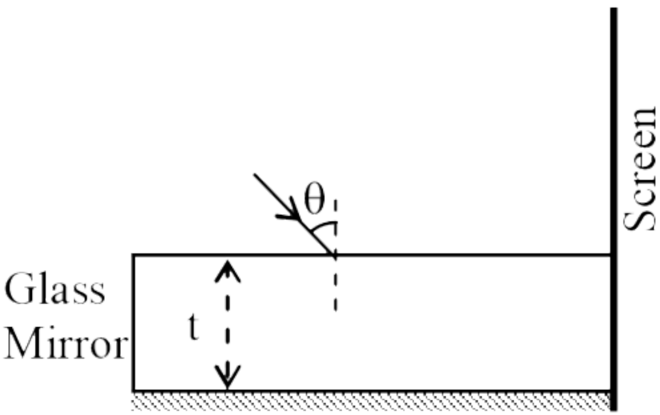
C.

D.

Answer: B

Watch Video Solution

223. The figure of a centimeter scale below shows a particular position of the vernier calipers. In this position the value of x shown in the figure is (figure is not to scale)



A. 0.02 cm

B. 3.65 cm

C. 4.15 cm

D. 0.03 cm

Answer: D

Watch Video Solution

224. A parallel beam of light is incident on a tank filled with water up to a height of 61.5 mm as shown in the figure below. Ultrasonic waves of frequency 0.5 MHz are sent along the length of the water column using a transducer placed at the top, and they form longitudinal standing waves in the water. Which of the schematic plots below best describes the intensity distribution of the light as seen on the screen ? Take the speed of sound in water to be 1,500 m/s.

A.

B.

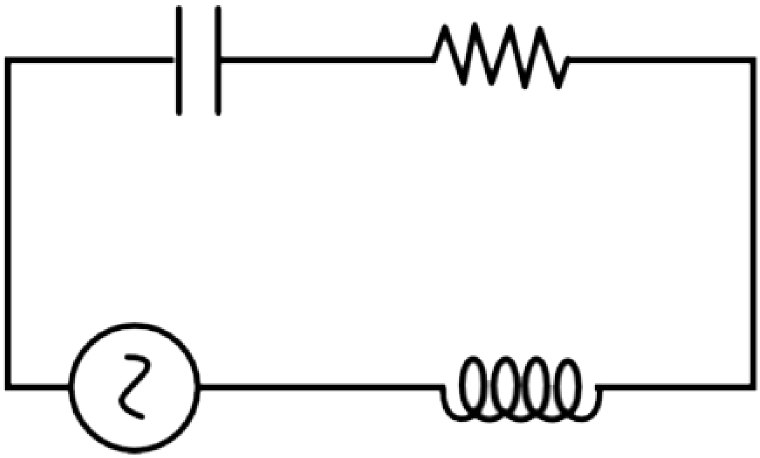
C.

D.

Answer: A

Watch Video Solution

225. A star of mass M (equal to the solar mass) with a planet (much smaller than the star) revolves around the star in a circular orbit. The velocity of the star with respect to the center of mass of the star-planet system is shown below :



A. 0.004 A.U.

B. 0.008 A.U.

C. 0.004 A.U.

D. 0.12 A.U.`

Answer: C

Watch Video Solution

226. Consider the following statements (X and Y stand for two different elements)

$\cdot_{32} X^{65}$ and $\cdot_{33} Y^{65}$ are isolopes.

$\cdot_{42} X^{89}$ and $\_ . (42)Y^{85}$ are isotopes.

$\cdot_{85} X^{174}$ and $\cdot_{88} Y^{177}$ have the same number of neutrons.

$\cdot_{92} X^{235}$ and $\cdot_{94} Y^{235}$ are isobars.

The correct statement are:

A. II and IV only.

B. I, II and IV only.

C. II, III and IV only.

D. I, II, III and IV only.

Answer: C

Watch Video Solution

227. A student performs an experiment to determine the acceleration due to gravity g. The student throws a steel ball up with initial velocity u and measures the height h travelled by it at different times t. The graph the student should plot on a graph paper to readily obtain the value of g is

A. h versus t.

B. h versus t^2

C. h versus $\sqrt{t}$

D. $\frac{h}{t}$ versus t

Answer: D

Watch Video Solution

228. A person goes from point P to point Q covergin 1/3 of the distance with speed 10km/hr, the next 1/3 of the distance at 20 km/hr and the last 1/3 of the distance at 60 km/hr. The average speed of the person is

A. 30 km/hr

B. 24 km/hr

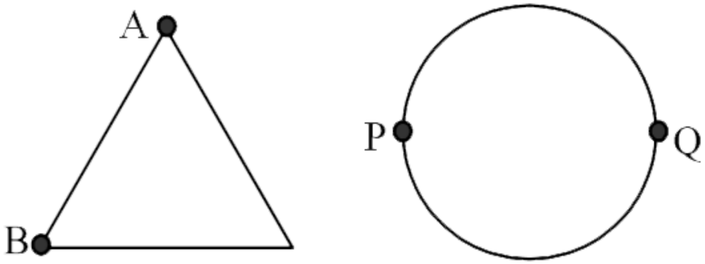
C. 18 km/hr

D. 12 km/hr

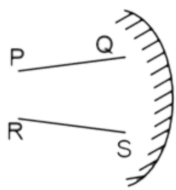
Answer: C

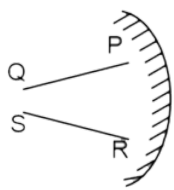
Watch Video Solution

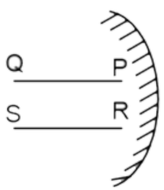
229. A person looks at the image of two parallel finite length lines PQ and RS in a convex mirror (see figure).

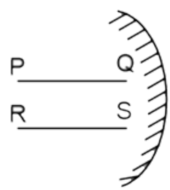


Which of the following represents schematically the image correctly ? (Note : Letters P, Q, R and S are used only to denote the endpoints of the lines.)

A.


B.


C


D.


A. A

B. B

C. C

D. D

Answer: B

Watch Video Solution

230. In Guericke's experiment to show the effect of atmospheric pressure, two copper hemispheres were tightly fitted to each other to form a hollow sphere and the air from the sphere was pumped out to create vacuum inside. If the radius of each hemisphere is R and the atmospheric pressure is P, then the minimum force required (when the two hemispheres are pulled apart by the same force) to separate the hemispheres is

A. $2\pi R^2 P$

B. $4\pi R^2 P$

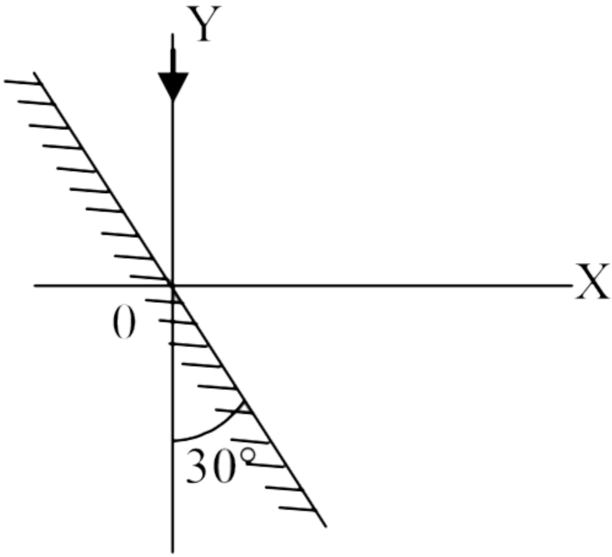
C. $\pi R^2 P$

D. $\pi R^2 P / 2$

Answer: C

Watch Video Solution

231. Positive point charges are placed at the vertices of a star shape as shown in the figure. Direction of the electrostatic force on a negative point charge at the centre O of the star is



A. towards right

B. vertically up

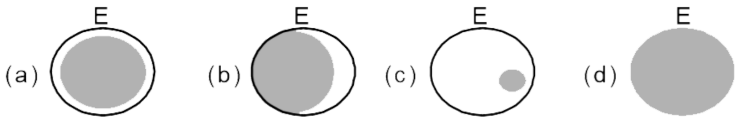
C. towards left

D. vertically down

Answer: A

Watch Video Solution

232. A total solar eclipse is observed from the earth. At the same an observer on the moon views the earth. She is most likely to see (E denotes the earth)



(B) b (C) c (D) d

A. a

B. b

C. c

D. d

Answer: B

Watch Video Solution

233. Ice in a freezer is at $-7^{\circ}C$. 100 g of this ice is mixed with 200 g of water at 15°C. Take the freezing temperature of water to be 0°C, the specific heat of ice equal to $2.2J/g.^{\circ}C$, specific heat of water equal to $4.2J/g.^{\circ}C$, and the latent heat of ice equal to 335 J/g. Assuming no loss of heat to the environment, the mass of ice in the final mixture is closest to

A. 88 g

B. 67 g

C. 54 g

D. 45 g

Answer: B

Watch Video Solution

234. A point source of light is placed at 2f from a converging lens of focal length f. A flat mirror is placed on the other side of the lens at a distanc d such that rays reflected from the mirror are parallel after passing through the lens again. If f = 30 cm, then d is equal to

A. 15 cm

B. 30 cm

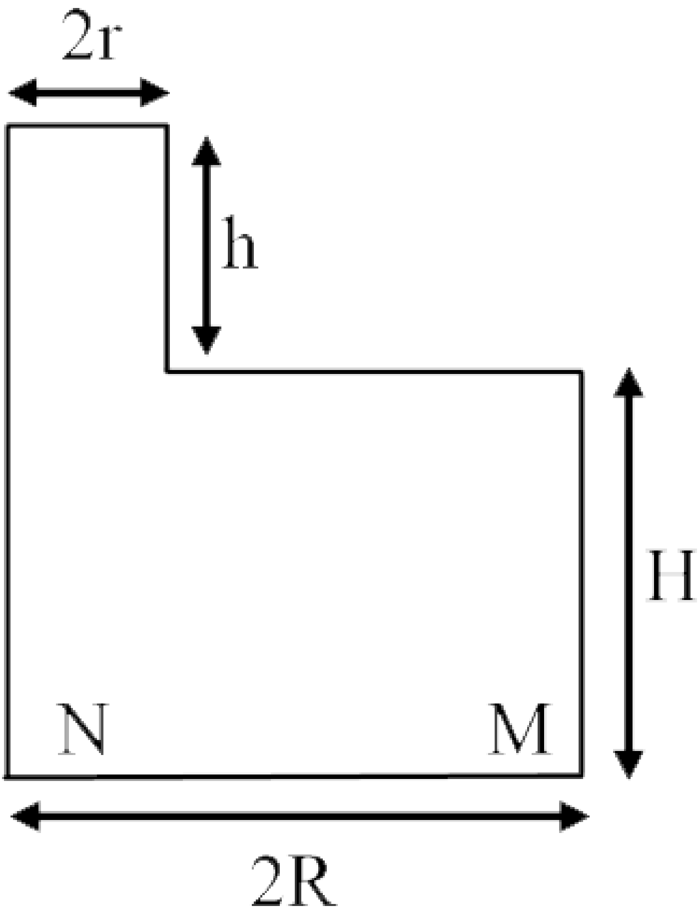
C. 45 cm

D. 75 cm

Answer: C

Watch Video Solution

235. The word "KVPY" is written on a board and viewed through different lense such that board is at a distance beyond the focal length of the lens.



Ignorging magnification effects, consider the following statements

(I) Image (i) has been viewed from the planar side of a plano-convex lens and image (ii) from the convex side of a plano-convex lens.

(II) Image (i) has been viewed from the concave side of a plano-concave lens and image (ii) from the planar side of a plano-convex lens.

(iii) Image (i) has been viewed from the cocave side of a plano-concave lens and image (ii) from the planar side of a plano-convex lens.

(iv) Image (i) has been viewed from the planar side of a plano-concave lens and image (ii) from the convex side of a plano-convex lens.

Which of the above statements are correct ?

A. All four.

B. Only (III).

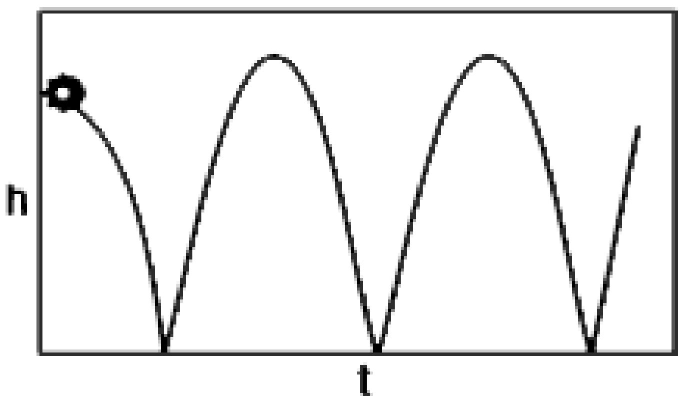
C. Only (IV).

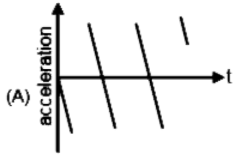
D. Only (II), (III) and (IV).

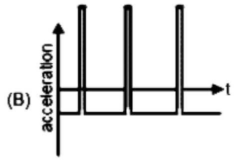
Answer: D

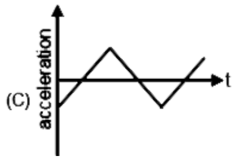
Watch Video Solution

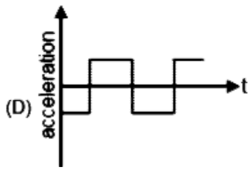
236. A ball is dropped vertically from heigth h and is bouncing elastically on the floor (see figure). Which of the following plots best depicts the acceleration of the ball as a function of time.



A. 

B. 

C. 

D. 

Answer: B

Watch Video Solution

237. A student studying the similarities and differences between a camera and the human eye makes the following observations.

(I) Both the eye and the camera have convex lenses.

(II) In order to focus, the eye lens expands or contracts while the camera lens moves forward or backward.

(III) The camera lens produces upside down real images while the eye lens produces only upright real image.

(IV) A screen in camera is equivalent to the retina in the eyes.

(V) A camera ajusts the amount of light entering in it by adjusting the apeture of the lens. In the eye the cornea controls the amount of light.

The correct statemetns are :

A. Only (I), (II) (IV).

B. Only (I), (III), (V).

C. Only (I), (II), (IV), (V).

D. All

Answer: A

Watch Video Solution

238. A particle starts moving along a line from zero initial velocity and comes to rest after moving distance d. During its motion it had a constant acceleration f over 2/3 of the distance, and covered the rest of the distance with constant retardation. The time taken to cover the distance is

A. $\sqrt{2d/3f}$

B. $2\sqrt{d/3f}$

C. $\sqrt{3d/f}$

D. $\sqrt{3d/2f}$

Answer: C

Watch Video Solution

239. If the image formed by a thin convex lens of power P has magnification m then image distance v is

A. $v = \frac{1-m}{P}$

B. $v = \frac{1+m}{P}$

C. $v = \frac{m}{P}$

D. $v = \frac{1+2m}{P}$

Answer: A

Watch Video Solution

240. A long cylindrical pipe of radius 20 cm is closed at its upper end and has an airtight piston of negligible mass as shown. When a 50 Kg mass is attached to the other end of the pistion, it moves down. If the air in the enclosure is cooled from temperature T to $T - \Delta T$, the piston moves back to its original position. Then $\Delta T / T$ is close to (Assuming air to be an ideal gas, $g = 10 m / s^2$, atmospheric pressure is 10_5 Pascal),

(i)

(ii)

A. 0.01

B. 0.02

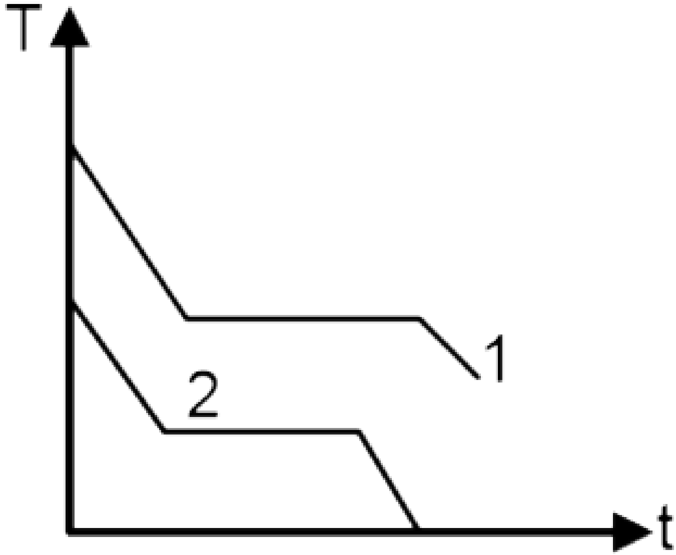
C. 0.04

D. 0.09

Answer: C

Watch Video Solution

241. Two different liquids of same mass are kept in two identical vessels, which are placed in a freezer that extracts heat from them at the same rate causing each liquid to transform into a solid. The schematic figure below shows the temperature T vs time t plot for the two materials. We denote the specific heat in the liquid status to be C_{L1} and C_{L2} for materials 1 and 2 respectively, and latent heats of fusion U_1 and U_2 respectively.



Choose the correct option.

A. $C_{L1} > C_{L2}$ and $U_1 < U_2$

B. $C_{L1} > C_{L2}$ and $U_1 > U_2$

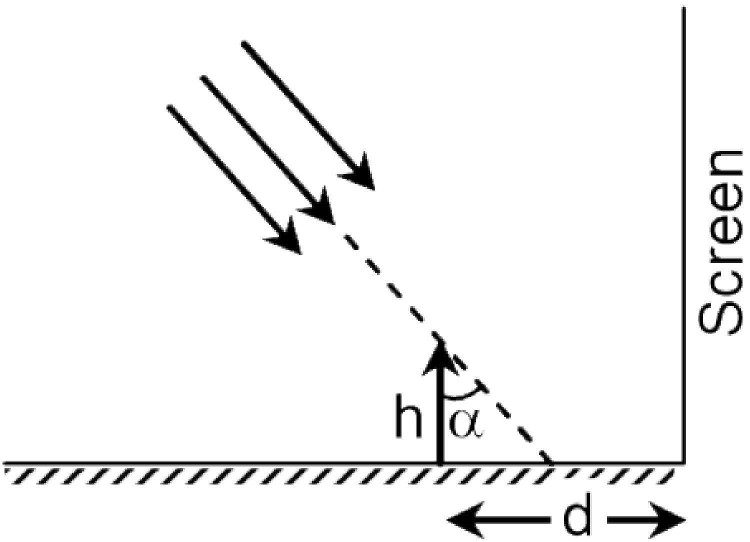
C. $C_{L1} < C_{L2}$ and $U_1 > U_2$

D. $C_{L1} < C_{L2}$ and $U_1 < U_2$

Answer: C

Watch Video Solution

242. A long horizontal mirror is next to a vertical screen (See figure). Parallel light rays are falling on the mirror at an angle α from the vertical. If a vertical object of height h is kept on the mirror at a distance $d > h\tan(\alpha)$. The length of the shadow of the object on the screen would be



A. h/2

B. $h\tan(\alpha)$

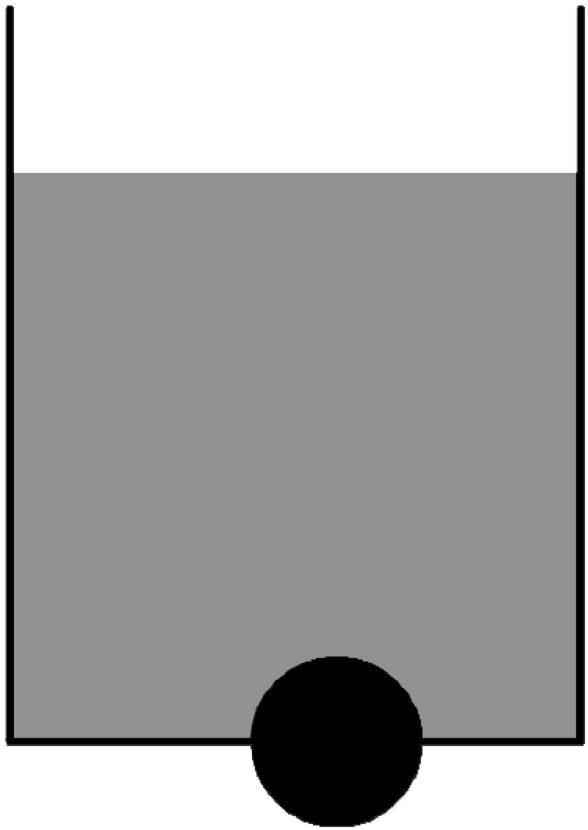
C. 2h

D. 4h

Answer: C

Watch Video Solution

243. A spherical marble of radius 1 cm is stuck in a circular hole of radius slightly smaller than its own radius (for calculation purpose, both can be taken same) at the bottom of a bucket of height 40 cm and filled with water up to 10 cm. If the mass of the marble is 20 g, the net force on the marble due to water is close to



A. 0.02N upward

B. 0.02 N downward

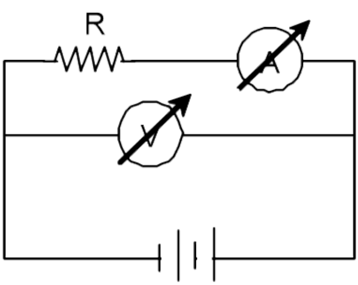
C. 0.04 N upward

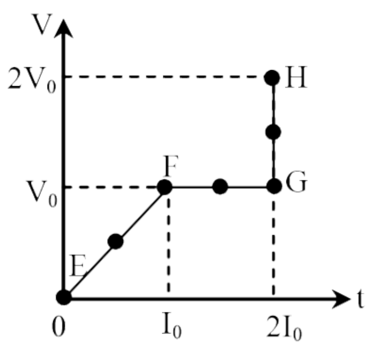
D. 0.04 N downward

Answer: D

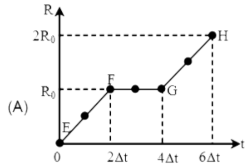
Watch Video Solution

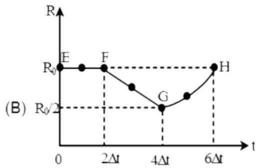
244. In the circuit shown below (on the left) the resistance and the emf source are both variable. The graph of seven readings of the voltmeter and the ammeter (V and I, respectively) for different setting of resistance and the emf, taken at equal intervals of time Δt, are shown (on the right) by the dots connected by the curve EFGH. Consider the interval resistance of the battery to be negligible and the voltmeter and ammeter to be ideal devices. Take $R_0 = V_0 / l_0$.

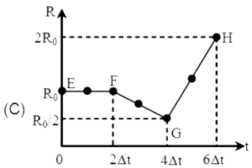


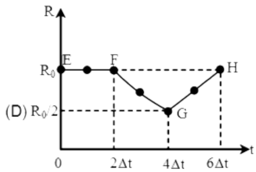


Then the plot of the resistance as a function of time corresponding to the curve EFGH is given by

A. 

B. 

C. 

D. 

Answer: D

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245. Stoke's law states that the viscous drag force F experienced by a sphere of radius a, moving with a speed V through a fluid with coefficient of viscosity η, is given by $F = 6\pi \text{na}v$. If this fluid is flowing through a cylindrical pipe of radius r, length l and a pressure difference of P across its two ends, then the volume of water V which flows through the pipe in time t can be written as c$\frac{V}{t} = k\left(\frac{P}{l}\right)\eta^b r^c$, where k is a dimensional constant. Correct values of a, b and c are

A. a = 1, b = –1, c = 4

B. a = -1, b = 1, c = 4

C. a = 2, b =-1, c = 3

D. a = 1, b =-2, $c = -4$

Answer: A

Watch Video Solution

246. The distance s travelled by a particle in time t is $s = ut - \frac{1}{2} g t^2$ The initial velocity of the particle was measured to be u = 1.11 ± 0.01 m/s and the time interval of the experiment was $t = 1.01 \pm 0.1$ s. The acceleration was taken to be g $g = 9.8 \pm 0.1 m / s^2$ .With these measurements, the student estimates the total distance travelled. How should the student report the result ?

A. 1.121 ± 0.1m

B. 1.1 ± 0.1 m

C. 1.12 ± 0.07m

D. 1.1 ± 0.07 m

Answer: B

Watch Video Solution

247. A massive black hole of mass m and radius R is spinning with angular velocity ω. The power P radiated by it as gravitational waves is given by $P = Gc^{-5}m^x R^y \omega^z$, where c and G are speed of light in free space, and the universal gravitational constant , respectively. Then

A. x =-1, y = 2, z = 4

B. x = 1, y = 1, z = 4

C. x = -1, y = 4, z = 4

D. x = 2, y = 4, z = 6

Answer: D

248. Consider the following statements for air molecules in an air tight container.

(I) the average speed of molecules is larger than root mean square speed

(II) mean free path of molecules is larger than the mean distance between molecules

(III) mean free path of molecules increases with temperature

(IV) the rms speed of nitrogen molecule is smaller than oxygen molecule

The true statements are :

A. only II

B. II & III

C. II & IV

D. I, II & IV

Answer: A

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249. Three circularly shaped linear polarisers are placed coaxially. The transmission axis of the first polariser is at 30°, the second one is at 60° and the third at 90° to the vertical all in the clockwise sense. Each polariser additionally absorbs 10% of the light. If a vertically polarised beam of light of intensity I = 100 W/m^2 is incident on this assembly of polarisers, then the final intensity of the transmitted light will be close to

A. 10W/m^2

B. 20W/m^2

C. 30W/m^2

D. 50 W/m^2

Answer: C

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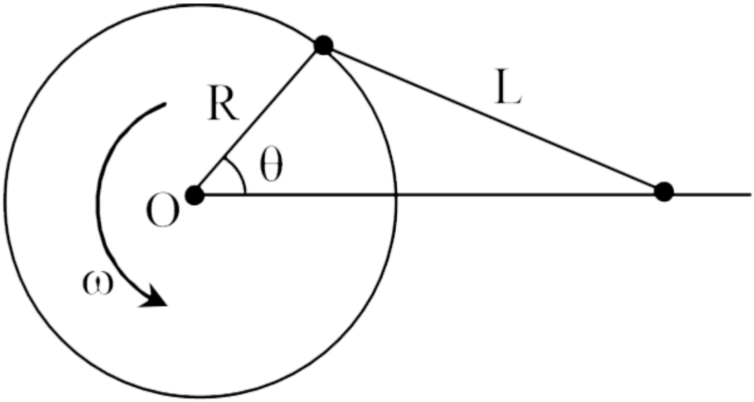
250. One end of a rod of length L is fixed to a point on the circumference of a wheel of radius R. The other end is sliding freely along a straight channel passing through the centre O of the wheel as shown in the figure below. The wheel is rotating with a constant angular velocity ω about O. Taking

$T = \frac{2\pi}{\omega}$ the motion of the rod is



A. simple harmonic with a period of T

B. simple harmonic with a period of T/2

C. not simple harmonic but periodic with a period of T

D. not simple harmonic but periodic with a period of T/2

Answer: C

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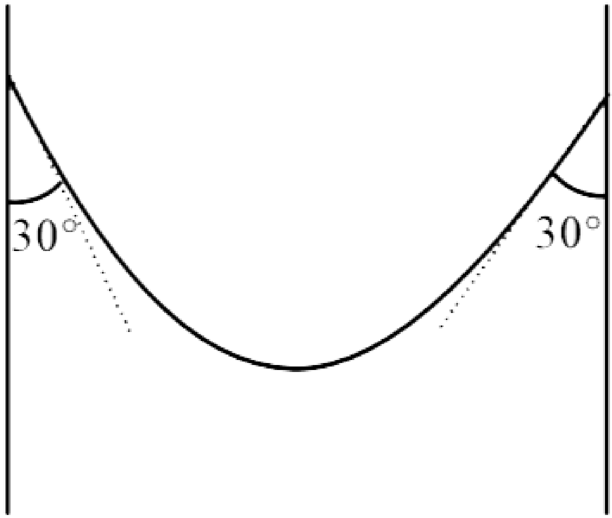
251. A rope of mass 5 kg is hanging between two supports as shown. The tension at the lowest point of the rope is close to (take g = $10m/s^2$)



A. 22 N

B. 44 N

C. 28 N

D. 14 N

Answer: D

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252. A uniform rope of total length l is at rest on a table with fraction f of its length hanging (see figure). If the coefficient of friction between the table and the chain is μ then

A. $f = \mu$

B. $f = 1/(1 + \mu)$

C. $f = 1/(1 + 1/\mu)$

D. $f = 1/(\mu + 1/\mu)$

Answer: C

Watch Video Solution

253. A light beam travelling along the x axis with planar wavefront is incident on a medium of thickness t. In the region, where light is falling the refractive index can be taken to be varying such that $\frac{dn}{dy} > 0$. The light beam on the other side of the medium will emerge

A. parallel to the x-axis

B. bending downward

C. bending upward

D. split into two or more beams

Answer: C

Watch Video Solution

254. Let the electrostatic field E at distance r from a point charge q not be an inverse square but, instead an inverse cubic, e.g. $\overrightarrow{E} = k\frac{q}{r^3}\hat{r}$ Here k is a constant. Consider the following two statements

(i) Flux through a spherical surface enclosing the charge is $\phi = \text{qenclosed} / \in 0$

(ii) A charge placed inside uniformly charged shell will experience a force.

Choose the correct option.

A. Only (i) is valid

B. Only (ii) is valid

C. Both (i) and (ii) are invalid

D. Both (i) and (ii) are valid

Answer: B

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255. A star of mass M and radius R is made up of gases. The average gravitational pressure compressing the star due to gravitational pull of the gases making up the star depends on R as

A. $\frac{1}{R^4}$

B. $\frac{1}{R}$

C. $\frac{1}{R^2}$

D. $\frac{1}{R^6}$

Answer: A

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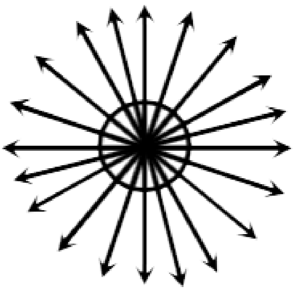
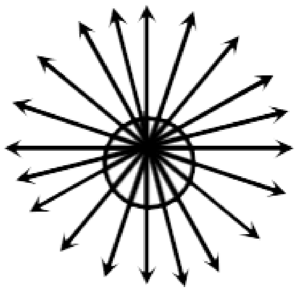
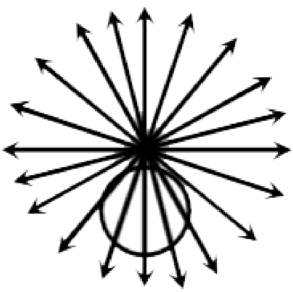
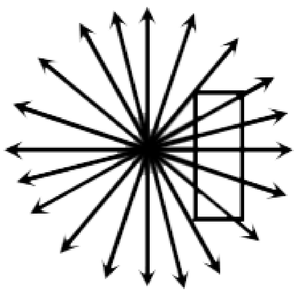
256. The black shapes in the figure below are closed surfaces. The electric field lines are in red. For which case the net flux through the surfaces is non-zero ?


(a)


(b)


(c)


(d)

A. In all cases net flux is non-zero

B. Only (c) and (d)

C. Only (a) and (b)

D. Only (b), (c) and (d)

Answer: C

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257. A particle of charge q and mass m enters a region of a transverse electric field of $E_0\hat{j}$ with initial velocity $v_0\hat{i}$. The time taken for the change in the de Broglie wavelength of the charge from the initial value of λ_0 to $\lambda_0/3$ is proportional to

A. $\frac{q}{m}$

B. $\frac{m}{q}$

C. $\sqrt{\frac{q}{m}}$

D. $\sqrt{\frac{m}{q}}$

Answer: B

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258. Consider the following nuclear reactions :

I $._7^{14} N + ._2^4 He \rightarrow ._8^{17} O + X$

II $._4^9 Be + ._2^4 H \rightarrow ._6^{12} He + Y$

Then

A. X and Y are both protons.

B. X and Y are both neutrons.

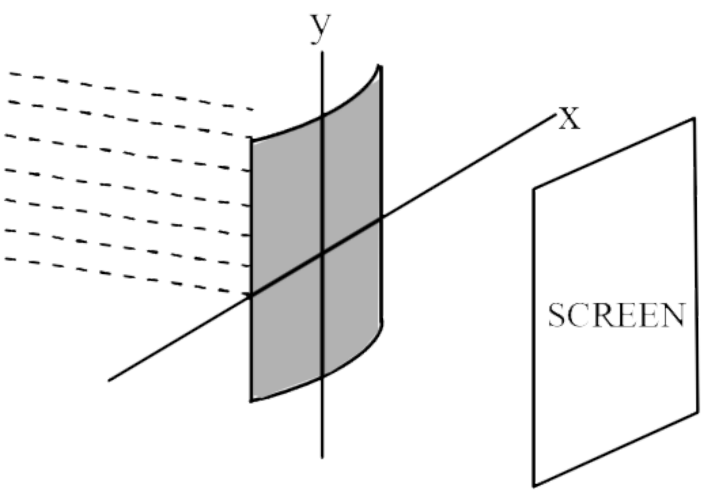
C. X is a proton and Y is a neutron.

D. X is a neutron and Y is a proton.

Answer: C

Watch Video Solution

259. Consider a plane parallel beam of light incident on a plano-cylindrical lens as shown below. Which of the following will you observe on a screen placed at the focal plane of the lens ?



A. The screen will be uniformly illuminated.

B. There will be a single bright spot on the screen.

C. There will be a single bright line on the screen parallel to the x-axis

D. There will be a single bright line on the screen parallel to the y-axis

Answer: D

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260. The n-side of the depletion layer of a p-n junction :

A. always has same width as of the p-side.

B. has no bound charges.

C. is negatively charged.

D. is positively charged.

Answer: D

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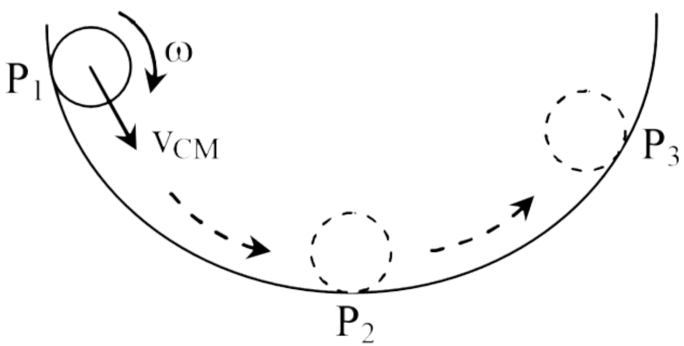
261. A small ring is rolling without slipping on the circumference of a large bowl as shown in the figure. The ring is moving down at P_1, comes down to the lower most point P_2 and is climbing up at P_3. Let $\overrightarrow{v}_{CM}$ denote the velocity of the centre of mass of the ring. Choose the correct statement regarding the frictional force on the ring.



A. It is opposite to $\overrightarrow{v}_{CM}$ at the points P_1, P_2 and P_3.

B. It is opposite to $\overrightarrow{v}_{CM}$ at P_1 and in the same direction as $\overrightarrow{v}_{CM}$ at P_3

C. It is in the same direction as $\overrightarrow{v}_{CM}$ at P_1 and opposite to $\overrightarrow{v}_{CM}$ at P_3.

D. It is zero at the points P_1, P_2 and P_3.

Answer: B

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262. A bomb explodes at time t = 0 in a uniform, isotropic medium of density ρ and releases energy E, generating a spherical blast wave. The radius R of this blast wave varies with time t as :

A. t

B. $t^{2/5}$

C. $t^{1/4}$

D. $t^{3/2}$

Answer: B

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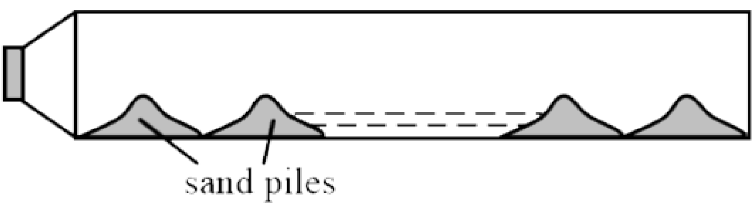
263. A closed pipe of length 300 cm contains some sand. A speaker is connected at one of its ends. The frequency of the speaker at which the sand will arrange itself in 20 equidistant piles is close to (velocity of sound is 300 m/s)



A. 10 kHz

B. 5 kHz

C. 1 kHz

D. 100 kHz

Answer: C

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264. A planet of radius R_p is revolving around a star of radius R^*, which is at temperature T^*. The distance between the star and the planet is d. If the planet's temperature is f T^*, then f is proportional to

A. $\sqrt{R^* / d}$

B. R^* / d

C. $R^{*}R_{P}/d^{2}$

D. $(R^{*}/d)^{4}$

Answer: A

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265. Some of the wavelength observed in the emission spectrum of neutral hydrogen gas are 912, 1026, 1216, 3646, 6563 Å. If broad band light is passing through neutral hydrogen gas at room temperature, the wavelength that will not be absorbed strongly is

A. 1026 Å

B. 1216 Å

C. 912 Å

D. 3646 Å

Answer: D

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266. One mole of an ideal monatomic gas undergoes the following four reversible processes :

Step 1 – it is first compressed adiabatically from volume $8.0m^3$ to $1.0m^3$.

Step 2 – then expanded isothermally at temperature T_1 to volume $10.0m^3$.

Step 3 – then expanded adiabatically to volume $80.0m^3$.

Step 4 – then compressed isothermally at temperature T_2 to volume $8.0m^3$.

Then T_1 / T_2

A. 2

B. 4

C. 6

D. 8

Answer: B

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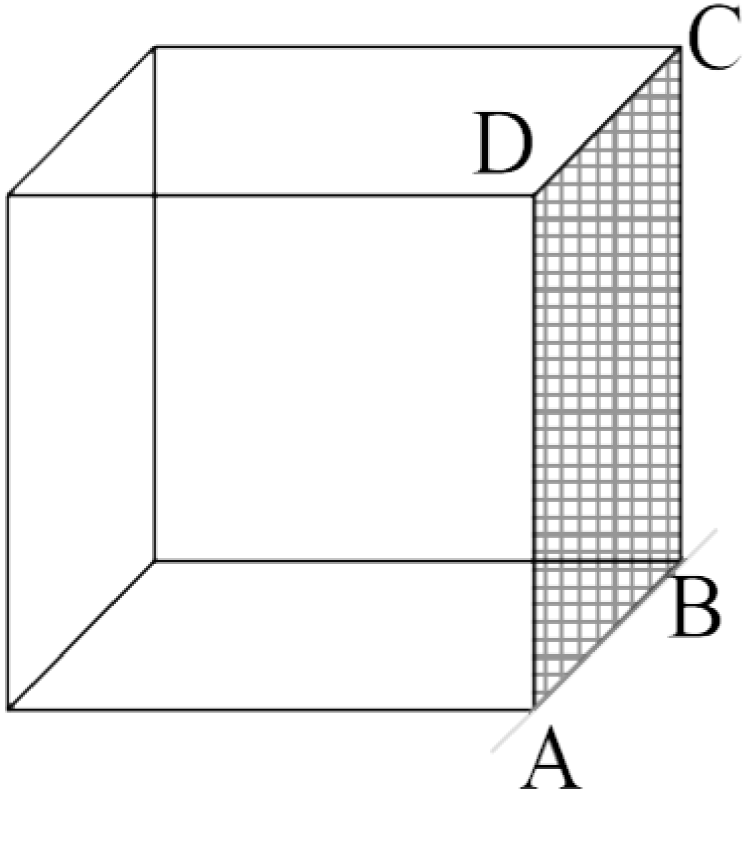
267. A solid cube of wood of side 2a and mass M is resting on a horizontal surface as shown in the figure. The cube is free to rotate about the fixed axis AB. A bullet of mass m $(< \; < M)$ and speed v is shot horizontally at the face opposite to ABCD at a height 'h' above the surface to impart the cube an angular speed ω_c so that the cube just topples over. Then ω_c is (note :

the moment of inertia of the cube about an axis perpendicular to the face and passing through the center of mass is $2Ma^3/3$)



A. $\sqrt{3gM/2ma}$

B. $\sqrt{3g/4h}$

C. $\sqrt{3g(\sqrt{2}-1)/2a}$

D. $\sqrt{3g(\sqrt{2}-1)/4a}$

Answer: D

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268. A uniform thin wooden plank AB of length L and mass M is kept on a table with its B end slightly outside the edge of the table. When an impulse J is given to the end B, the plank moves up with centre of mass rising a distance 'h' from the surface of the table. Then-

A. $h > 9J^2/8M^2g$

B. $h = J^2/2M^2g$

C. $J^2/2M^2g < h < 9J^2/8M^2g$

D. $h < J^2/2M^2g$

Answer: C

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269. A square-shaped wire loop of mass m, resistance R and side 'a' moving with speed v0, parallel to the x-axis, enters a region of uniform magnetic field B, which is perpendicular to the plane of the loop. The speed of the loop changes with distance x $(x < a)$ in the filed, as

A. $v_0 - \frac{B^2a^2}{Rm}$

B. $v_0 - \frac{B^2a^2}{2Rm}$

C. $v_0 - \frac{B^2a}{Rm}$

D. v_0

Answer: A

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270. The emission series of hydrogen atom is given by $\frac{1}{\lambda}=R\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)$ where R is the Rydberg constant. For a transition from n_2 to n_1, the relative change $\Delta\lambda/\lambda$ in the emission wavelength if hydrogen is replaced by deuterium (assume that the mass of proton and neutron are the same and approximately 2000 times larger than that of electrons) is

A. $0.025\,\%$

B. $0.005\,\%$

C. $0.0025\,\%$

D. $0.05\,\%$

Answer: A

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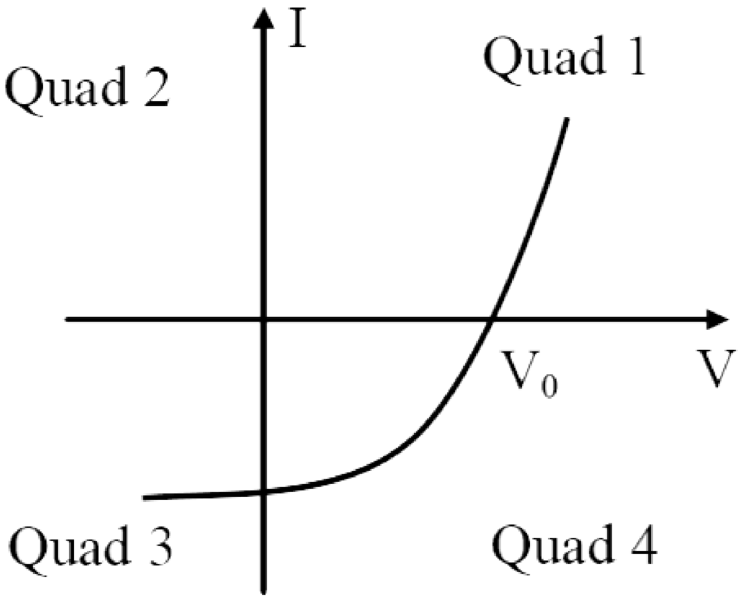
271. When light shines on a p-n junction diode, the current (I) vs, voltage (V) is observed as in the figure below :



In which quadrant(s) does the diode generate power, so that it can be used as a solar cell ?

A. Quad 1 only

B. Quad 1 and 3 only

C. Quad 4 only

D. Quad 1 and 4 only

Answer: C

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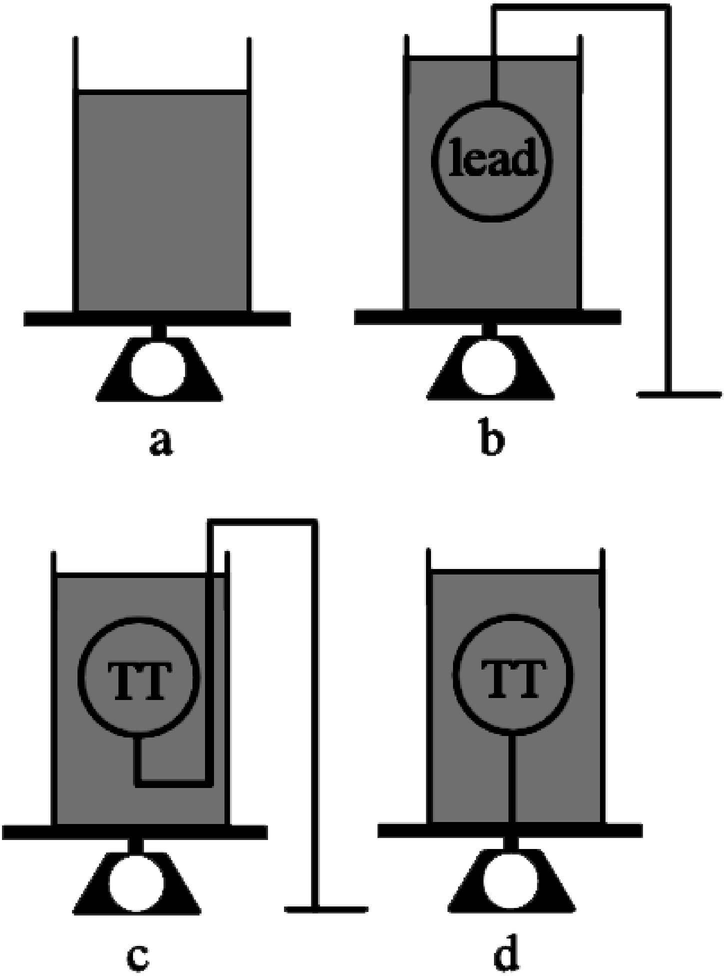
272. Four identical beakers contain same amount of water as shown below. Beaker 'a' contains only water. A lead ball is held submerged in the beaker 'b' by string from above. A same sized plastic ball, say a table tennis (TT) ball, is held submerged in beaker 'c' by a string attached to a stand from outside. Beaker 'd' contains same sized TT ball which is held submerged from a string attached to the bottom of the beaker. These beakers (without stand) are placed on weighing pans and register reading W_a, W_b, W_c and W_d for a, b, c and d, respectively. (Effects of the mass and volume of the stand and string are to be neglected)



A. $W_a = W_b = W_c = W_d$

B. $W_b = W_c > W_d > W_a$

C. $W_b = W_c > W_a > W_d$

D. $W_b > W_c > W_d > W_a$

Answer: B

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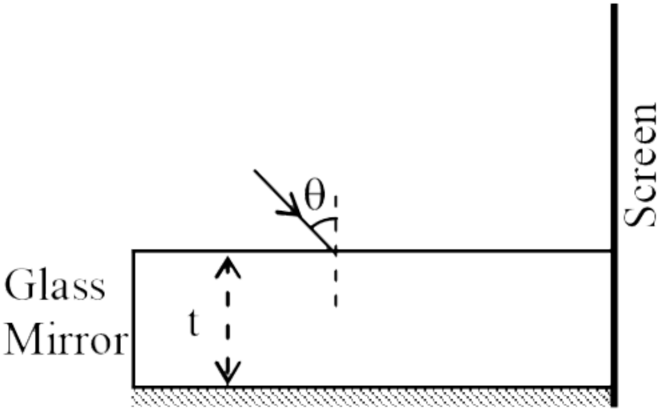
273. Back surface of a glass (refractive index n and thickness t) is polished to work as a mirror as shown below. A laser beam falls on it and is partially reflected and refracted at the air-glass interface and fully reflected at the mirror surface respectively. A pattern of discrete spots of light is observed on the screen.



The spacing between the spots on the screen will be

A. $\dfrac{2t\cos\theta}{\sqrt{n^2-\sin^2\theta}}$

B. $\dfrac{2t\sin\theta}{\sqrt{n^2-\sin^2\theta}}$

C. $\dfrac{2t\tan\theta}{\sqrt{n^2-\sin^2\theta}}$

D. $\dfrac{2t\sin\theta}{\sqrt{1-\frac{\sin^2\theta}{n^2}}}$

Answer: A

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274. Consider the following statements regarding the photoelectric effect experiment :

(I) Photoelectrons are emitted as soon as the metal is exposed to light

(II) There is a minimum frequency below which no photo-current is observed

(III) The stopping potential is proportional to the frequency of light

(IV)The photo-current varies linearly with the intensity of the light

Which of the above statements indicate that light consists of quanta (photons) with energy proportional to frequency ?

A. I and III only

B. II and III only

C. II, III and IV only

D. I, II and III only

Answer: D

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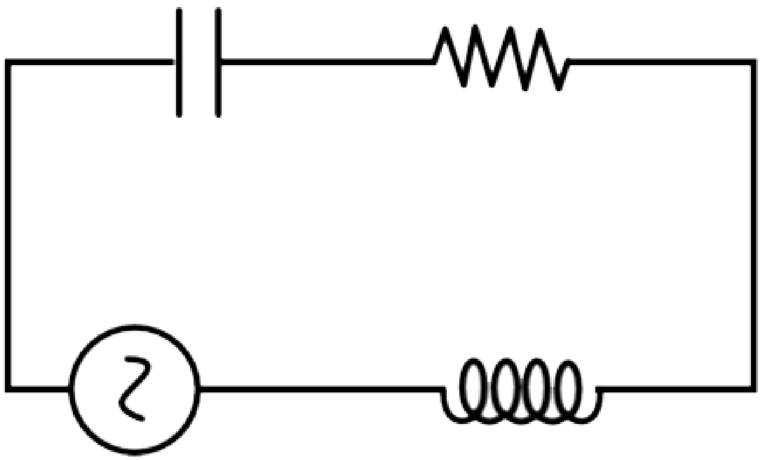
275. Consider the R-L-C circuit given below. The circuit is driven by a 50 Hz AC source with peak voltage 220 V. If R = 400 Ω, C = 200μF and L = 6 H, the maximum current in the circuit is closest to



A. 0.120 A

B. 0.55 A

C. 1.2 A

D. 5.5 A

Answer: A

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exercise

1. What is the force on q?

A. $\left(\sqrt{2}-\frac{1}{2}\right)\frac{q^2}{16\pi\varepsilon_0 d^2}$

B. $\frac{q^2}{16\pi\varepsilon_0 d^2}$

C. $\frac{q^2}{32\pi\varepsilon_0 d^2}$

D. $\left(\sqrt{2}\frac{q^2}{16\pi\varepsilon_0 d^2}\right.$

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2. Which of the following is a result of diffraction?

A. working of an optical fibre

B. rainbow formation

C. the colours that we see on aCD orDVD

D. none

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3. Ratio of gravitational force and electrostatic force between two electrons

A. 10^{-40}

B. 10^{-38}

C. 10^{-43}

D. 10^{-48}

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4. Rat jumps off from 15th floor of the building. Each floor is 3m high. Rat lands 12m from building. What is the horizontal speed with which rat jumped

A. 1 m/s

B. 2 m/s

C. 3 m/s

D. 4 m/s

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5. At what depth the acceleration due to gravity will be equal to acceleration of gravity at height h = 10 km

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6. Two projectile are projected which have the same range, if first projectile is projected at 30 degrees and its maximum height is h then the maxium height of other projectile is

A. h

B. 3h

C. 5h

D. 7h

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7. 2 rods made of same material have their radii in the ratio 2:1. Same force was applied on them. Ratio of stress in them is

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8. An object was thrown at 24 m/s by an performer aiming at the loop held by another performer at the height of 45m. When the performer throws the object at that another performer drops the loop downward. At what height will the object cross the loop if the horizontal distance between performer and loop holder was 25m?

A. 11m

B. 23m

C. 22m

D. 40m

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9. Time period(T) in terms of pressure(P), density(ρ) and surface tension(S) is on basis of dimensional analysis

A. $T = K\left(\frac{P^{-3}}{2}\right)\left(\frac{\rho^1}{2}\right)S^1$

B. $T = K\left(\frac{P^1}{2}\right)\left(\frac{\rho^3}{2}\right)S^1$

C. $T = K\left(\frac{P^3}{2}\right)\left(\frac{\rho^1}{2}\right)S^1$

D. $T = KP\rho S$

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10. Force is given by $-kx^3$ and time period is T for amplitude A, then for amplitude 2A Time period would be

A. T

B. 2T

C. T/2

D. T/4

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11. Potential inside a uniformly charged solid sphere is given by $Q\frac{a+b\left(\frac{r}{R}\right)^{c}}{4\pi\varepsilon_0}$ What are the values of a,b,c?

A. $a=\frac{3}{2}, b=-\frac{1}{2}, c=2$

B. $a=\frac{1}{2}, b=-\frac{1}{2}, c=2$

C. $a=\frac{3}{2}, b=\frac{1}{2}, c=2$

D. $a=\frac{3}{2}, b=-\frac{1}{2}, c=-2$

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12. In YDSE, a source of light was used which emits a bichromatic beam. The two colours had wavelengths 800 nm and 400 nm each of intensity I_0. Find the maximum intensity which can be present at any point on the screen

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13. A person is driving a bicycle and applies the front brakes. The force that slows the bicycle down is provided by

A. the brakes

B. the front wheel

C. the back wheel

D. the road

Watch Video Solution

14. Due to a tower clock 80m high the loudness of sound heard at 8km from the clock was 30dB then what is the loudness heard at the base of the clocktower.

A. 60dB

B. 90dB

C. 70dB

D. 50dB

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15. A capacitor is getting charged by a battery of emf V what is the ratio of heat dissipated in the resistor to work done by battery when charge on capacitor is CV/2

A. 44199

B. 44198

C. 44259

D. 44291

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PART I (Physics)

1. The ratio of radii of two wires of same material is $2:1$. If these wires are stretched by equal forces, then the ratio of stresses produced in them will be

A. $\frac{1}{4}$

B. $\frac{1}{2}$

C. $\frac{3}{4}$

D. 1

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2. A submarine has a window of area $30 \times 30cm^2$ on its ceiling and is at a depth of 100m below sea level in a sea. If the pressure inside the submarine is maintained at the sea-level atmosphere pressure, then the force acting on the window is (consider density of sea water $= 1.03 \times 10^3 kg/m^3$, acceleration due to gravity $= 10 m/s^2$

A. $0.93 \times 10^5 N$

B. $0.93 \times 10^3 N$

C. $1.86 \times 10^5 N$

D. $1.86 \times 10^3 N$

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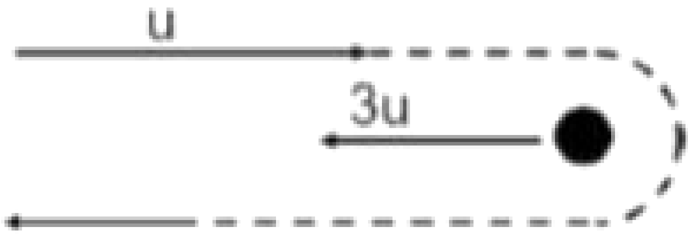
3. A spacecraft which is moving with a speed u relative to the earth in the x-direction, enters the gravitational field of a much more massive planet which is moving with a speed 3u in the negative x-direction. The spacecraft exits following the trajectory as shown below.



The speed of the spacecraft with respect to the earth a long time after it has escaped the planet's gravity is given by

A. u

B. 4u

C. 2u

D. 7u

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4. The earth's magnetic field was flipped by 180° a million years ago. This flip was relatively rapid and took 10^{5} years. Then the average change in orientation per year during the flip was closest to,

A. 1 seconds

B. 5 seconds

C. 10 seconds

D. 30 seconds

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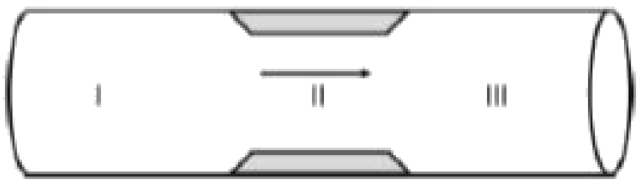
5. The platelets are drifting with the blood flowing in a streamline flow through a horizontal artery as shown below.



Artery is contracted in region II. Choose the correct statement.

A. As the platelets enter a constriction, the platelets get squeezed closer together in the narrow region and hence the fluid pressure must rise there.

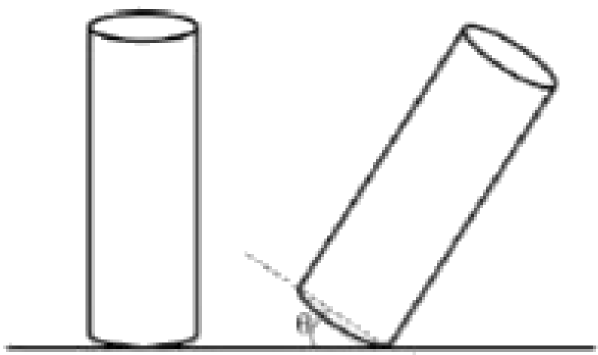
B. As the platelets enter a constriction, pressure is lower there.

C. The artery's cross section area is smaller in the constriction and thus the pressure must be larger there because pressure equals the force divided by area.

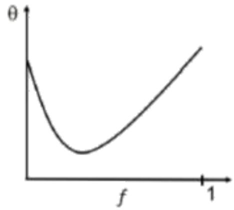
D. Pressure is same in all the parts of the artery.

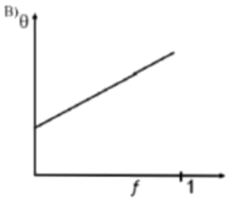
Watch Video Solution

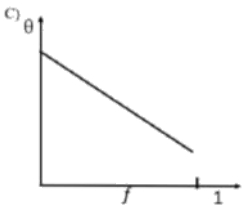
6. Figure below shows a shampoo bottle in a perfect cylindrical shape

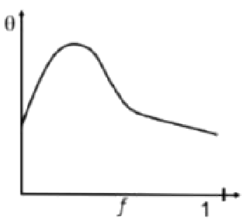


In a simple experiment, the stability of the bottle filled with different amount of shampoo volume is observed. The bottle is tilted from one side and then released. Let the angle θ depicts the critical angular displacement resulting in the bottle losing its stability and tripping over. Choose the graph correctly depicting the fraction f of shampoo filled (f= 1 corresponds to completely filled) vs the tripping angle θ

A. 

B. 

C. 

D. 

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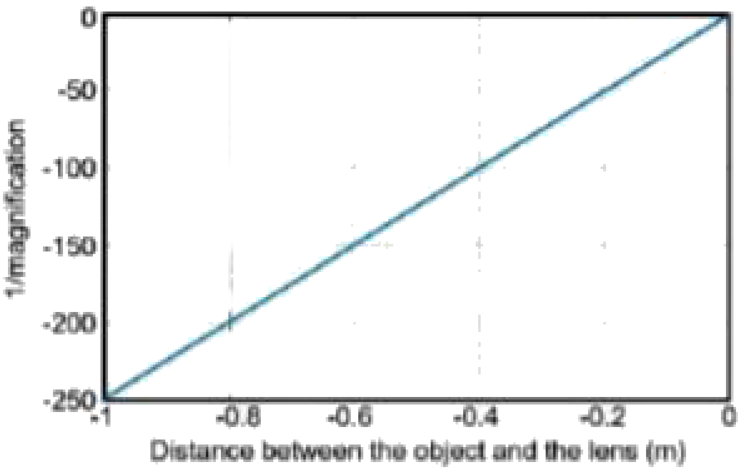
7. The following graph depicts the inverse of magnification versus the distance between the object and lens data for a setup. The focal length of the lens used in the setup is



A. 250m

B. 0.004m

C. 125m

D. 0.002m

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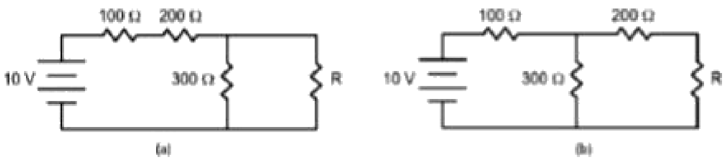
8. A student was trying to constant the circuit shown in the figure below marked (a), but ended up constructing the circuit marked (b). Realizing her mistake, she corrected the circuit, but the her surpris, the output voltage (across R) did not change



A. 100Ω

B. 150Ω

C. 200Ω

D. 300Ω

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9. The ratio of gravitational force and electrostatic repulsive force between two electrons is approximatly (gravitational constant $= 6.7 \times 10^{-11} Nm^2 / Kg^2$, mass of an electron $= 9.1 \times 10^{-31} kg$, charge on an electron $= 1.6 \times 10^{-19} C$)

A. 24×10^{-24}

B. 24×10^{-36}

C. 24×10^{-44}

D. 24×10^{-54}

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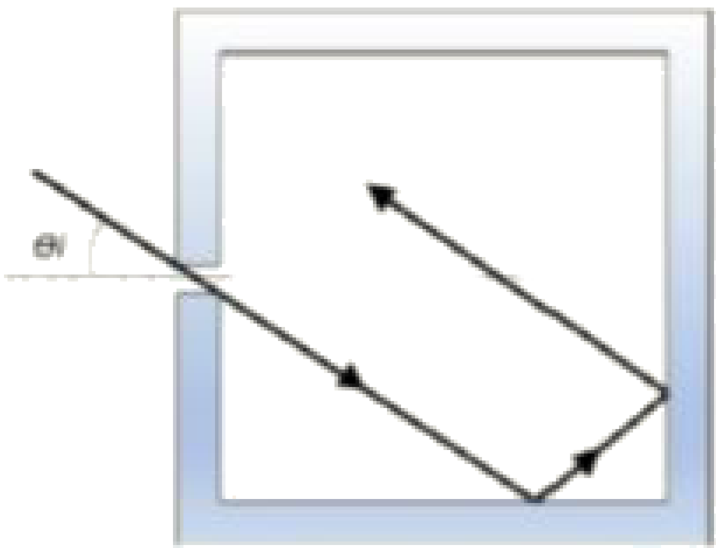
10. A monochromatic beam of light enters a square enclosure with mirrored interior surface at an angle of incidence $\theta I(\neq 0)$ (see the figure below). For some value (s) of θi, the beam is reflected by every mirrored wall (other than the one with the opening) exactly once and exits the enclosure through the same hole. which of the following statements about this beam is correct?



A. The beam will not come out of the enclosure for any value of θi

B. The beam will coe out for more than two values of θi

C. The beam will come out only at $\theta i = 45^\circ$

D. The beam will come out for exactly two value of θi

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PART-I Physics

1. A proton and an antiproton come close to each other in vacuum such that the distance between them is 1.0 cm. Consider the potential energy to be zero at infinity. The velocity at this distance will be

A. 1.17m/s

B. 2.3 m/s

C. 3.0 m/s

D. 23m/s

Watch Video Solution

2. The output voltage (taken across the resistance) of a LCR series resonant circuit falls to half is peak value at a frequency of 200 Hz and again reaches the same value at 800 Hz. The bandwidth of this circuit is

A. 200 Hz

B. $200\sqrt{3}Hz$

C. 400 Hz

D. 600 Hz

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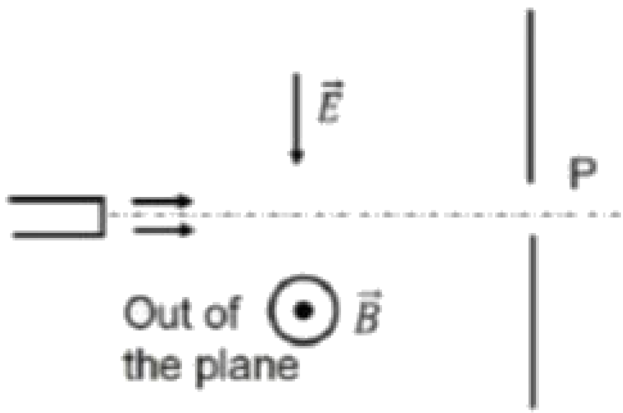
3. A collimated beam of charged and uncharged particles is directed towards a hole marked P on a screen as shown below. If the electric and magnetic fields as indicated below are turned on.



A. only particles with speed E/B will go through the hole P.

B. only charged particles with speed E/B and neutral particles will go through ?

C. only neutral particles will go though P.

D. only positively charged particles with speed E/B and neutral particles will go through P

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4. An engine runs between a reservoir at temperature 200 K and a hot body which is initially at temperature of 600 K. If the hot body cools down to a temperature of 400 K in the process, then the maximum amount of work that the engine can do (while working in a cycle) is (the heat capacity of the hot body is 1 J/K)

A. 200(1-ln2)J

B. 200(1-ln3/2)J

C. 200(1+ln3/2)J

D. 200J

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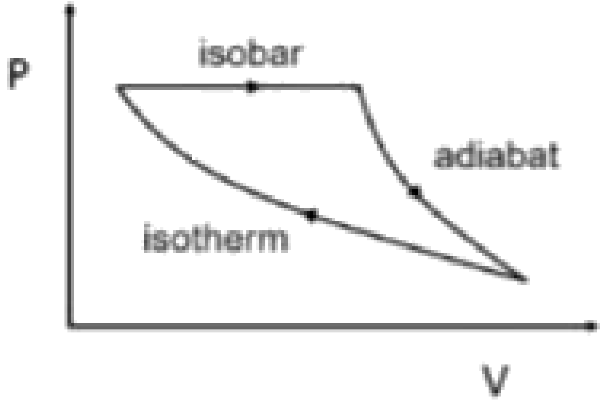
5. The efficiency of the cycle shown below in the figure (consisting of one isobar , one adiabatic and one isotherm (is 50 % the ratio ,x, between the highest and lowest temperature attained in this cycle obeys (the working substance is an ideal gas)



A. $x = e^{x-1}$

B. $x^2 = e^{x-1}$

C. $x = e^{x^2-1}$

D. $x^2 = e^{x^2-1}$

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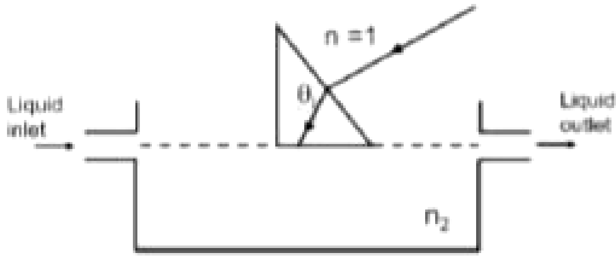
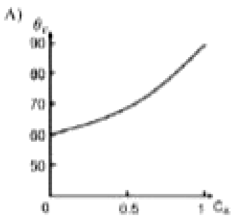
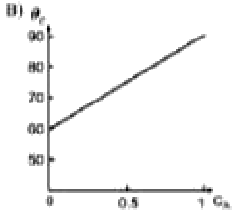
6. A right - angled isoceles prism is held on the surface of a liquid composed of miscible solvents A and B of refractive index $n_A = 1.50$ and $n_B = 1.30$ respectively . The refractive index of prism is $n_p = 1.5$ and that of the liquid is given by $N_L = C_A n_A + (1 - C_A) n_B$ where C_A is the percentage of solventA in the liquid

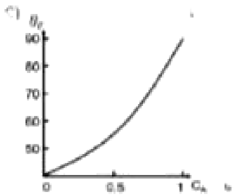


IF θ_C is the critical angle at prism - liquid interface . the plot which best represents the variation of the critical angle with the percentage of solvent is

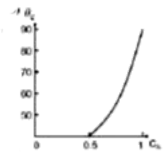
A. 



B.



C.



D.

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7. Instead of angular momentum quantization a student posits that energy is quantized as $E = -E_0 / n (E_0 > 0)$

and n is a positive interger . Which of the following options is correct ?

A. The radius of the electron orbit is $r \propto \sqrt{n}$

B. The speed of the electron is $v \propto \sqrt{n}$

C. The angular speed of the electron is $\omega \propto 1/n$

D. The angular momentum of the electron is $\propto \sqrt{n}$

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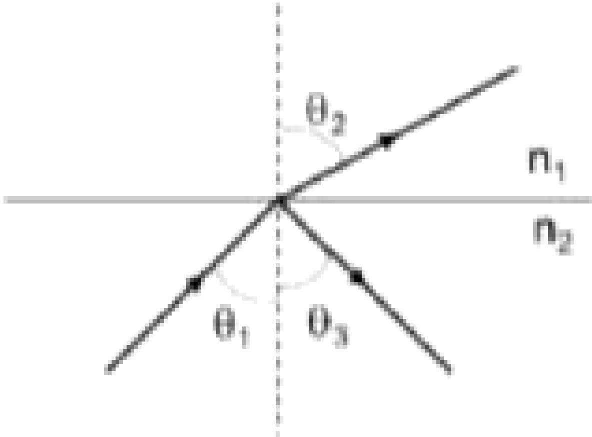
8. A monochromatic beam of light is incident at the interface of two materials of refractive index n_1 and n_2 as shown . If $n_1 > n_2$ and θ_C is the critical angle then which of the following statements is NOT true ?



A. $\theta_1 = \theta_3$ for all values of θ_1

B. $\cos\theta_2$ is imaginary for $\theta_1 > \theta_2$

C. $\cos\theta_2 = 0$ for $\theta_1 = \theta_C$

D. $\cos\theta_3$ is imaginary for $\theta_1 = \theta_c$

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9. The intensity of light from a continuously emitting laser source operating at 638 nm wavelength is modulated at 1 GHz . The modulation is done by momentarily cutting the intensity off with a frequency of 1 GHz . What is the farthest distance apart two detectors can be placed in the line of the laser light so that they can see the portions of the same pulse simultaneously ? (consider the speed of light in air $3 \times 10^8 m / s$)

A. 30 μm

B. 30 cm

C. 3 m

D. 30 m

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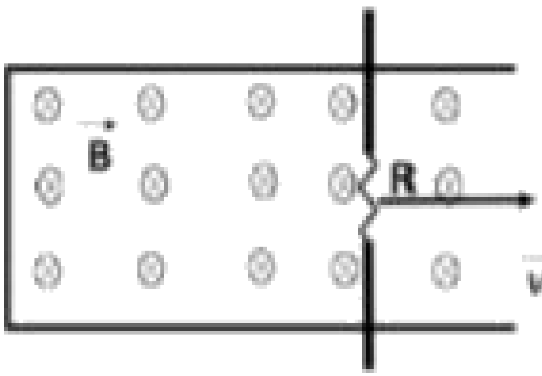
10. A conducting rod, with a resistor of resistance R. is pulled with constant speed v on a smooth conducting rail as shown in figure. A constant magnetic field $\vec{B}$ is directed into the page. If the speed of the bar is doubled, by what factor does the rate of heat dissipation across the resistance R change?



A. 0

B. $\sqrt{2}$

C. 2

D. 4

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11. Consider the following statements regarding the real images formed with a converging lens. I -Real images can be seen only if the image is projected onto the screen .(2)The real image can be seen only from the same side of the lens as that on which the object is positioned. (3)Real images produced by converging lenses are not only laterally but also longitudinally inverted as with mirrors. Which of the above statement/statements is/are incorrect?

A. Only I and III

B. All three

C. None

D. Only II

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12. A zinc ball of radius, R=1 cm charged to a potential -0.5 V. The ball is illuminated by a monochromatic ultraviolet (UV) light with a wavelength 290 nm. The photoelectric threshold for zinc is 332 nm. The potential of ball after a prolonged exposure to the UV is

A. $-0.5V$

B. $0V$

C. $0.54V$

D. $0.79V$

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13. A source simultaneously emitting light at two wavelengths 400 nm and 800 nm is used in the Young's double slit experiment. If the intensity of light at the slit for each wavelength is I_0, then the maximum intensity that can be observed at any point on the screen is

A. I_0

B. $2I_0$

C. $4I_0$

D. $8I_0$

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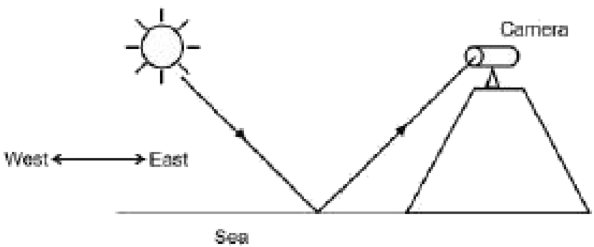
PART II PHYSICS

1. A camera filled with a polarizer is placed on a mountain in a manner to record only the reflected image of the sun from the surface of a shown in the figure. If the sun rise at 6.00 AM and sets at 6.00 PM during the summer, then at what time in the aftermoon will the recorded image have the lowest intensity, assuming there are no clouds and intensity of the sun at the sea surface is constant throughout the day?



A. 12.32 PM

B. 3.32PM

C. 5.00PM

D. 6.00PM

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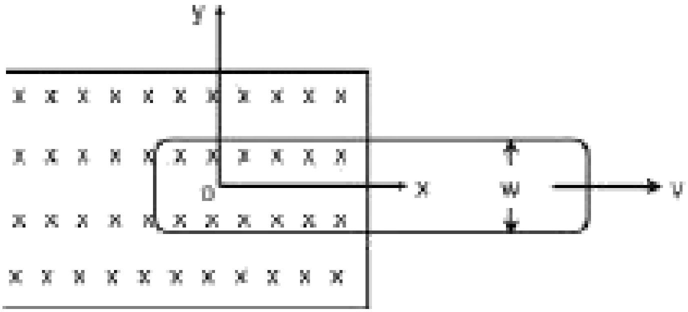
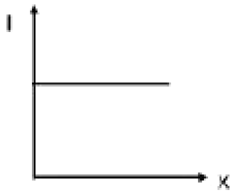
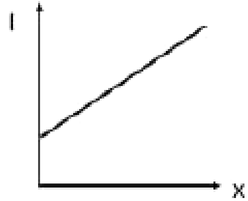
2. Suppose a long rectangular loop of width w is moving along the x-direction with its left arm in a magnetic field perpendicular to the plane of the loop (see figure). The resistance of the loop is zero and it has an inductance L. At time t = 0, its left arm passes the origin O.



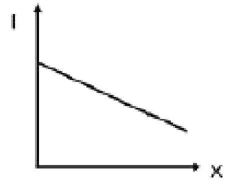
If for $t \geq 0$ the current in the loop is I and the distance of its

left are arm from the origin is x then I versus x graph will be

A. 

B. 

C. 

D. 

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3. Imagine a would where free magnetic charges exist. In this world, a circuit is made with a U shape wire and a rod free to slide on it. A current carried by free magnetic charges can flow in the circuit. When the circuit is placed in a uniform electric field. E perpendicular to the plane of the plane of the circuit and the rod is pulled to the right with a constant speed v, the "magnetic EMF" in the current and the direction of the corresponding current. arising because of changing electric flux will be (l is the length of the rod and c is speed of light).

A. vEl clockwise.

B. vEL counterclock wise

C. $\frac{vEl}{c^2}$ clockwise

D. $\frac{vEl}{c^2}$ counterclockwise

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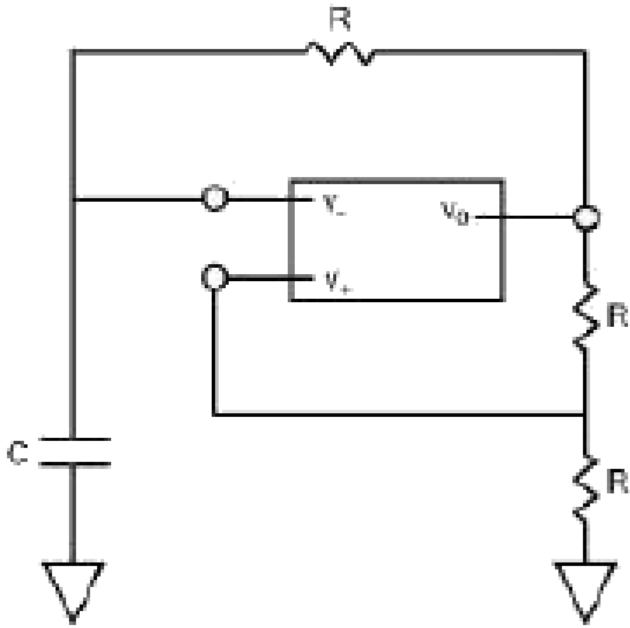
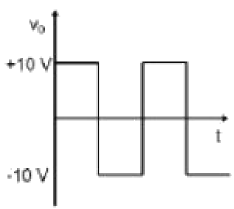
4. The box in the circuit below has two inputs marked $v+$ and$v-$ and a single output marked V_o. The output obeys

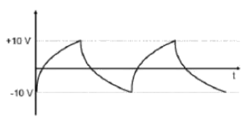
$$+10V \quad \text{if} \quad v+ > v-$$

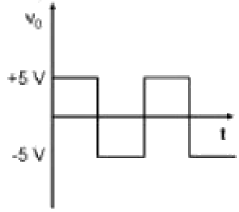
$$V_0 = -10V \quad \text{if} \quad v+ < v-$$



The output V_0 of this circuit a long time after is switched on is best represented by

A. 

B. 

C. 

D. 

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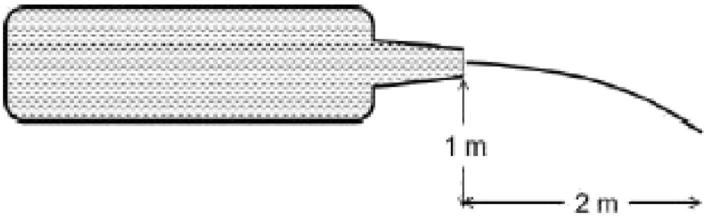
5. A bottle has a thin nozzle on top. It is filled with water, held horizontally at a height of 1 m and squeezed slowly by hands so that the water jet coming out of the nozzle hits the ground at a distance of 2m . If the area over which the hands squeeze it is $10cm^2$. the force applied by hand is close to (take g= 10

m/s^2 and density of water= 1000 kg/m^3)



A. 20N

B. 10 N

C. 5 N

D. 2.5 N

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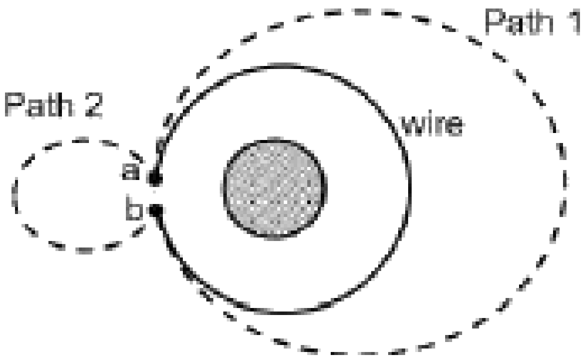
6. The circular wire in figure below encircles solenoid in which the magnetic flux is increasing at a constant rate out of the plane of the page.



The clockwise emf around the circular loop is $\varepsilon 0$. By definition a voltammeter measures the volatage difference between the two pointws given by $V_b - V_a = -\int_a^b \overline{E}.\, d\overline{s}$. We assume that a and b are infinitestically close to each other. The values of $V_b - V_a$ alon the path 1 and $V_a - V_b$ along the path 2, respectively are

A. $-\varepsilon 0, \ -\varepsilon 0$

B. $-\varepsilon, 0$

C. $-\varepsilon, \varepsilon lo 0$

D. $\varepsilon, \varepsilon 0$

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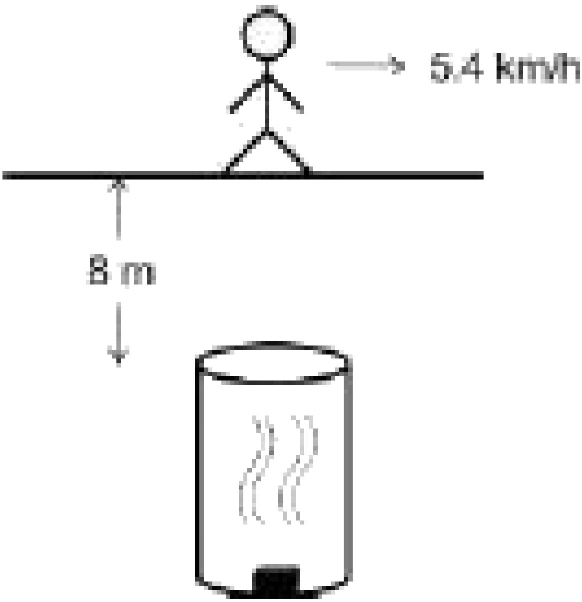
7. A student is jogging on a straight path with the speed 5.4 km per hour. Perpendicular to the path is kept a pipe with its opening 8m from the road (see figure). Diameter of the pipe is 0.45 m . At the other end of the pipe is a speaker emitting sound of 1280 Hx to wards the opening of the pipes. As the student passes in front of the pipe, she hears the speaker for

T seconds. T is in the range (Take speed of sound, 320 m/s)



A. $6 - 12$

B. $12 - 18$

C. $3 - 6$

D. $18 - 22$

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8. A solar cell is to be fabricated for efficient conversion of solar radiation to emf using material A. The solar cell is to be mechanically protected with the help of a coating using material B. If the band gap energy of materials A and B are E_A and E_B respectively, then which of the following choices is optimum for better performance of the solar cell.

A. $E_A = 1.5eV, E_B = 5eV$

B. $E_A = 1.5eV, E_b = 1.5eV$

C. $E_A = 3eV, E_B = 1.5eV$

D. $E_A = 0.5eV, E_B = 5eV$

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9. The "Kangi" is and earthen pot used to stay warm in Kashmir during the winter monts. Assume that the " Kangri" is shericla and of surface are $7 \times 10^{10^{-2}} m^2$. It contains 300 g of mixture of coal. Wood and leaves with calorific value of 30 kj/g (and provides heat with 10 % efficiency.) The surface temperature of the "Kangri" is $60^{\circ} C$ and the room temperature is $0^{\circ} C$. Then, a reasonable estime for the duration t(in hours) that the "kangri" heat will last is (take the "kangri" to be a black body).

A. 8

B. 10

C. 12

D. 16

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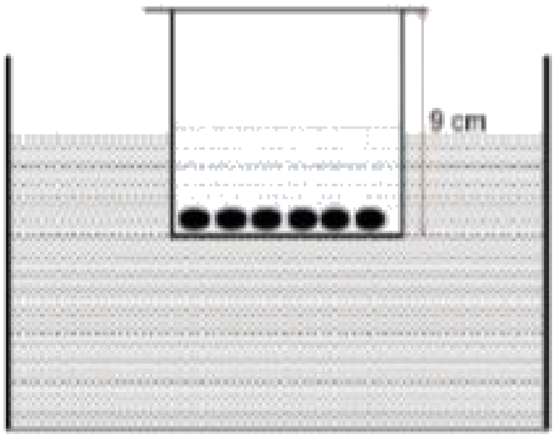
PART I (Chemistry)

1. A wide bottom cylindrical massless plastic container of height 9 cm has 40 identical coins inside it and is floating on water with 3 cm inside the water. If we start putting more of such coins on its lid. It is observed that after N coins are put, its equilibrium changes from stable to unstable. Equilibrium in floating is stable if the geometric center of the submerged portion is above the center of mass of the object) The value of

N is closed to



A. 6

B. 10

C. 16

D. 24

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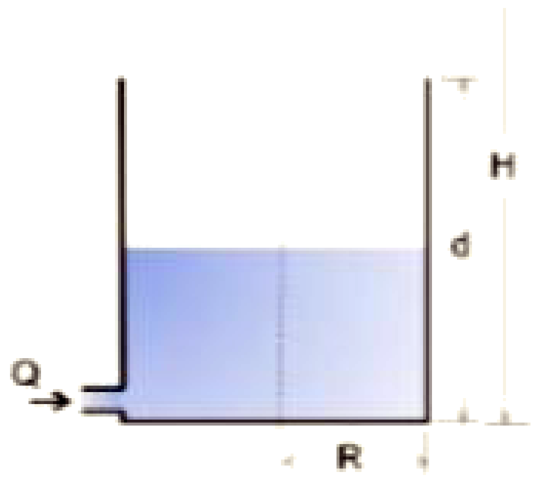
2. A small coin is fixed at the center of the base of an empty of cylindrical stell container having radius R = 1 m and height d = 4 m . At time t = 0 s, the container starts gettting filled with water at a flowrate of $Q = 0.1m^3 / s$ without disturbing the coin . Find the approximate time when the coin will first be seen by teh observer "O" from the height of H= 5.75 m above and L = 1.5 m radially away from the coin as shown in the figure. Refractive index of water in n = 1.33



A. 0 s

B. 32 s

C. 63 s

D. 150 s

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Others

1. The bob of a simple pendulum is a spherical hollow ball filled with water. A plugged hole near the bottom of the oscillating bob gets suddenly unplugged. During observation, till water is coming out, the time period of lscillation would.

A. T decreases first and then increases

B. T increases first and then decreases

C. T increases throughout

D. T does not change

Answer: B

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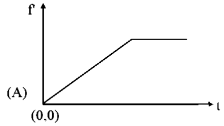
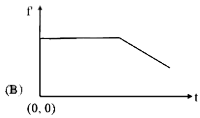
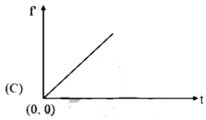
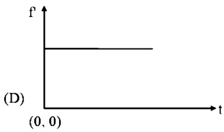
2. A block of mass M rests on a rough horizontal table. A steadily increasing horizontal force is applied such that the block starts to slide on the table without toppling. The force is contained even after sliding has started. Assume the coefficients of static end kinetic friction between the table and block to be equal. The correct representation of the variation of the frictional force , f_1 exerted by the table on the block with time t is given by -

A. 

B. 

C. 

D. 

Answer: A

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3. A soldier with a machine gun, falling from an airplane gets detached from his parachute. He is able to resist the downward acceleration if the shoots 40 bullets a second at the speed of 500 m/s. If the weight of a bullet is 49 gm, what is the weight of the man with the gun ? Ignore resistance due to air and assume the acceleration due to gravity $g = 9.8 ms^{-2}$ -

A. 50 kg

B. 75 kg

C. 100 kg

D. 125 kg

Answer: C

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4. A planet of mass m is moving around a star of mass M and radius R in a circular orbit of radius r. The star abruplly shrinks to half its radius without any loss of mass. What change will be there in the orbit of the planet ?

A. The planet will escape from the star

B. The radius of the orbit will increase

C. The radius of the orbit will decrease

D. The radius of the orbit will not change

Answer: D

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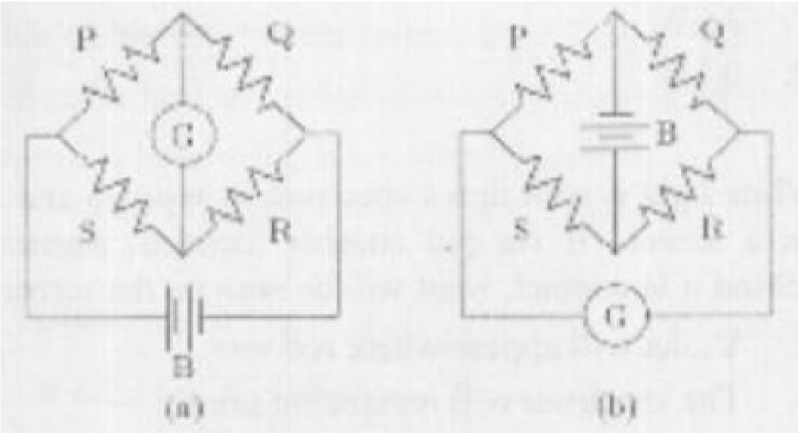
5. Figure (a) below shows a wheat stone bridge in which P, Q, R, S are fixed resistances, G is a galvanometer and B is a battery. For this particular case the galvanometer shows zero deflection. Now, only the positions of B and G are interchanged, as shown in figure (b). The new deflection of the

galvanometer -



s

A. is to the left

B. is to the right

C. is zero

D. depends on the values of P, Q, R, S

Answer: C

Watch Video Solution

6. 12 positive charges of magnitude q are placed on a circle of radius R in a manner that they are equally spaced. A charge Q is placed at the centre. If one of the charges q is removed, then the force on Q is -

A. Zero

B. $\frac{qQ}{4\pi\varepsilon_0 R^2}$ away from the position of the removed charge

C. $\frac{11qQ}{4\pi\varepsilon_0 R^2}$ away from the position of the removed charge

D. $\frac{qQ}{4\pi\varepsilon_0 R^2}$ towards the position of the removed charge

Answer: D

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7. An electric heater consists of a nichrome coil and runs under 220 V, consuming 1 kW power. Part of its coil burned out and it was reconnected after cutting off the burn portion. The power it will consume now is -

A. more than 1 kW

B. less than 1 kW, but not zero

C. 1 kW

D. 0 kW

Answer: A

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8. White light is split into a spectrum by a prism and it is seen on a screen. If we put another indentical inverted prism behind it in contact, what will be seen on the screen ?

A. Violet will appear where red was

B. The spectrum will remain the same

C. There will be no spectrum, but only the original light with no deviation

D. There will be no spectrum, but the original light will be larcrally displaced

Answer: C

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9. Two identical blocks of metal are at 20°C and 80°C respectively. The specific heat of the material of the two blocks increases with temperature. Which of the following is true about the final temperature T_f when the two blocks are brought into contact (assuming that so seta is lost to the surroundings) -

A. T_f will be $50T^\circ$C

B. T_f will be more than 50°C

C. T_f will be less than 50°C

D. T_f can be either more than or less than 50°C depending on the precise variation of the specific heat with temperature

Answer: D

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10. A new temperature scale uses X as a unit of temperature, where the numerical value of the temperature t_x in this scale is related to the absolute temperature T by $t_x = 3T + 300$. If the specific heat of a material using this unit is $1400 Jkg_1 X_1$ its specific heat in the S.I. system of units is- c

A. 4200 J $Kg^{-1}K^{-1}$

B. 1400 J $Kg^{-1}K^{-1}$

C. 466.7 J $Kg^{-1}K^{-1}$

D. impossible to determine from the information provided

Answer: A

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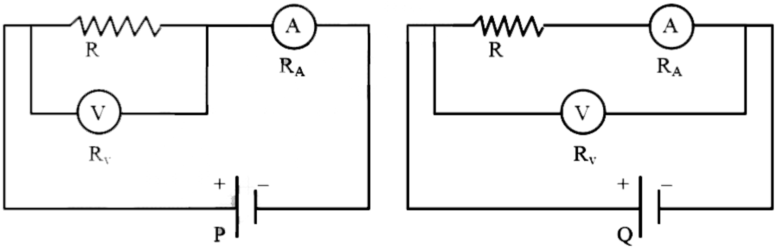
11. Consider the two circuits P and Q, shown below, which are used 20 measure the unknown resistance R.



In each case, the resistance is estimated by using Ohm's law $R_{\text{est}} = V / I$, Where V and I are the readings of the voltmeter and the ammeter respectively. The meter resistances, R_v and R_A are such that $R_A < < R < < R_v$. The internal resistance of the battery may be ignored. The absolute error in the estimate of the resistance is denoted by $\delta R = |R = R_{\text{est}}|$.

A. Express δR_p in terms of the given resistance values

B. Express δR_Q in terms of the given resistance values

C. For what value of R will $\delta R_P \approx \delta R_Q 7$

D. N/A

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12. A point source is placed 20 cm to the left of a concave lens of focal length 10 cm.

A. Where is the image formed ?

B. Where to the right of the lens would you place a concave mirror of focal length 5 cm so that the final image is coincident with the source ?

C. For the plane mirror, reflection forms an image 40 cm to the right of the lens. Using the lens formula, we see that the final image is formed at a distance of 40/3 cm to the left of the lens.

D. N/A

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13. A pen of mass 'm' is lying on a piece of paper of mass M placed on a rough table. If the coefficient of friction between the pen and paper, and, the paper and table are μ_1 and μ_2, respectively, then the minimum horizontal force with which the paper has to be pulled for the pen to start slipping is given by-

A. $(m+M)(\mu_1+\mu_2)$ g

B. $(m\mu_1 + M\mu_2)$g

C. $\{m\mu_1 + (m + M)\mu_2\}$ g

D. $m(\mu_1 + \mu_2)$ g

Answer: A

Watch Video Solution

14. Two masses m_1 and m_2 connected by a spring of spring constant k rest on a frictionless surface. If the masses are pulled apart and let go, the time period of oscillation is-

A. $T = 2\pi\sqrt{\frac{1}{k}\left(\frac{m_1 m_2}{m_1 + m_2}\right)}$

B. $T = 2\pi\sqrt{\frac{1}{k}\left(\frac{m_1 + m_2}{m_1 m_2}\right)}$

C. $T = 2\pi\sqrt{\left(\frac{m_1}{k}\right)}$

D. $T = 2\pi\sqrt{\left(\frac{m_2}{k}\right)}$

Answer: A

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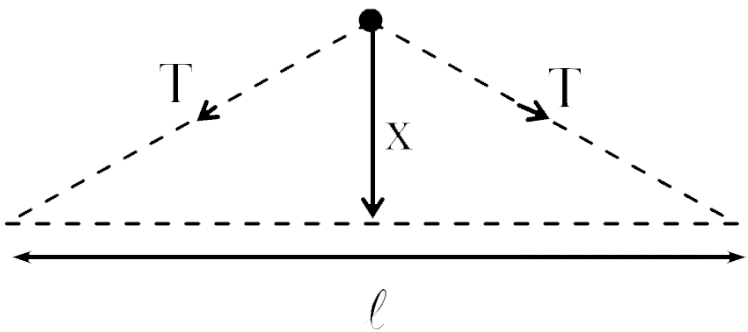
15. A bead of mass m is attached to the mid-point of a taut, weightless string of length l and placed on a frictionless horizontal table.



Under a small transverse displacement x, as shown, if the tension in the string is T, then the frequency of oscillation is-

A. $\frac{1}{2\pi}\sqrt{\frac{2T}{ml}}$

B. $\frac{1}{2\pi}\sqrt{\frac{4T}{ml}}$

C. $\frac{1}{2\pi}\sqrt{\frac{4T}{m}}$

D. $\frac{1}{2\pi}\sqrt{\frac{2T}{m}}$

Answer: B

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16. A comet (assumed to be in an elliptical orbit around the sun) is at a distance of 0.4 AU from the sun at the perihelion. If the time period of the comet is 125 years, what is the aphelion distance ? AU : Astronomical Unit.

A. 50 AU

B. 25 AU

C. 49.6 AU

D. 24.6 AU

Answer: C

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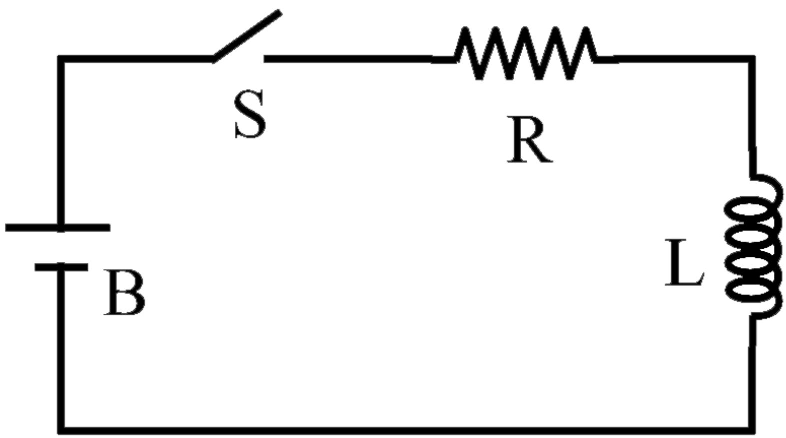
17. The circuit shown consists of a switch (S), a battery (B) of emf E, a resistance R, and an inductor L.



The current in the circuit at the instant the switch is closed is-

A. E / R

B. $E / R(1-e)$

C. ∞

D. 0

Answer: D

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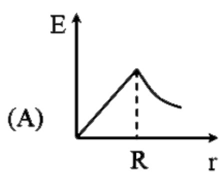
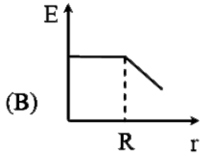
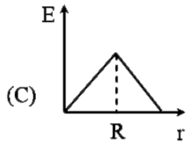
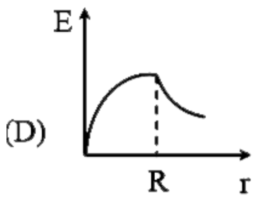
18. Consider a uniform spherical volume charge distribution of radius R. Which of the following graphs correctly represents the magnitude of the electric field E as a distance r from the center of the sphere ?

A. 

B. 

C. 

D. 

Answer: A

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19. A charge +q is placed somewhere inside the cavity of a thick conducting spherical shell of inner radius R_1 and outer radius R_2. A charge – Q is placed at a distance $r > R_2$ from the centre of the shell. Then the electric field in the hollow cavity-

A. depends on both +q and – Q

B. is zero

C. is only that due to -Q

D. is only that due to +q

Answer: D

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20. The following travelling electromagnetic wave $E_x = 0, E_y = E_0 \sin(kx + \omega t), E_z = -2E_0 \sin(kx + \omega t)$ is-

A. elliptically polarized

B. circularly polarized

C. linearly polarized

D. unpolarized

Answer: B

Watch Video Solution

21. A point source of light is placed at the bottom of a vessel which is filled with water of refractive index μ to a height h. If a floating opaque disc has to be placed exactly above it so that the source is invisible from above, the radius of the disc should be-

A. $\dfrac{h}{\sqrt{\mu - 1}}$

B. $\dfrac{h}{\sqrt{\mu^2 - 1}}$

C. $\dfrac{h}{\mu^2 - 1}$

D. $\dfrac{\mu h}{\sqrt{\mu^2 - 1}}$

Answer: B

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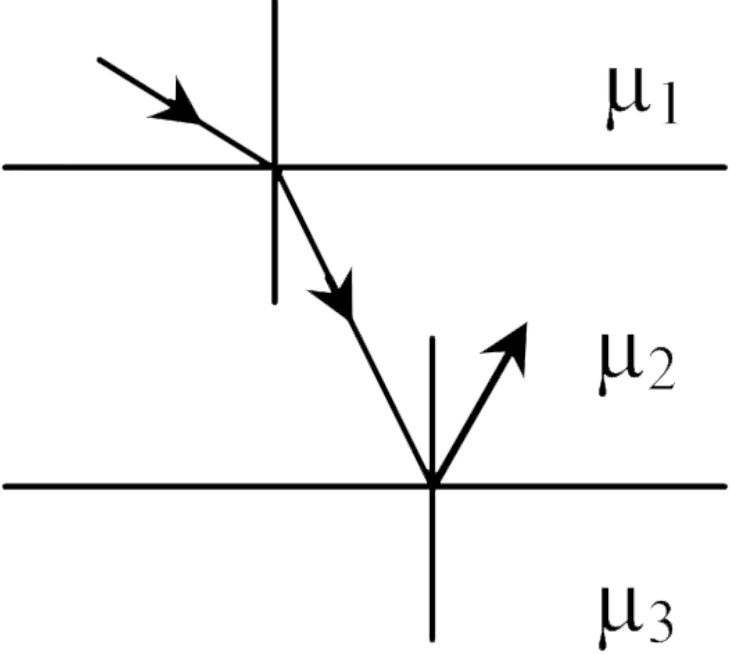
22. Three transparent media of refractive indices $\mu_1, \mu_2, \mu(3)$ respectively, are stacked as shown. A ray of light follows the path shown. No light enters the third medium.



Then-

A. $\mu_1 < \mu_2 < \mu_3$

B. $\mu_2 < \mu_1 < \mu_3$

C. $\mu_1 < \mu_3 < \mu_2$

D. $\mu_3 < \mu_1 < \mu_2$

Answer: D

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23. A nucleus has a half-life of 30 minutes. At 3 PM its decay rate was measured as 120,000 counts/sec. What will be the decay rate at 5 PM ?

A. 120,000counts/sec

B. 60,000counts/sec

C. 30,000counts/sec

D. 7500counts/sec

Answer: D

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24. A book is resting on shelf that is undergoing vertical simple harmonic oscillations with an amplitude of 2.5 cm. What is the minimum frequency of oscillation of the shell for which the book will lose contact with the shelf ? (Assume that $g = 10m / s^2$)

A. 20 Hz

B. 3.18 Hz

C. 125.6 Hz

D. 10 Hz

Answer: B

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25. A van der Waal's gas obeys the equation of state $\left(P+\frac{n^2a}{V^2}\right)(V-nb)=nRT$. Its internal energy is given by $U=CT-\frac{n^2a}{V^2}$. The equation of a quasistatic adiabat for this gas is given by-

A. $T^{C/nR}$ V=constant

B. $T^{(C+nR)/nR}$ V=constant

C. $T^{C/nR}$ (V-nb)=constant

D. $P^{(C+nR)/nR}$ (V-nb)=constant

Answer: C

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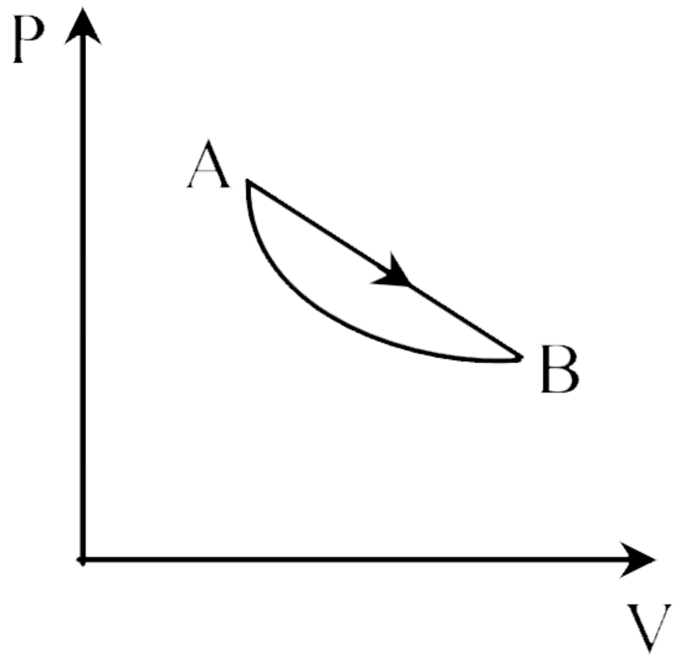
26. An ideal gas is made to undergo a cycle depicted by the PV diagram alongside. The curved line from A to B is an adiabat.



Then-

A. The efficiency of this cycle is given by unity as no heat is released during the cycle

B. Heat is absorbed in the upper part of the straight line path and released in the lower part

C. If T_1 and T_2 are the maximum and minimum temperatures reached during the cycle, then the efficiency is given by

D. The cycle can only be carried out in the reverse of the direction shown in figure

Answer: B

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27. A bus driving along at 39.6 kmph is approaching a person who is standing at the bus stop, while honking repeatedly at an interval of 30 seconds. If the speed of the sound is 330 m/s, at what interval will the person hear the horn ?

A. 31 seconds

B. 29 seconds

C. 30 seconds

D. the interval will depend on the distance of the bus from the passenger

Answer: B

Watch Video Solution

28. Velocity of sound measured at a given temperature in oxygen and hydrogen is in the ratio -

A. $1:4$

B. $4:1$

C. $1:1$

D. $32:1$

Answer: A

Watch Video Solution

29. In Young's double slit experiment, the distance between the two slits is 0.1 mm, the distance between the slits and the screen is 1 m and the wavelength of the light used is 600 nm. The intensity at a point on the screen is 75% of the maximum intensity. What is the smallest distance of this point from the central fringe ?

A. 1.0mm

B. 2.0mm

C. 0.5mm

D. 1.5mm

Answer: A

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30. Two masses m_1 and m_2 are connected by a massless spring of spring constant k and unstreched length l. The masses are placed on a frictionless straight channel – which we consider our x-axis. They are initially at rest at x = 0 and x = l, respectively. At t = 0, a velocity of v0 is suddenly imparted to the first particle. At a later time t0, the centre of mass of the two masses is at-

A. $x = \dfrac{m_2 l}{m_1 + m_2}$

B. $x = \dfrac{m_1 l}{m_1 + m_2} + \dfrac{m_2 v_0 t}{m_1 + m_2}$

C. $x = \dfrac{m_2 l}{m_1 + m_2} + \dfrac{m_2 v_0 t}{m_1 + m_2}$

D. $x = \dfrac{m_2 l}{m_1 + m_2} + \dfrac{m_1 v_0 t}{m_1 + m_2}$

Answer: D

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31. A charged particle of charge q and mass m, gets deflected through an angle θ upon passing through a square region of side 'a' which contains a uniform magnetic field B normal to its plane. Assuming that the particle entered the square at right angles to one side, what is the speed of the particle ?

A. $\frac{qB}{m}a\cot(\theta)$

B. $\frac{qB}{m}a\tan(\theta)$

C. $\frac{qB}{m}a\cot^2(\theta)$

D. $\frac{qB}{m}a\tan^2(\theta)$

Answer: A

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32. A piece of hot copper at 100°C is plunged into a pond at 30°C. The copper cools down to 30°C, while the pond, being huge, stays at its initial temperature. Then-

A. copper loses some entropy, the pond stays at the same entropy

B. copper loses some entropy, and the pond gains exactly the same amount of entropy

C. copper loses entropy, and the pond gains more than this amount of entropy

D. both copper and the pond gain in entropy

Answer: C

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33. A ball is dropped vertically from a height of h onto a hard surface. If the ball rebounds from the surface with a fraction r of the speed with which it strikes the latter on each impact, what is the net distance traveled by the ball up to the 10^{th} impact ?

A. $2h\dfrac{1-r^{10}}{1-r}$

B. $h\dfrac{1-r^{20}}{1-r^2}$

C. $2h\dfrac{1-r^{22}}{1-r^2}-h$

D. $2h\dfrac{1-r^{20}}{1-r^2}-h$

Answer: D

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34. A certain planet completes one rotation about its axis in time T. The weight of an object placed at the equator on the planet's surface is a fraction f (f is close to unity) of its weight recorded at a latitude of 60°. The density of the planet (assumed to be a uniform perfect sphere is given by-

A. $\dfrac{4-f}{1-f}\dfrac{3\pi}{4GT^2}$

B. $\dfrac{4-f}{1+f}\dfrac{3\pi}{4GT^2}$

C. $\dfrac{4-3f}{1-f}\dfrac{3\pi}{4GT^2}$

D. $\dfrac{4-2f}{1-f}\dfrac{3\pi}{4GT^2}$

Answer: A

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35. Three equal charges +q are placed at the three vertices of an equilateral triangle centered at the origin. They are held in equilibrium by a restoring force of magnitude F(r) = kr directed towards the origin, where k is a constant. What is the distance of the three charges from the origin ?

A. $\left[\frac{1}{6\pi\varepsilon_0}\frac{q^2}{k}\right]^{1/2}$

B. $\left[\frac{\sqrt{3}}{12\pi\varepsilon_0}\frac{q^2}{k}\right]^{1/2}$

C. $\left[\frac{1}{6\pi\varepsilon_0}\frac{q^2}{k}\right]^{2/3}$

D. $\left[\frac{\sqrt{3}}{4\pi\varepsilon_0}\frac{q^2}{k}\right]^{2/3}$

Answer: B

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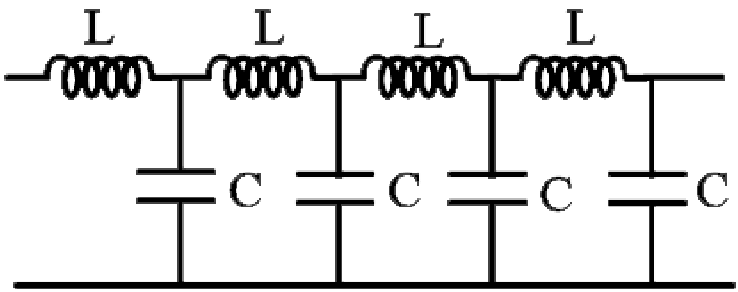
36. Consider the infinite ladder circuit shown below.



For which angular frequency ω will the circuit behave like a pure inductance ?

A. $\dfrac{LC}{\sqrt{2}}$

B. $\dfrac{1}{LC}$

C. $\dfrac{2}{\sqrt{LC}}$

D. $\dfrac{2L}{\sqrt{C}}$

Answer: C

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37. A narrow parallel beam of light falls on a glass sphere of radius R and refractive index μ at normal incidence. The distance of the image from the outer edge is given by-

A. $\dfrac{R(2-\mu)}{2(\mu-1)}$

B. $\dfrac{R(2+\mu)}{2(\mu-1)}$

C. $\dfrac{R(2-\mu)}{2(\mu+1)}$

D. $\dfrac{R(2+\mu)}{2(\mu+1)}$

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38. A particle of mass m undergoes oscillations about x = 0 in a potential given by $V(x)=\frac{1}{2}kx^2-v_0\cos\left(\frac{x}{a}\right)$, where V_0,K,a are constants. If the amplitude of oscillation is much smaller than a, the time period is given by-

A. $2\pi\sqrt{\dfrac{ma^2}{ka^2+V_0}}$

B. $2\pi\sqrt{\dfrac{m}{k}}$

C. $2\pi\sqrt{\dfrac{ma^2}{V_0}}$

D. $2\pi\sqrt{\dfrac{ma^2}{ka^2-V_0}}$

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39. An ideal gas with heat capacity at constant volume C_V undergoes a quasistatic process described by PV^{α} in a P-V diagram, where α is a constant. The heat capacity of the gas during this process is given by-

A. C_V

B. $C_V + nR$

C. $C_V + \dfrac{nR}{1-\alpha}$

D. $C_V + \dfrac{nR}{1-\alpha^2}$

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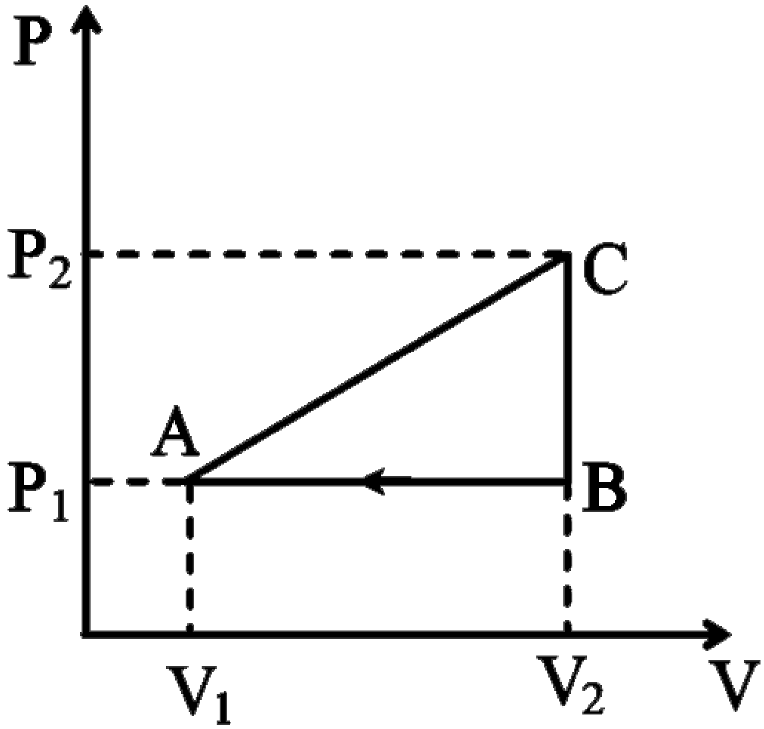
40. An ideal gas with constant heat capacity $C_V = \dfrac{3}{2} nR$ is made to carry out a cycle that is depicted by a triangle in the figure given below.



The following statement is true about the cycle-

A. The efficiency is given $1 - \frac{P_1V_1}{P_2V_2}$

B. The efficiency is given by $1 - \frac{1}{2}\frac{P_1V_1}{P_2V_2}$

C. Net heat absorbed in the cycle is $(P_2 - P_1)(V_2 - V_1)$

D. Heat absorbed in part AC is given by

$$2\left(P_2V_2 - P_1V_1 + \frac{1}{2}(P_1V_2 - P_2V_1)\right.$$

41. At time t = 0, a container has N_0 radioactive atoms with a decay constant λ. In addition, c numbers of atoms of the same type are being added to the container per unit time. How many atoms of this type are there at t = T ?

A. $\frac{c}{\lambda}\exp(-\lambda T) - N_0\exp(-\lambda T)$

B. $\frac{c}{\lambda}\exp(-\lambda T) + N_0\exp(-\lambda T)$

C. $\frac{c}{\lambda}\{1\text{-}\exp(-\lambda T)\} + N_0\exp(-\lambda T)$

D. $\frac{c}{\lambda}\{1+\exp(-\lambda T) - N_0\exp(-\lambda T)$

42. A narrow but tall cabin is falling freely near the earth's surface. Inside the cabin, two small stones A and B are released from rest (relative to the cabin). Initially A is much above the centre of mass and B much below the centre of mass of the cabin. A close observation of the motion of A and B will reveal that -

A. both A and B continue to be exactly at rest relative to the cabin

B. A moves slowly upward and B moves slowly downward relative to the cabin

C. both A and B fall to the bottom of the cabin with constant acceleration due to gravity

D. A and B move slightly towards each other vertically

Answer: B

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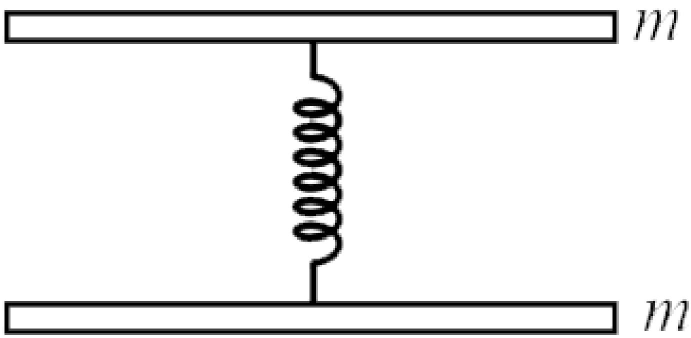
43. Two plates each of the mass m are connected by a massless spring as shown

A weight W is put on the upper plate which compresses the spring further. When W is removed, the entire assembly jumps up. The minimum weight W needed for the assembly to jump up when the weight is removed is just more than -



A. mg

B. 2mg

C. 3mg

D. 4mg

Answer: B

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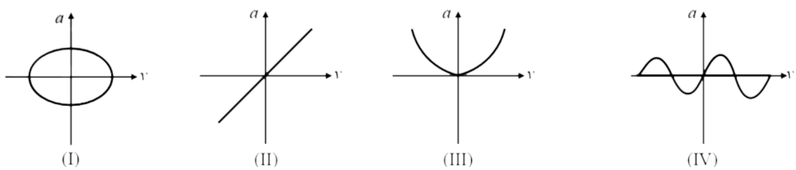
44. If the speed (v) of the bob in a simple pendulum is plotted against the tangential acceleration (a), the correct graph will be represented by



A. I

B. II

C. III

D. IV

Answer: A

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45. A container with rigid walls is covered with perfectly insulating material. The container is divided into two parts by a partition. One part contains a gas while the other is fully evacuated (vacuum). The partition is suddenly removed. The gas rushes to fill the entire volume and comes to equilibrium after a little time. If the gas is not ideal,

A. the initial internal energy of the gas equals its final internal energy

B. the initial temperature of the gas equals its final temperature

C. the initial pressure of the gas equals its final pressure

D. the initial entropy of the gas equals its final entropy

Answer: A

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46. Two bulbs of identical volumes connected by a small capillary are initially filled with an ideal gas at temperature T. Bulb 2 is heated to maintain a temperature 2T while bulb 1 remains at temperature T. Assume throughout that the heat conduction by the capillary is negligible. Then the ratio of final mass of the gas in bulb 2 to the initial mass of the gas in the same bulb is close to

A. $1/2$

B. $2/1$

C. $1/3$

D. 1

Answer: B

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47. Two rods, one made of copper and the other steel of the same length and cross sectional area are joined together. (The thermal conductivity of copper is $385 J.\,s^{-1}.\,m^{-1}.\,K^{-1}$ and steel is $50 J.\,s^{-1}.\,m^{-1}.\,K^{-1}$.) If the copper end is held at

$100^{\circ}C$ and the steel end is held at $0^{\circ}C$, what is the junction temperature (assuming no other heat losses) ?

A. 0.12

B. 0.5

C. 0.73

D. 0.88

Answer: D

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48. Jet aircrafts fly at altitudes above 30,000 ft where the air is very cold at $-40^{\circ}C$ and the pressure is 0.28 atm. The cabin is maintained at 1 atm pressure by means of a compressor which exchanges air from outside adiabatically. In order to have a comfortable cabin temperature of $25^\circ C$, we will require in addition

A. a heater to warm the air injected into the cabin

B. an air-conditioner to cool the air injected into the cabin

C. neither a heater nor an air-conditioner , the compressor is sufficient

D. alternatively heating and cooling in the two halves of the compressor cycle

Answer: B

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49. A speaker emits a sound wave of frequency f_0. When it moves towards a stationary observer with speed u, the observer measures a frequency f_1. If the speaker is stationary, and the observer moves towards it with speed u, the measured frequency is f_2. Then -

A. $f_1 = f_2 < f_0$

B. $f_1 > f_2$

C. $f_1 < f_2$

D. $f_1 = f_2 > f_0$

Answer: B

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50. A plane polarized light passed through successive polarizers which are rotated by 30° with respect to each other in the clockwise direction. Neglecting absorption by the polarizers and given that the first polarizer's axis is parallel to the plane of polarization of the incident light, the intensity of light at the exit of the fifth polarizer is closest to

A. same as that of the incident light

B. 17.5% of the incident light

C. 30% of the incident light

D. zero

Answer: C

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51. At $23^{\circ}C$, a pipe open at both ends resonates at a frequency of 450 hertz. At what frequency does the same pipe resonate on a hot day when the speed of sound is 4 percent higher than it would be at $23^\circ C$?

A. 446 Hz

B. 454 Hz

C. 468 Hz

D. 459 Hz

Answer: C

Watch Video Solution

52. In a Young's double slit set-up, light from a laser source falls on a pair of very narrow slits separated by 1.0 micrometer and bright fringes separated by 1.0 millimeter are observed on a distant screen. If the frequency of the laser light is doubled, what will be the separation of the bright fringes ?

A. 0.25 mm

B. 0.5 mm

C. 1.0 mm

D. 2.0 mm

Answer: B

Watch Video Solution

53. For a domestic AC supply of 220 V at 50 cycles per second, the potential difference between the terminals of a two pin electric outlet in a room is given by

A. $V(t) = 220\sqrt{2}\cos(100\pi t)$

B. V(t) = 220 cos (50 t)

C. $V(t) = 220\cos(100\pi t)$

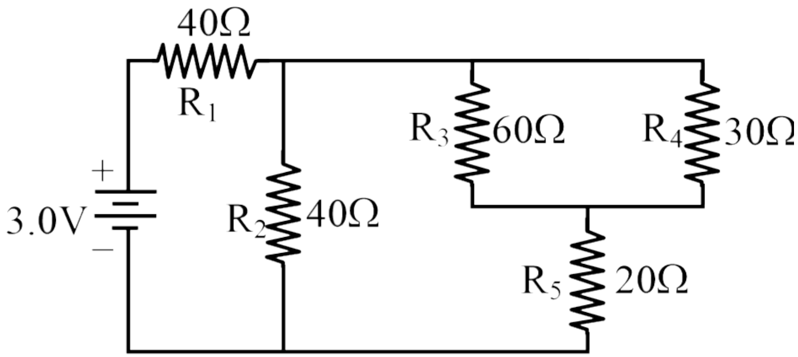
D. $V(t) = 220\sqrt{2}\cos(50t)$

Answer: A

Watch Video Solution

54. In the circuit shown below the resistance are given in ohms and the battery is assumed ideal with emf equal to 3.0

volts. The resistor that dissipates the most power is -



A. R_1

B. R_2

C. R_3

D. R_4

Answer: A

Watch Video Solution

55. An electron collides with a free molecules initially in its ground state. The collision leaves the molecules in an excited state that is metastable and does not decay to the ground state by radiation. Let K be the sum of the initial kinetic energies of the electron and the molecule, and $\overrightarrow{P}$ the sum of their initial momenta. Let K' and $\overrightarrow{P}$ represent the same physical quantities after the collision. Then

A. $K = K', \overrightarrow{P} = \overrightarrow{P}'$

B. $K' < K, \overrightarrow{P} = \overrightarrow{P}'$

C. $K = K', \overrightarrow{P} \neq \overrightarrow{P}'$

D. $K' < K, \overrightarrow{P} \neq \overrightarrow{P}'$

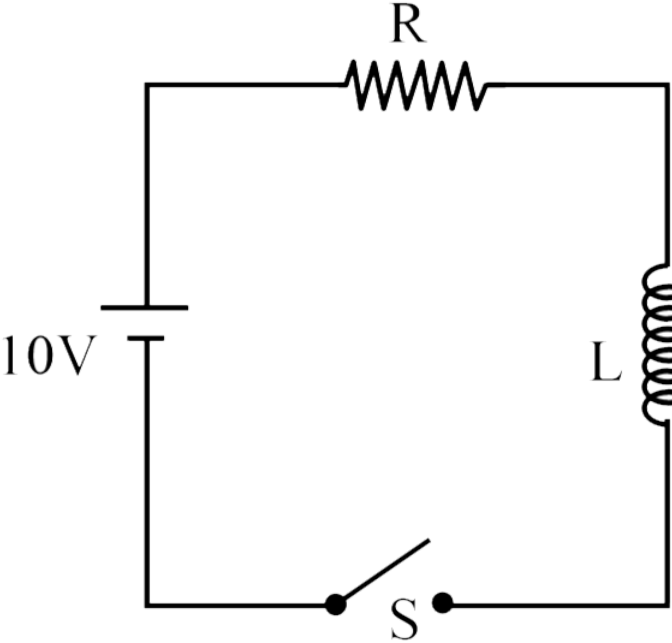
Answer: B

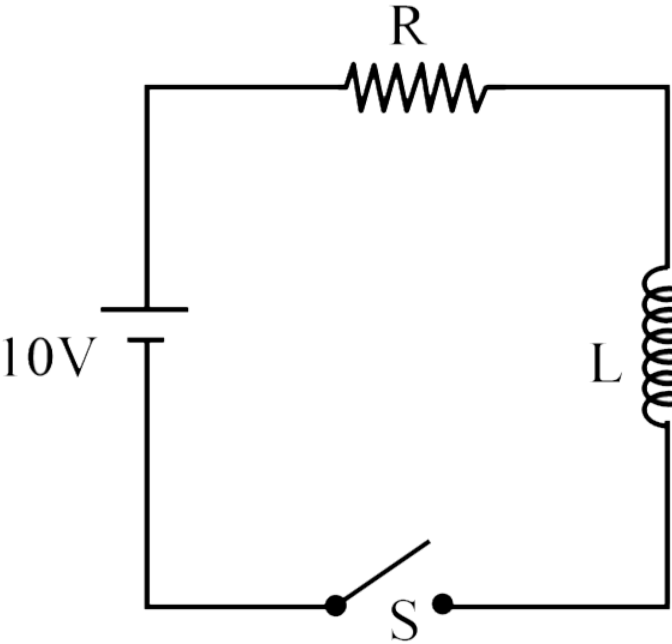
Watch Video Solution

56. In the circuit shown, the switch is closed at time t = 0.

Which of the graphs shown below best represents the voltage

across the inductor, as seen on an oscilloscope ?





A. I

B. II

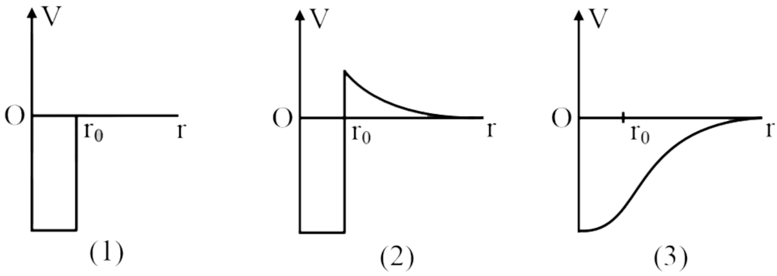
C. III

D. IV

Answer: D

Watch Video Solution

57. Given below are three schematic graphs of potential energy V(r) versus distance r for three atomic particles : electron (e^{-}), proton (p^{+}) and neutron (n), in the presence of a nucleus at the origin O. The radius of the nucleus is r_0. The scale on the V-axis may not be the same for all figures. The correct pairing of each graph with the corresponding atomic particle is -



A. $(1, n), (2, p^{+}), (3, e^{-})$

B. $(1, p^{+}), (2, e^{-}), (3, n)$

C. $(1, e^{-}), (2, p^{+}), (3, n)$

D. $(1, p^{+}), (2, n), (3, e^{-})$

Answer: A

Watch Video Solution

58. Due to transitions among its first three energy levels, hydrogenic atom emits radiation at three discrete wavelengths $\lambda_1, \lambda_2, \quad \text{and} \quad \lambda_3 (\lambda_1 < \lambda_2 < \lambda_3)$. Then

A. $\lambda_1 = \lambda_2 + \lambda_3$

B. $\lambda_1 + \lambda_2 = \lambda_3$

C. $1/\lambda_1 + 1/\lambda_2 = 1/\lambda_3$

D. $1/\lambda_1 = 1/\lambda_2 + 1/\lambda_3$

Answer: D

Watch Video Solution

59. The total radiative power emitted by spherical blackbody with radius R and temperature T is P. If the radius if doubled and the temperature is halved then the radiative power will be

-

A. $P/4$

B. $P/2$

C. 2P

D. 4P

Answer: A

Watch Video Solution

60. The Quantum Hall Resistance R_H is a fundamental constant with dimensions of resistance. If h is Planck's constant and e the electron charge, then the dimension of R_H is the same as

A. e^2/h

B. h/e^2

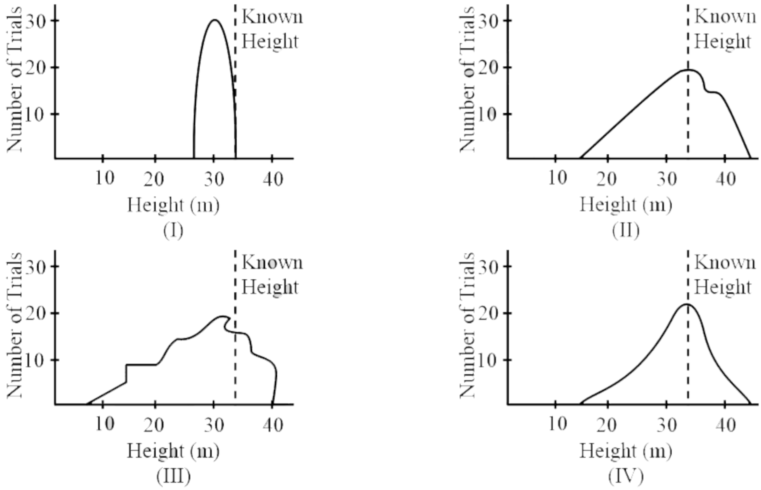
C. h^2 / e

D. e / h^2

Answer: B

Watch Video Solution

61. Four students measure the height of a tower. Each student uses a different method and each measures the height many different times. The data for each are plotted below. The measurement with highest precision is



A. I

B. II

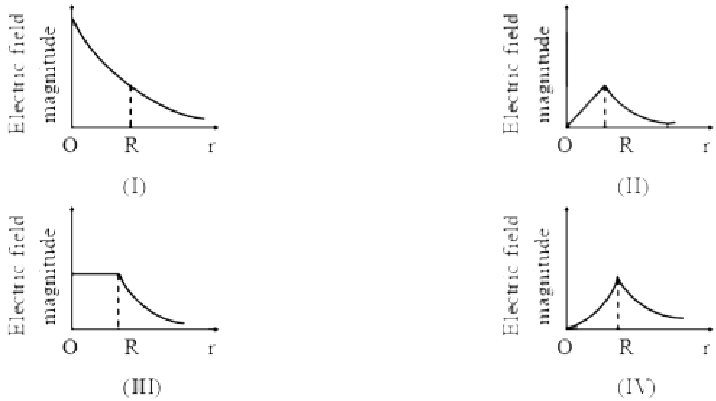
C. III

D. IV

Answer: A

Watch Video Solution

62. An isolated sphere of radius R contains uniform volume distribution of positive charge. Which of the curves shown below correctly illustrates the dependence of the magnitude of the electric field of the sphere as a function of the distance r from its centre ?



A. I

B. II

C. III

D. IV

Watch Video Solution

63. The surface of a planet is found to be uniformly charged. When a particle of mass m and no charge is thrown at an angle from the surface of the planet, it has a parabolic trajectory as in projectile motion with horizontal range L. A particle of mass m and charge q, with the same initial conditions has a range L/2. The range of particle of mass m and charge 2q with the same initial conditions is-

A. L

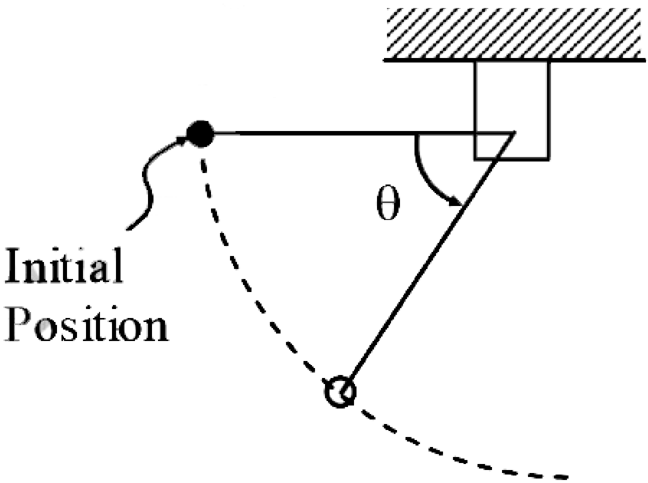
B. L/2

C. L/3

D. L/4

Watch Video Solution

64. Figure below shows a small mass connected to a string, which is attached to a vertical post. If the ball is released when the string is horizontal as shown, the magnitude of the total acceleration (including radial and tangential) of the mass as a function of the angle Θis



A. $g \sin \theta$

B. $g\sqrt{3 \cos^2 \theta + 1})$

C. $g \cos \theta$

D. $g\sqrt{3 \sin^2 \theta + 1})$

Watch Video Solution

65. One mole of an ideal gas at initial temperature T, undergoes a quasi-static process during which the volume V is doubled. During the process the internal energy U obeys the equation $U = aV(3)$ where a is a constant. The work done during this process is-

A. 3RT/2

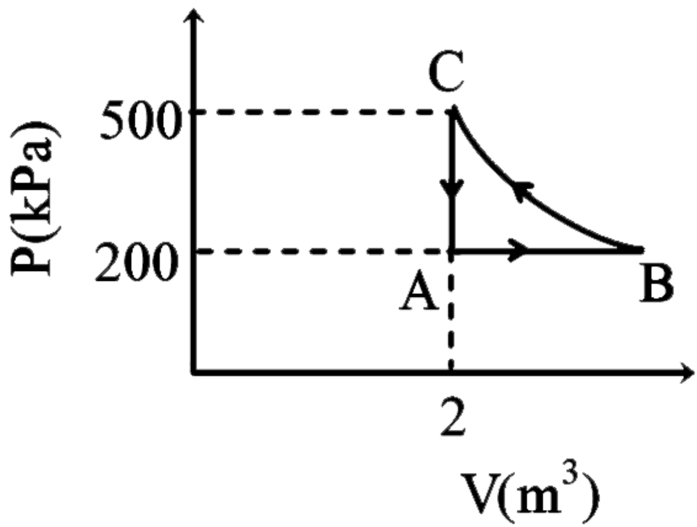
B. 5RT/2

C. 5RT/3

D. 7RT/3

Watch Video Solution

66. A constant amount of an ideal gas undergoes the cyclic process ABCA in the PV diagram shown below



The path BC is an isothermal. The work done by the gas during one complete cycle, beginning and ending at A, is nearly-

A. 600kj

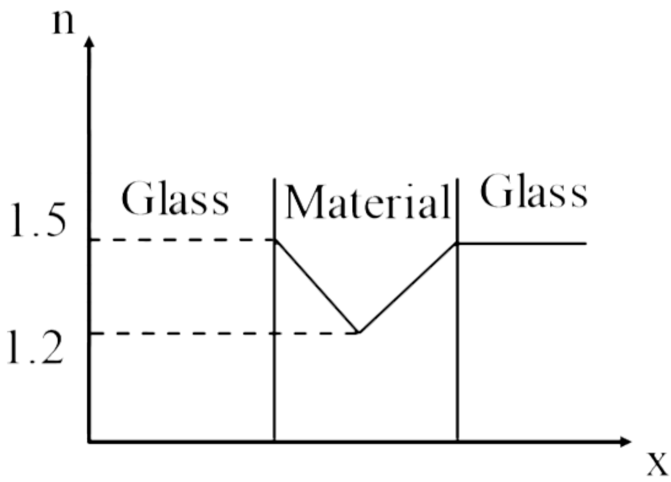
B. 300kj

C. $-300kj$

D. $-600kj$

Watch Video Solution

67. A material is embedded between two glass plates. Refractive index n of the material varies with thickness as shown below. The maximum incident angle (in degrees) on the material for which beam will pass through the material is-



A. 60.1

B. 53.1

C. 43..5

D. 32.3

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68. At a distance l from a uniformly charged long wire, a charged particle is thrown radially outward with a velocity u in the direction perpendicular to the wire. When the particle reaches a distance 2l from the wire its speed is found to be $\sqrt{2}u$. The magnitude of the velocity, when it is a distance 4l away from the wire, is (ignore gravity)

A. $\sqrt{3}u$

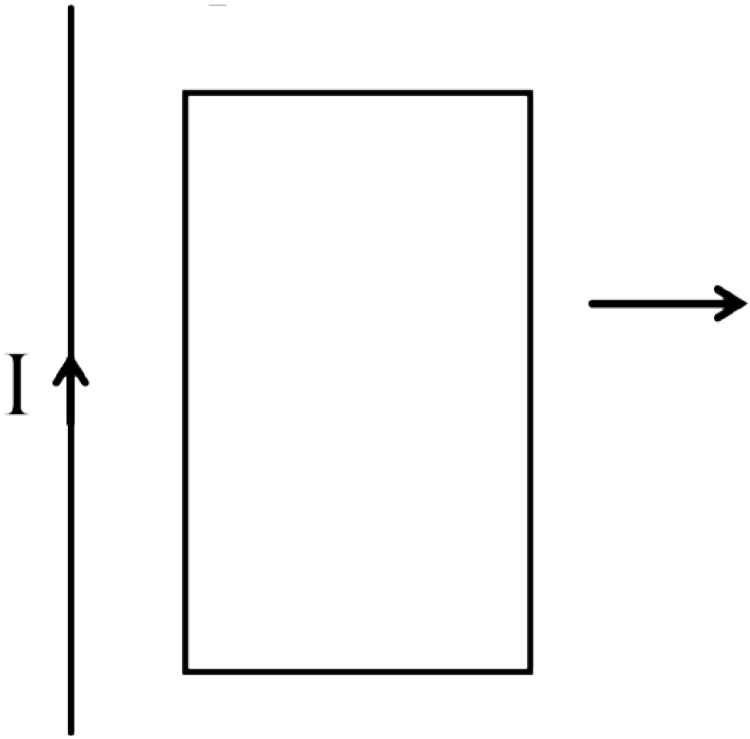
B. 2u

C. $2\sqrt{2}u$

D. 4u

Watch Video Solution

69. A rectangular loop of wire shown below is coplanar with a long wire carrying current I.



The loop is pulled to the right as indicated. What are the directions of the induced current in the loop and the magnetic forces on the left and the right sides of the loop

A. {:("Induced current","Force on left side","Force on right side"),("Counterclockwise","To the left","To the right"):}

B. {:("Induced current","Force on left side","Force on right side"),("Clockwise","To the left","To the right"):}

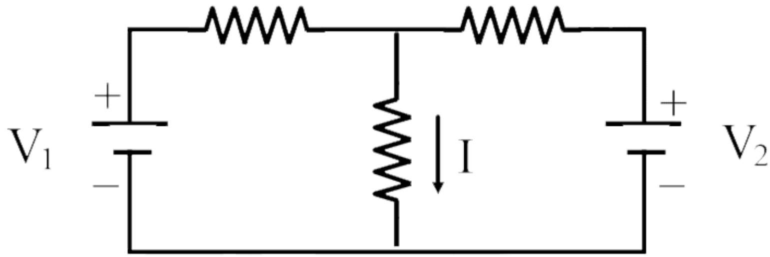
C. {:("Induced current","Force on left side","Force on right side"),("Counterclockwise","To the right","To the left "):}

D. {:("Induced current","Force on left side","Force on right side"),(" Clockwise","To the right","To the left "):}

Watch Video Solution

70. Two batteries V_1 and V_2 are connected to three resistors as shown below. If $V_1 = 2V$ and V_2 = 0 V, the current I = 3 mA. If V_1 = 0 V and V_2 = 4V, the current I = 4mA. Now, if V_1 = 10 V and

V_2 = 10 V, the current I will be-



A. 7mA

B. 15mA

C. 20mA

D. 25mA

Watch Video Solution

71. A particle moves in a plane along an elliptic path given by $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ At point (0, b), the x-component of velocity is u.

The y-component of acceleration at this point is-

A. $-bu^2/a^2$

B. $-u^2/b$

C. $-au^2/b^2$

D. $-u^2/a$

Watch Video Solution

72. A clay ball of mass m and speed v strikes another metal ball. of same mass m, which is at rest. They stick together after collision. The kinetic energy of the system after collision is –

A. $mv^2/2$

B. $mv^2/4$

C. $2mv^2$

D. mv^2

Answer: B

Watch Video Solution

73. A ball falls vertically downward and bounces off a horizontal floor. The speed of the ball just before reaching the floor (u_1) is equal to the speed just after having contact with the floor (u_2) , $u_1 = u_2$. The corresponding magnitudes of accelerations are denoted respectively by a_1 and a_2 . The air resistance during motion is proportional to speed and is not negligible. If g is acceleration due to gravity, then–

A. $a_1 < a_2$

B. $a_1 > a_2$

C. $a_1 = a_2 \neq g$

D. $a_1 = a_2 = g$

Answer: A

Watch Video Solution

74. Which of the following statements is true about the flow of electrons in an electric circuit ?

A. Electrons always flow from lower to higher potential

B. Electrons always flow from higher to lower potential

C. Electrons flow from lower to higher potential except through power sources

D. Electrons flow from higher to lower potential, except through power sources

Answer: C

Watch Video Solution

75. A boat crossing a river moves with a velocity v relative to still water. The river is flowing with a velocity v/2 with respect to the bank. The angle with respect to the flow direction with which the boat should move to minimize the drift is–

A. 30°

B. 60°

C. 150°

D. 120°

Answer: D

View Text Solution

76. In the Arcitc region hemispherical houses called Igloos are made of ice. It is possible to maintain a temperature inside an Igloo as high as $20^\circ C$ because–

A. Ice has high thermal conductivity

B. Ice has low thermal conductivity

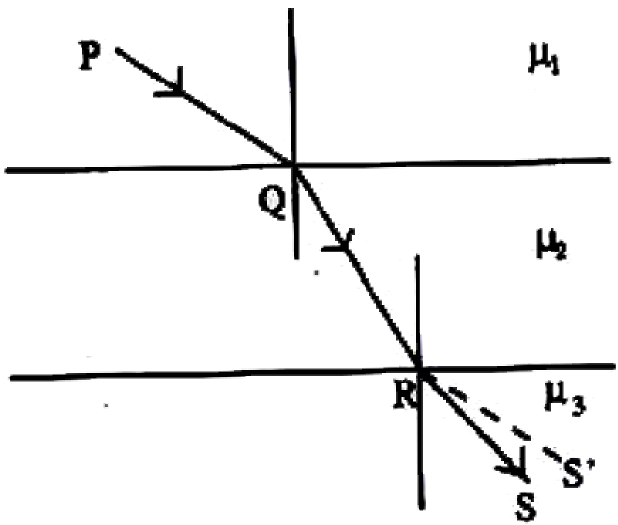
C. Ice has high specific heat

D. Ice has higher density than water

Answer: B

View Text Solution

77. In the figure below, PQRS denotes the path followed by a ray of light as it travels through three media in succession. The absolute refractive indices of the media are μ_1 ,mu_(2) and mu_(3)` respectively. (The line segment RS' in the figure is parallel to PQ).



A. $\mu_1 > \mu_2 > \mu_3$

B. $\mu_1 = \mu_3 < \mu_2$

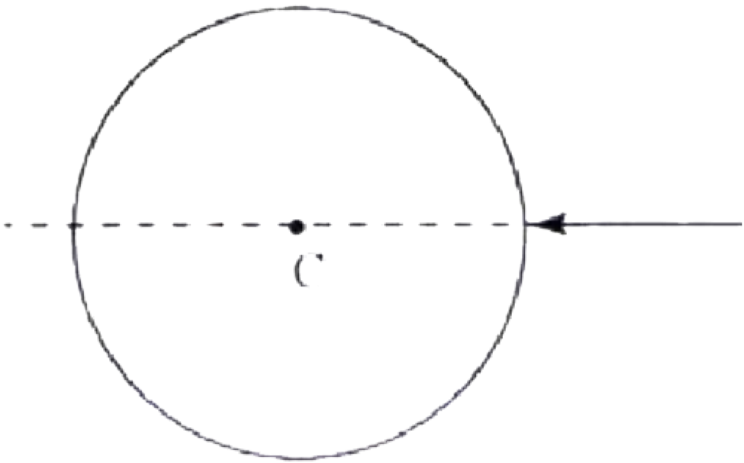
C. $\mu_1 > \mu_2 > \mu_3$

D. $\mu_1 < \mu_3 < \mu_2$

Answer: D

View Text Solution

78. A ray of white light is incident on a spherical water drop whose center is C as shown below. When observed from the opposite side, the emergent light –



A. Will be white and will emerge without deviating

B. Will be internally reflected

C.

D.

Answer: A

View Text Solution

79. A convex lens of focal length 15 cm is placed in front of a plane mirror at a distance 25 cm from the mirror. Where on the optical axis and from the centre of the lens should a small object be placed such that the final image coincides with the object ?

A. 15 cm and on the opposite side of the mirror

B. 15 cm and between the mirror and the lens

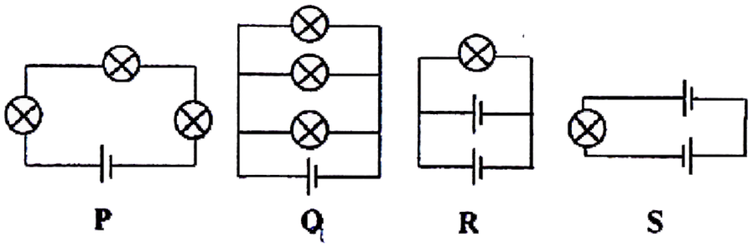
C. 7.5 cm and on the opposite side of the mirror

D. 7.5 cm and between the mirror and the lens

Answer: A

View Text Solution

80. Following figures show different combinations of identical bulb(s) connected to identical battery(ies). Which option is correct regarding the total power dissipated in the circuit–



A. PltQltRltS

B. PltQltR=S

C. RltQltPltS

D. PltRltQltS

Answer: D

View Text Solution

81. A circular metallic ring of radius R has a small gap of width d. The coefficient of thermal expansion of the metal is α in appropriate units. If we increase the temperature of the ring by a amount ΔT, then width of the gap – (A) Will increases by an amount $d\alpha\Delta T$

A. Will increases by an amount $d\alpha\Delta T$

B. will not change

C. Will increases by an amjoint $(2\pi R - d)\alpha\Delta T$

D. Will decreases by an amount $d\alpha\Delta T$

Answer: A

View Text Solution

82. A girl holds a book of mass m against a vertical wall with a horizontal force F using her finger so that the book does not move. The frictional force on the book by the wall is –

A. F and along the finger but pointing towards the girl

B. μF upwards where μ is the coefficient of static friction

C. mg and upwards

D. Equal and opposite to the resultant of F and mg

Answer: C

View Text Solution

83. A solid cube and a solid sphere both made of same material are completely submerged in water but to different depths. The sphere and the cube have same surface area. The buoyant force is–

A. Greater for the cube than the sphere

B. Greater for the sphere than the cube

C. Same for the sphere and the cube

D. Greater for the object that is submerged deeper

Answer: B

View Text Solution

84. $._{92}^{238} U$ atom distintgrates to $._{84}^{214} Po$ with a half life of 4.5×10^{9} years by emitting six alpha particles and n electrons. Here n is -

A. 6

B. 4

C. 10

D. 7

Answer: B

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85. Which statements about the Rutherford model of the atom is NOT true ?

A. There is a positively charged center in an atom called the nucleus

B. Nearly all the mass of an atom resides in the nucleus

C. Size of the nucleus is completely to the atom

D. Electrons occupy the space surrounding the nucleus

Answer: C

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86. A girl brings a positively charged rod near a thin neutral stream of water from a tap. She observes that the water stream bends towards her. Instead, if she were to bring a negatively charged rod near to the steam, it will–

A. Bend in the same direction

B. Bend in the opposite direction

C. Not bend at all

D. Bend in the opposite direction above and below and rod

Answer: A

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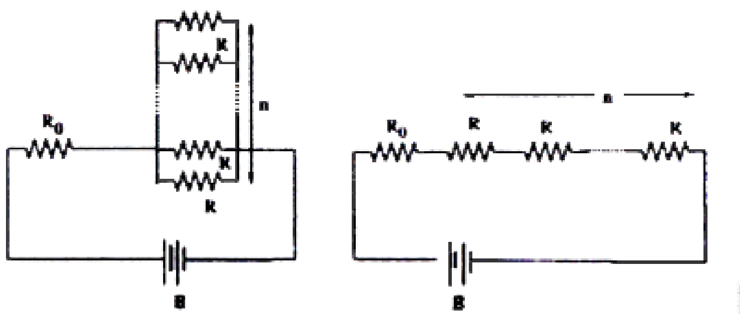
87. In the circuit shown, n identical resistors R are connected in parallel (n gt 1) and the combination is connected in series to another resistor R0. In the adjoining circuit n resistors of resistance R are all connected in series along with R_0-



The batteries in both circuits are identical and net power dissipated in the n resistors in both circuits is same. The ratio R_0 / R is

A. 1

B. n

C. n^2

D. 1/n

Answer: A

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88. A firecracker is thrown with velocity of $30 ms^{-1}$ in a direction which makes an angle of 75° with the vertical axis. At some point on its trajectory, the firecracker splits into two identical pieces in such a way that one piece fall 27 m far from the shooting point. Assuming that all trajectories are contained in the same plane, how far will the other piece fall from the shooting point ? (Take $g = 10ms^{-2}$ and neglect air resistance)–

A. 63 m or 144 m

B. 72 m or 9 m

C. 28 m or 72 m

D. 63 m or 117 m

Answer: D

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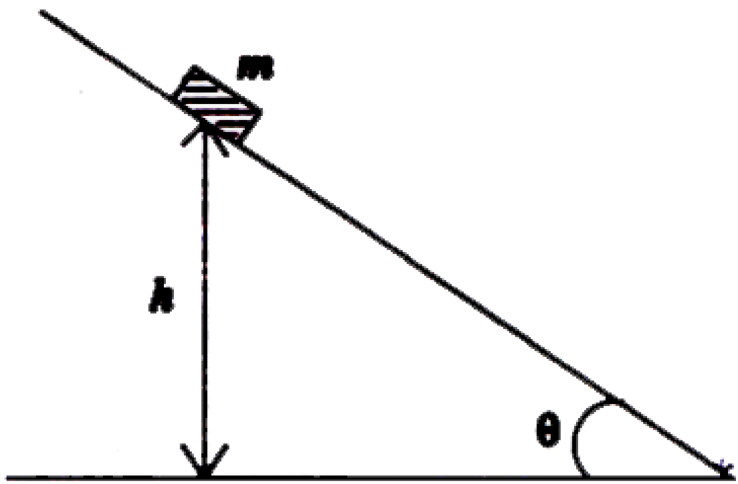
89. A block of mass m is sliding down an inclined plane with constant speed. At a certain instant t0, its height above the ground is h. The coefficient of kinetic friction between the block and the plane is μ. If the block reaches the ground at a later instant t_g, then the energy dissipated by friction in the time interval $\left(t_g - t_0\right)$ is -



A. $\mu m g h$

B. $\mu m g h / \sin \theta$

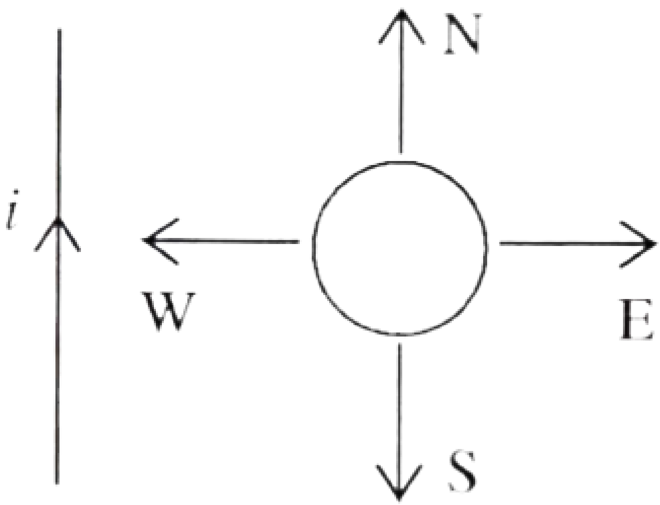
C. mgh

D. $\mu mgh / \cos\theta$

Answer: C

Watch Video Solution

90. A circular loop of wire s in the same plane as an infinitely long wire carrying a constant current i. Four possible motions of the loop are marked by N, E, W, and S as shown.



A clockwise current is induced in the loop when loop is pulled towards

A. N

B. E

C. W

D. S

Answer: B

Watch Video Solution

91. 150 g of ice is mixed with 100 g of water at temperature $80^\circ C$. The latent heat of ice is 80 cal/g and the specific heat of water is $1 cal / g - .^\circ C$. Assuming no heat loss to the environment, the amount of ice which does not melt is –

A. 100 g

B. 0 g

C. 150 g

D. 50 g

Answer: D

Watch Video Solution

92. A solid cylinder P rolls without slipping from rest down an inclined plane attaining a speed vP at the bottom. Another smooth solid cylinder Q of same mass and dimensions slides without friction from rest down the inclined plane attaining a speed vQ at the bottom. The ratio of the speeds $\left(\frac{v_Q}{v_P}\right)$ is -

A. $\sqrt{3/4}$

B. $\sqrt{3/2}$

C. $\sqrt{2/3}$

D. $\sqrt{4/3}$

Answer: B

Watch Video Solution

93. A body moves in a circular orbit of radius R under the action of a central force. Potential due to the central force is given by V(r) = kr (k is a positive constant). Period of revolution of the body is proportional to-

A. $R^{1/2}$

B. $R^{-1/2}$

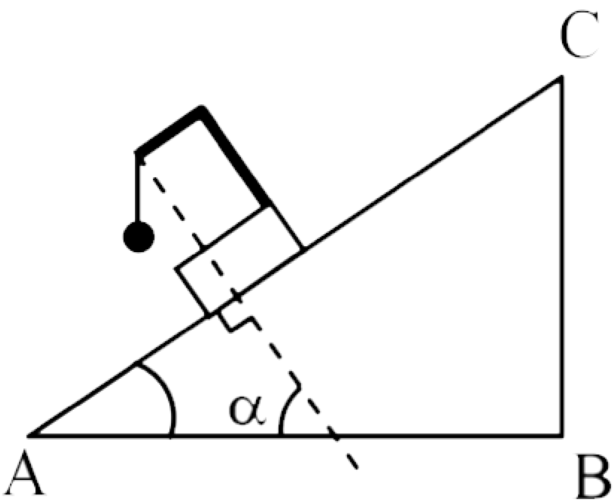
C. $R^{3/2}$

D. $R^{-5/2}$

Answer: A

Watch Video Solution

94. A simple pendulum is attached to the block which slides without friction down an inclined plane (ABC) having an angle of inclination α as shown.



While the block is sliding down the pendulum oscillates in such a way that its mean position the direction of the string is-

A. at angle α to the perpendicular to the inclined plane AC .

B. parallel to the inclined plane AC

C. vertically downwards

D. perpendicular to the inclined plane AC

Answer: D

Watch Video Solution

95. Water containing air bubbles flows without turbulence through a horizontal pipe which has a region of narrow cross-section. In this region the bubbles

A. move with greater speed and are smaller than in the rest of the pipe

B. move with greater speed and are larger in size than in the rest of the pipe

C. move with lesser speed and are smaller than in the rest of the pipe

D. move with lesser speed and are of the same size as in the rest of the pipe

Answer: B

Watch Video Solution

96. A solid expands upon heating because

A. the potential energy of interaction between atoms in the solid is asymmetric about the equilibrium positions of atoms

B. the frequency of vibration of the atoms increases

C. the heating generates a thermal gradient between opposite sides

D. a fluid called the caloric flows into the interatomic spacing of the solid during heating thereby expanding it.

Answer: A

Watch Video Solution

97. Consider two thermometers T_1 and T_2 of equal length which can be used to measure temperature over the range θ_1 to θ_2. T_1 contains mercury as the thermometric liquid while T_2 contains bromine. The volumes of the two liquids are the same at the temperature θ_1. The volumetric coefficients of expansion of mercury and bromine are $18 \times 10^{-5} K^{-1}$ and $108 \times 10^{-5} K^{-1}$, respectively . The increase in length of each liquid is the same for the same increase in temperature. If the diameters of the capillary tubes of the two thermometers are d_1 and d_2 respectively, then the ratio $d_1 : d_2$ would be closest to

A. 6.0

B. 2.5

C. 0.6

D. 0.4

Answer: D

Watch Video Solution

98. An ideal gas follows a process described by $PV^2 = C$ from (P_1, V_1, T_1) to (P_2, V_2, T_2) (C is a constant). Then

A. if $P_1 > P_2$ then $T_2 > T_1$

B. if $V_2 > V_1$ then $T_2 < T_1$

C. if $V_2 > V_1$ then $T_2 > T_1$

D. if $P_1 > P_2$ then $V_1 > V_2$

Answer: B

Watch Video Solution

99. A whistle emitting a loud sound of frequency 540 Hz is whirled in a horizontal circle of radius 2 m and at a constant angular speed of $15 rad/s$. The speed of sound is $330 m/s$. The ratio of the highest to the lowest frequency heard by a listener standing at rest at a large distance from the center of the circle is

A. 1.0

B. 1.1

C. 1.2

D. 1.4

Answer: C

Watch Video Solution

100. Monochromatic light passes through a prism. Compared to that in air, inside the prism the light's

A. speed and wavelength are different but frequency remains same

B. speed and frequency are different but wavelength remains same.

C. wavelength and frequency are different, but speed remains same.

D. speed, wavelength and frequency are all different

Answer: A

Watch Video Solution

101. The flat face of a plano-convex lens of focal length 10 cm is silvered. A point source placed 30 cm in front of the curved surface will produce a

A. real image 15 cm away from the lens

B. real image 6 cm away from the lens

C. virtual image 15 cm away from the lens

D. virtual image 6 cm away from the lens

Answer: B

Watch Video Solution

102. Two identical metallic square loops L_1 and L_2 are placed next to each other with their sides parallel on a smooth horizontal table. Loop L_1 is fixed and a current which increases as a function of time is passed through it. Then loop L_2

A. rotates about its center of mass

B. moves towards L_1.

C. remains stationary

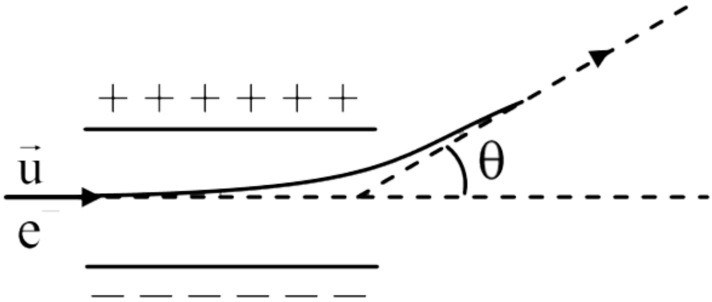
D. moves away from L_1

Answer: D

Watch Video Solution

103. An electron enters a parallel plate capacitor with horizontal speed u and is fond to deflect by angle θ on leaving the capacitor as shown. It is found that $\tan\theta = 0.4$ and gravity is negligible

If the initial horizontal speed is doubled, then $\tan\theta$ will be



A. 0.1

B. 0.2

C. 0.8

D. 1.6

Answer: A

Watch Video Solution

104. Consider a spherical shell of radius R with a total charge $+Q$ uniformly spread on its surface (center of the shell lies at the origin x= 0). Two point charge, $+q$ and $-q$ are brought, one after the other, from far away and placed at $x = -a/2$ and $x = +a/2(a < R)$, respectively. Magnitude of the work done in this process is

A. $(Q+q)^2/4\pi\varepsilon_0 a$

B. zero

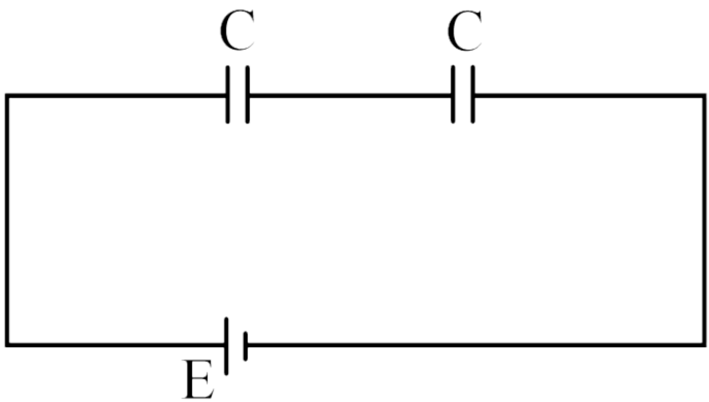
C. $q^2/4\pi\varepsilon_0 a$

D. $Qq/4\pi\varepsilon_0 a$

Answer: C

Watch Video Solution

105. Two identical parallel plate capacitors of capacitance C each are connected in series with a battery of emf, E as shown. If one of the capacitors is now filled with a dielectric of dielectric constant k, the amount of charge which will flow through the battery is (neglect internal resistance of the battery)



A. $\frac{k+1}{2(k-1)}CE$

B. $\frac{k-1}{2(k+1)}CE$

C. $\frac{k-2}{k+2}CE$

D. $\frac{K+2}{k-2}CE$

Answer: B

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106. A certain $p-n$ junction, having a depletion region of width $20\mu m$, was found to have a breakdown voltage of 100 V. If the width of the depletion region is reduced to $1\mu m$ during its production, then it can be used as a Zener diode for voltage regulation of

A. 5V

B. 10 V

C. 7.5 V

D. 2000 V

Answer: A

Watch Video Solution

107. The half life of a particle of mass $1.6 \times 10^{-26} kgis6.9$ s and a stream of such particles is travelling with the kinetic energy of a particle being 0.05 eV. The fraction of particles which will decay when they travel a distance of 1 m is -

A. 0.1

B. 0.01

C. 0.001

D. 0.0001

Answer: D

Watch Video Solution

108. A 160 watt light source is radiating light of wavelength 6200 Å uniformly in all directions. The photon flux at a distance of 1.8 m is of the order of (Planck's constant $6.63 \times 10^{-34} J - s$)

A. $10^2 m^{-2} s^{-1}$

B. $10^{12} m^{-2} s^{-1}$

C. $10^{19} m^{-2} s^{-1}$

D. $10^{25} m^{-2} s^{-1}$

Answer: C

Watch Video Solution

109. The wavelength of the first Balmer line caused by a transition from the n = 3 level to the n = 2 level in hydrogen is

λ_1. The wavelength of the line caused by an electronic transition from n = 5 to n = 3 is -

A. $\frac{375}{128}\lambda_1$

B. $\frac{125}{64}\lambda_1$

C. $\frac{64}{125}\lambda_1$

D. $\frac{128}{375}\lambda_1$

Answer: B

Watch Video Solution

110. The binding energy per nucleon of $._5 B^{10}$ is 8.0 MeV and that of $._5 B^{11}$ is 7.5 MeV. The energy required to remove a neutron from$._5 B^{11}$ is (mass of electron and proton are 9.11×10^{31} kg and 1.67×10^{27} kg, respectively)

A. 2.5 MeV

B. 8.0 MeV

C. 0.5 MeV

D. 7.5 MeV

Answer: A

Watch Video Solution

111. A table has a heavy circular top of radius $1m$ and mass $20kg$, placed on four light (considered massless) legs placed symmetrically on its circumference. The maximum mass that can be kept anywhere on the table without toppling it is close to

A. $20kg$

B. $34kg$

C. $47k$

D. $59kg$

Answer: C

Watch Video Solution

112. Air (density ρ) is the being down on soap film (surface tension T) by pipe of radius R with its opening right next to the film. The film is deformed and a bubble detached from the film when the shape of the deformed surface is a hemisphere. Given that the dynamic pressure on the film due to the air blown at speed v is $\frac{1}{2}\rho v^2$ the speed at which the bubble is formed is

A. $\sqrt{\frac{T}{\rho R}}$

B. $\sqrt{\frac{2T}{\rho R}}$

C. $\sqrt{\frac{4T}{\rho R}}$

D. $sqt\left(\frac{8T}{\rho R}\right)$

Answer: D

Watch Video Solution

113. For an ideal gas the internal energy is given by $U = 5PV/2 + C$, where C is a constant. The equation of the adiabatic in the PV plane will be

A. $P^5V^7 =$ constant

B. $P^7V^5 =$ constant

C. $P^3V^5 =$ constant

D. $P^5V^2 =$ constant

Answer: A

Watch Video Solution

114. An ideal gas undergoes change in its state from the initial state I to the final state F via two possible paths as shown. Then

A. there is no change in internal energy along path 1

B. heat is not absorbed by the gas in both paths

C. the temperature of the gas first increases and then decreases for path 2

D. work done by the gas is larger in path 1.

Answer: C

Watch Video Solution

115. A thermally insulated rigid container of one litre volume contains a diatomic ideal gas at room temperature. A small paddle installed inside the container is rotated from the outside such that the pressure rises by $10^5 Pa$. The change in internal energy is close to

A. $0J$

B. $67J$

C. $150J$

D. $250J$

Answer: D

Watch Video Solution

116. In a Young's double slit experiment the amplitudes of the two waves incident on the two slits are A and $2A$. If I_0 is the maximum intensity, then the intensity at a spot on the screen where the phase difference between the two interfering waves is ϕ .

A. $I_0 \cos^2(\phi / 2)$

B. $\frac{I_0}{3} \sin^2(\phi / 2)$

C. $\left(\frac{I_0}{9}(5 + 4\cos(\phi))\right)$

D. $\frac{I_0}{9}(5 + 8\cos(\phi))$

Answer: C

Watch Video Solution

117. Figure below show water flowing through a horizontal pipe from left to right. Note that the pipe in the middle is narrower. Choose the most appropriate depiction of water levels in the vertical pipes.

A.

B.

C.

D.

Answer: A

Watch Video Solution

118. A plank is moving in a horizontal direction with a constant acceleration $a\hat{i}$. A uniform rough cubical block of side l rests on the plank, and is at rest relative to the plank.

Let the center of mass of the block be at $(0, l/2)$ at a given instant. If $a = g/10$, then the normal reaction exerted by the plank on the block at that instant acts at

A. $(0, 0)$

B. $(-l/20, 0)$

C. $(-l/10, 0)$

D. $(l/10, 0)$

Answer: B

119. Using the Heisenberg uncertainty principle, arrange the following particles in the order of increasing lowest energy possible

A. an electron in H_2 molecule

B. a H atom in a H_2 molecule

C. a proton in the carbon nucleus

D. a H_2 molecule within a nanotube

Answer: C

Watch Video Solution

120. The current is flowing along the path abcd of a cube (shown to the left) produces a magnetic field at the centre of cube of magnitude B. Dashed line depicts the non-conducting part of the cube.

Consider a cubical shape shown to the right which is identical in size and shape to the left. If the same current now flows in along the path daefgcd, then the magnitude of magnetic field at the centre will be

A. zero

B. $\sqrt{2}B$

C. $\sqrt{3}B$

D. B

Answer: C

Watch Video Solution

121. A thin metallic disc is rotating with constant angular velocity about a vertical axis that is perpendicular to its plane and passes through its centre. The rotation causes the free electrons in the disc to redistribute. Assume that there is no external electric or magnetic field. Then

A. a point on the rim of the disc is at a higher potential than the centre.

B. a point on the rim of the disc is at a lower potential than the centre.

C. a point on the rim of the disc is at the same potential as the centre

D. the potential in the material has an extremum between center and the rim

Answer: B

Watch Video Solution

122. One mole of a monatomic gas and one mole of a diatomic gas are initially in the same state. Both gases are expanded isothermally and then adiabatically such that they acquire the same final state. Choose the correct statement.

A. work done by diatomic gas is more than that by monatomic gas

B. work done by monatomic gas is more than that by diatomic gas

C. work done by both the gases are equal

D. change in internal energies of both the gases are equal

Answer: B

Watch Video Solution

123. An ideal gas is made to undergo the cyclic process shown in the figure below. Let $\triangle W$ depict the work done, $\triangle U$be the change in internal energy of the gas and Q be the heat added to the gas. sign of each of these three quantities for the whole cycle will be (0 refers to no change)

A. $-, 0 -$

B. $+, 0, +$

C. $0, 0, 0$

D. $+, +, +$

Answer: A

Watch Video Solution

124. Two balls of mass M and $2M$ are thrown horizontally with the same initial velocity v_0 from top of a tall tower and experience a drag force of $-kv(k > 0)$, where v is the instantaneous velocity. Then

A. the heavier ball will hit the ground further away than the lighter ball

B. the heavier ball will hit the ground closer than the lighter ball

C. both balls will hit the ground at the same point

D. both balls will hit the ground at the same time

Answer: A

Watch Video Solution

125. Consider a glass cube of dielectric bound by the planes $x = 0, x = a, u = 0, y = b, z = 0, z = c,$ with $b > a > c$. The slab is placed in air andhas a refractive index of n. The minimum value of n such that all rays entering the dielectric at $y = 0$ reach $y = b$ is

A. 1

B. $\sqrt{2}$

C. $\sqrt{3}$

D. 2

Answer: B

Watch Video Solution

126. The graph shows the log of activity $(\log R)$ of a radioactive material as a function of time t in minutes

The half -life (in minutes) for the decay is closest to

A. 2.1

B. 3.0

C. 3.9

D. 4.4

Answer: B

Watch Video Solution

Watch Video Solution

127. The magnetic field is uniform for $y > 0$ and points into the plane. The magnetic field is uniform and points out of the plane for $y < 0$. A proton denoted by filled circle leaves $y = 0$ in the y direction with some speed as shown below.

Which of the following best denotes the trajectory of the proton.

A.

B.

C.

D.

Answer: D

Watch Video Solution

128. The Hitomi satellite recently observed the Lyman alpha emission line $(n = 2$ to $n = 1)$ of Hydrogen-like iron ion (atomic number of iron is 26) from the Perseus galaxy cluster. The wavelength of the line is closest to

A. 2Å

B. 1Å

C. 50Å

D. 10Å

Answer: A

Watch Video Solution

129. Assume that the drag force on a football depends only on the density of the air, velocity of the ball and the cross-sectional area of the ball. Balls of different sizes but the same density are dropped in an air column. The terminal velocity reached by balls of masses $250g$ and $125g$ are in the ratio :

A. $2^{1/6}$

B. $2^{1/3}$

C. $2^{1/2}$

D. $2^{2/3}$

Answer: A

Watch Video Solution

130. An electrostatic field line leaves at an angle α from pint change q_1 and connects with point charge $-q_2$ at an angle β (q_1 and q_2 are positive) (see figure below). If $q_2 = \frac{3}{2}q_1$ and $\alpha = 30^\circ$, then

A. $0^0 < \beta < 30^\circ$

B. $\beta = 30^\circ$

C. $30^\circ < \beta < 60^\circ$

D. $60^\circ < \beta < 90^\circ$

Answer: C

Watch Video Solution

131. An arrangement of spring , strings, pulley and masses is shown in the figure . the pulley and the String are massless and $M > m$. the spring is light with spring constant k. If the string Connecting m to the ground detached , then immediately after detachment

A. the magnitude of te acceleration of is zero and of M is

B. the magnitude of the acceleration of m is $(M - m)g/m$ and that of M is zero

C. the accelerations of both masses are same

D. the elongation in the spring is $(M - m)g/k$

Answer: B

Watch Video Solution

132. A wheel of radius R is trapped in a mud pit and spinning. As the wheel is spinning , it splashes mud blobs with initial speed u from various points on its circumference . the maximum height from the center of the wheel , to which mud blob can reach is

A. $u^2 / 2g$

B. $\frac{u^2}{2g} + \frac{gR^2}{2u^2}$

C. $\frac{u^2}{2g}$

D. $R + \frac{u^2}{2g}$

Answer: B

Watch Video Solution

133. Two rods of copper and iron with the same cross sectional area are joined at S and a steady current i flows through the rods as shown in the figure

Choose the most appropriate representation of charges accumulated near the junction S.

A.

B.

C.

D.

Answer: B

Watch Video Solution

134. Graphs below show the entropy vs energy (U) of two systems I and II at constant volume. The initial energies of the systems are indicated by UI, i and UII, i respectively. Graphs are drawn to the same scale. The same scale . the systems are then brought into thermal contact with each other . Assume that at all Time the combined energy of the two systems remains constant. Choose the most appropriate option indicating the energies of the two systems and the total entropy after they achieve the equilibrium.

A. UI increases and UII decreases and the total entropy remains the same

B. UI decreases and UII increases and thes total entropy remains the same.

C. UI increases and UII decreases and the total entropy increases.

D. UI decreases and UII increases and the total entropy increases.

Answer: C

Watch Video Solution

135. The image of an object O due to reflection from the surface of a lake is elongated due to the ripples on the water surface caused by a light breeze. This is because the ripples act as tilted mirrors as shown. Consider the case where O and the observer E are at the same height above the surface of the lake. If the maximum angle that the ripples make with the horizontal is a, the angular extent δ of the image will be

A. $\frac{\alpha}{2}$

B. α

C. 2α

D. 4α

Answer: C

Watch Video Solution

136. A spiral galaxy can be approximated as an infinitesimally thin disk of a uniform surface mass density (mass per unit area) located at $z = 0$. Two stars A and B start from rest from heights $2z_0$ and z_0 ($z_0 < <$ radial extent of the disk), respectively, and fall towards the disk, cross over to the other side, and execute periodic oscillations. The ratio of time periods of A and B is

A. $2^{-1/2}$

B. 2

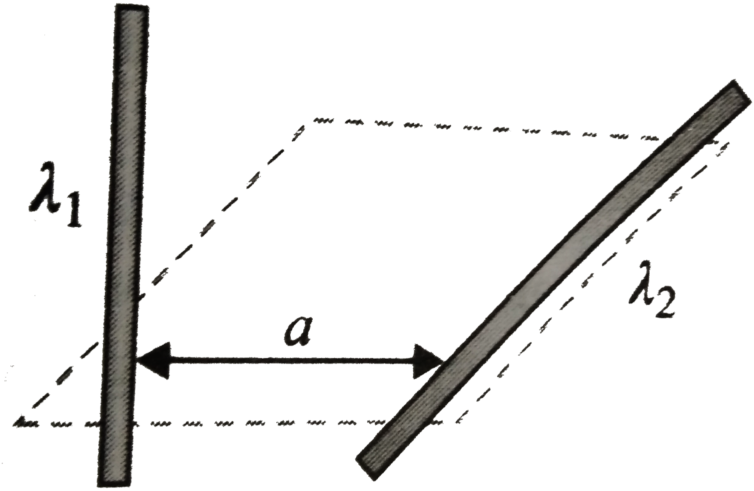
C. 1

D. $2^{1/2}$

Answer: D

Watch Video Solution

137. Two mutually perpendicular long straight conductors carrying uniformly distributed charges of linear charges densities λ_1 and λ_2 are position at a distance a from each other. How does the interaction between the rods depends on a ?



A. $1/r$

B. $1/r^2$

C. r

D. r^0

Answer: D

Watch Video Solution

138. The graph below shows the variation of a force (F) with time (t) on a body which is moving in a straight line. Dependence of force on time is $F \propto t^n$. Initially body is rest.

If the speed of the object is $2m/s$ at $3s$, the speed at $4s$ will be approximately (m/s)

A. 2.5

B. 6.5

C. 7.8

D. 3.1

Answer: B

Watch Video Solution

139. A block of wood is floating on water at $0^\circ C$ with volume V_0 above water. When the temperature of water increases from 0 to $10^\circ C$, the change in the volume of the block That is above water is best described schematically by the graph

A.

B.

C.

D.

Answer: A

Watch Video Solution

140. A very large block of ice of the size of a volleyball court and of uniform thickness of $8m$ is floating on water. A person standing near its edge wishes to fetch a bucketful of water using a rope. The smallest length of rope required for this is about

A. $3.6m$

B. $1.8m$

C. $0.9m$

D. $0.4m$

Answer: C

Watch Video Solution

141. A box filled water has a small hole on its side near the bottom. It is dropped from the top of a tower. As it falls, a camera attached on the side of the box records the shape of the water stream coming out of the hole. The resulting video will show

A. the water coming down forming a parabolic stream.

B. the water going up forming a parabolic stream.

C. the water coming out in a straight line.

D. no water coming out.

Answer: D

Watch Video Solution

142. An earthen pitcher used in summer cools water in it essentially by evaporation of water from its porous surface. If a pitcher carries $4kg$ water and the rate of evaporation is $20g$ per hour, temperature of water in it decreases by $\triangle T$ in two hours. The value of $\triangle T$ is close to (ratio of latent of evaporation to specific heat of water is $540^\circ C$)

A. $2.7^\circ C$

B. $4.2^\circ C$

C. $5.4^\circ C$

D. $10.8^\circ C$

Answer: C

Watch Video Solution

143. Two plane mirrors are kept on a horizontal table making an angle θ with each other as shown schematically in the figure. The angle is such that any ray of light reflected after striking both the mirrors returns parallel to its incident path. For this to happen, the value of θ should be

A. 30°

B. 45°

C. 60°

D. 90°

Answer: D

Watch Video Solution

144. A certain liquid has a melting point of $50^\circ C$ and a boiling point of $150^\circ C$. A thermometer is designed with this liquid and its melting and boiling points are designated as $0^\circ L$ and $100^\circ L$. The melting and boiling points of water on this scale are

A. $25^\circ L$ and $75^\circ L$, respectively

B. $0^\circ L$ and $100^\circ L$, respectively

C. $20^\circ L$ and $70^\circ L$, respectively

D. $30^\circ L$ and $80^\circ L$, respectively

Answer: A

Watch Video Solution

145. One can define an alpha-Volt (αV) to be the energy acquired by an a particle when it is accelerated by a potential of 1 Volt. For this problem you may take a proton to be 2000 times heavier than an electron. Then

A. $1\alpha V = 1ev/4000$

B. $1\alpha V = 2eV$

C. $1\alpha V = 8000eV$

D. $1\alpha V = 1eV$

Answer: B

Watch Video Solution

146. In a particle accelerator, a current of $500\mu A$ is carried by a proton beam in which each proton has speed of $3 \times 10^7 m/s$. The cross sectional area of the beam is $1.50mm^2$. The charge density in this beam in Coulomb/m3 is close to

A. 10^{-8}

B. 10^{-7}

C. 10^{-6}

D. 10^{-5}

Answer: D

Watch Video Solution

147. Which of the following is NOT true about the total lunar eclipse?

A. A lunar eclipse can occur on a new moon and full moon day.

B. The lunar eclipse would occur roughly every month is the orbits of earth and moon were perfectly coplanar.

C. The moon appears red during the eclipse because the blue light is absorbed in earth's atmosphere and red is transmitted.

D. A lunar eclipse can occur only on a full moon day.

Answer: D

Watch Video Solution

148. Many exoplanets have been discovered by the transit method, wherein one monitors a dip in the intensity of the parent star as the exoplanet moves in front of it. The exoplanet has a radius R and the parent star has radius $100R$. If I_0 is the intensity observed on earth due to the parent star, then as the exoplanet transits,

A. The minimum observed intensity of the parent star is $0.9I_0$

B. The minimum observed intensity of the parent star is $0.99I_0$

C. The minimum observed intensity of the parent star is $0.999I_0$

D. The minimum observed intensity of the parent star is $0.9999I_0$

Answer: D

View Text Solution

149. A steady current I is set up in a wire whose cross-sectional area decreases in the direction of the flow of the current. Then, as we examine the narrowing region

A. the current density decreases in value.

B. the magnitude of the electric field increases.

C. the current density remains constant.

D. the average speed of the moving charges remains constant.

Answer: B

View Text Solution

150. Select the correct statement about rainbow:

A. We can see a rainbow in the western sky in the late afternoon

B. The double rainbow has red on the inside and violet on the outside.

C. A rainbow has an arc shape since the earth is round.

D. A rainbow on the moon is violet on the inside and red on the outside.

Answer: B

View Text Solution

151. Remote sensing satellites move in an orbit that is at an average height of about $500 km$ from the surface of the earth. the camera onboard one such satellite has a screen of area A on which the images captured by it are formed. If the focal length of the camera lens is $50 cm$, then the terrestrial area that can be observed from the satellite is close to

A. $2 \times 10^3 A$

B. $10^6 A$

C. $10^{12} A$

D. $4 \times 10^{12} A$

Answer: C

View Text Solution

152. If a ball is thrown at a velocity of $45 m / s$ in vertical upward direction, then what would be the velocity profile as function of height? Assume $g = 10 m / s^2$

A.

B.

C.

D.

Answer: A

View Text Solution

153. A coffee maker makes coffee by passing steam through a mixture of coffee powder, milk and water. If the steam is mixed at the rate of $50g$per minute in a mug containing $500g$ of mixture, then it takes about t_0 seconds to make coffee at $70^\circ C$ when the initial temperature of the mixture is $25^\circ C$. The value of t_0 is close to (ratio of latent heat of evaporation to specific heat of water is $540^\circ C$) and specific heat of the mixture can taken to be the same as that of water)

A. 30

B. 45

C. 60

D. 90

Answer: B

View Text Solution

154. A person in front of a mountain is beating a drum at the rate of 40 per minute and hears no distinct echo. If the person moves 90 m closer to the mountain, he has to beat the drum at 60 per minute to not hear any distinct echo. The speed of sound is

A. $320ms^{-1}$

B. $340ms^{-1}$

C. $360ms^{-1}$

D. $380ms^{-1}$

Answer: C

View Text Solution

155. A glass beaker is filled with water up to $5cm$. It is kept on top of a $2cm$ thick glass slab. When a coin at the bottom of the glass slab is viewed at the normal incidence from above the beaker, its apparent depth from the water surface is dcm. Value of d is close (the refractive index of water and glass are 1.33 and 1.50,respectively)

A. 2.5

B. 5.1

C. 3.7

D. 6

Answer: B

View Text Solution

156. A proton of mass m and charge e is projected from a very large distance towards an α particle with velocity v. Intially, particle is at rest, but it is free to move. If gravity is neglected, then the minimum separation along the straight line of their motion will be

A. $e^2 / 4\pi\varepsilon_0 mv^2$

B. $5e^2 / 4\pi\varepsilon_0 mv^2$

C. $2e^2 / 4\pi\varepsilon_0 mv^2$

D. $4e(2) / 4\pi\varepsilon mv^2$

Answer: B

157. A potential is given by $V(x) = (x + \alpha)^{2/2}$ for $x < 0$ and $V(X) = k(X - \alpha)^{2/2}$ for $x > 0$. The schematic variation of oscillation pertiod (T) for a performing periodic motion in this potential as a function of its energy E is:

A.

B.

C.

D.

Answer: B

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