Central Board of Secondary Education

Question Paper Name :	B Tech 4 Apr 2015 Shift 1
Subject Name :	B. Tech
Duration :	180
Total Marks :	360
Display Marks:	Yes

B. Tech

Group Number :	1
Group Maximum Duration :	0
Group Minimum Duration :	180
Show Attended Group? :	No
Edit Attended Group? :	No
Break time :	0
Group Marks :	360

Mathematics Section A

Section Number :	1
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	30
Number of Questions to be attempted :	30
Section Marks :	120
Maximum Instruction Time :	0
Sub-Section Number :	1
Question Shuffling Allowed :	Yes
Is Section Default? :	No

Question Number : 1 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

If the function.

$$g(x) = \begin{cases} k\sqrt{x+1}\ , & 0 \le x \le 3 \\ mx+2, & 3 < x \le 5 \end{cases}$$

is differentiable, then the value of $k + m$ is :

Options :

A. $\frac{10}{3}$

B. 4

C. 2

D. $\frac{16}{5}$

Question Number : 2 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The mean of the data set comprising of 16 observations is 16. If one of the observation valued 16 is deleted and three new observations valued 3, 4 and 5 are added to the data, then the mean of the resultant data, is :

Options :

A. 15.8

B. 14.0

C. 16.8

D. 16.0

Question Number : 3 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

$$\lim_{x \to 0} \frac{(1 - \cos 2x)(3 + \cos x)}{x \tan 4x}$$

is equal to

Options :

A. 2

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

C. 4

D. 3

Question Number : 4 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Let α and β be the roots of equation $x^2 - 6x - 2 = 0$. If

$$a_n = \alpha^n - \beta^n,$$

for $n \geq 1$, then the value of

$$\frac{a_{10} - 2a_8}{2a_9}$$

is equal to :

Options :

A. 3

B. -3

C. 6

D. -6

Question Number : 5 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

If 12 different balls are to be placed in 3 identical boxes, then the probability that one of the boxes contains exactly 3 balls is :

Options :

A. $220\left(\frac{1}{3}\right)^{12}$

B. $22\left(\frac{1}{3}\right)^{11}$

C. $\frac{55}{3}\left(\frac{2}{3}\right)^{11}$

D. $55\left(\frac{2}{3}\right)^{10}$

Question Number : 6 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The integral

$$\int_{2}^{4} \frac{\log x^2}{\log x^2 + \log(36 - 12x + x^2)} dx$$

is equal to :

Options :

A. 1

B. 6

C. 2

D. 4

Question Number : 7 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Let $y(x)$ be the solution of the differential equation

$$(x \log x)\frac{dy}{dx} + y = 2x \log x, (x \geq 1).$$

Then $y(e)$ is equal to :

Options :

A. 2

B. $2e$

C. e

D. 0

Question Number : 8 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The area (in sq. units) of the region described by

$\{(x, y) : y^2 \leq 2x \quad \text{and} \quad y \geq 4x - 1\}$ is :

Options :

A. $\frac{15}{64}$

B. $\frac{9}{32}$

C. $\frac{7}{32}$

D. $\frac{5}{64}$

Question Number : 9 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The integral

$$\int \frac{dx}{x^2(x^4+1)^{3/4}}$$

equals :

Options :

A. $-(x^4+1)^{\frac{1}{4}} + c$

B. $-\left(\frac{x^4+1}{x^4}\right)^{\frac{1}{4}}+c$

C. $\left(\frac{x^4+1}{x^4}\right)^{\frac{1}{4}}+c$

D. $\left(x^4+1\right)^{\frac{1}{4}}+c$

Question Number : 10 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The set of all values of λ for which the system of linear equations:

$$2x_1 - 2x_2 + x_3 = \lambda x_1$$
$$2x_1 - 3x_2 + 2x_3 = \lambda x_2$$
$$-x_1 + 2x_2 = \lambda x_3$$

has a non-trivial solution

Options :

A. contains two elements

B. contains more than two elements

C. in an empty set

D. is a singleton

Question Number : 11 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Let $f(x)$ be a polynomial of degree four having extreme values at $x = 1$ and $x = 2$. If

$$\lim_{x \to 0}\left[1+\frac{f(x)}{x^2}\right]=3$$

, then f(2) is equal to :

Options :

A. 0

B. 4

C. -8

D. -4

Question Number : 12 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

If

$$A = \begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & -2 \\ a & 2 & b \end{bmatrix}$$

is a matrix satisfying the equation

$$AA^T = 9\mathrm{I},$$

where I is 3×3 identity matrix, then the ordered

pair (a, b) is equal to :

Options :

A. $(2, 1)$

B. $(-2, -1)$

C. $(2, -1)$

D. $(-2, 1)$

Question Number : 13 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Let

$$\tan^{-1}y = \tan^{-1}x + \tan^{-1}\left(\frac{2x}{1-x^2}\right),$$

where

$$|x| < \frac{1}{\sqrt{3}}.$$

Then a value of y is :

Options :

A. $\dfrac{3x - x^3}{1 + 3x^2}$

B. $\dfrac{3x + x^3}{1 + 3x^2}$

C. $\dfrac{3x - x^3}{1 - 3x^2}$

D. $\frac{3x + x^3}{1 - 3x^2}$

Question Number : 14 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Let O be the vertex and Q be any point on the parabola, $x^2 = 8y$. If the point P divides the line segment OQ internally in the ratio $1 : 3$, then locus of P is :

Options :

A. $y^2 = 2x$

B. $x^2 = 2y$

C. $x^2 = y$

D. $y^2 = x$

Question Number : 15 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Locus of the image of the point $(2, 3)$ in the line

$$(2x - 3y + 4) + k(x - 2y + 3) = 0,\ k \in R,$$

is a :

Options :

A. circle of radius $\sqrt{2}$.

B. circle of radius $\sqrt{3}$.

C. straight line parallel to x-axis

D. straight line parallel to y-axis

Question Number : 16 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The number of points, having both co-ordinates as integers, that lie in the interior of the triangle with vertices $(0, 0)$ $(0, 41)$ and $(41, 0)$ is :

Options :

A. 820

B. 780

C. 901

D. 861

Question Number : 17 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

If m is the A.M. of two distinct real numbers l and n

$$(l, n > 1)$$

and G_1, G_2 and G_3 are three geometric means between l and n, then $G_1^4 + 2G_2^4 + G_3^4$ equals:

Options :

A. $4\,lmn^2$

B. $4\,l^2m^2n^2$

C. $4\,l^2mn$

D. $4\,lm^2n$

Question Number : 18 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The number of integers greater than 6,000 that can be formed, using the digits 3, 5, 6, 7 and 8, without repetition, is:

Options :

A. 120

B. 72

C. 216

D. 192

Question Number : 19 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

A complex number z is said to be unimodular if

$$|z| = 1$$

. Suppose z_1 and z_2 are complex numbers such that

$$\frac{z_1 - 2z_2}{2 - z_1z_2}$$

is unimodular and z_2 is not unimodular. Then the point z_1 lies on a :

Options :

A. circle of radius 2.

B. circle of radius $\sqrt{2}$.

C. straight line parallel to x-axis

D. straight line parallel to y-axis.

Question Number : 20 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Let A and B be two sets containing four and two elements respectively. Then, the number of subsets of the set $A \times B$, each having atleast three elements are

Options :

A. 219

B. 256

C. 275

D. 510

Question Number : 21 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The number of common tangents to the circles

$$x^2 + y^2 - 4x - 6x - 12 = 0$$

and

$$x^2 + y^2 + 6x + 18y + 26 = 0,$$

is :

Options :

A. 3

B. 4

C. 1

D. 2

Question Number : 22 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The distance of the point $(1, 0, 2)$ from the point of intersection of the line

$$\frac{x-2}{3} = \frac{y+1}{4} = \frac{z-2}{12}$$

and the plane

$$x - y + z = 16,$$

is :

Options :

A. $3\sqrt{21}$

B. 13

C. $2\sqrt{14}$

D. 8

Question Number : 23 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be three non-zero vectors such that no two of them are collinear and

$$\left(\vec{a} \times \vec{b}\right) \times \vec{c} = \frac{1}{3}\left|\vec{b}\right|\left|\vec{c}\right|\vec{a}.$$

If θ is the angle between vectors $\vec{b}$ and $\vec{c}$, then a value of $\sin\theta$ is :

Options :

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

B. $\frac{-2\sqrt{3}}{3}$

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

D. $\frac{-\sqrt{2}}{3}$

Question Number : 24 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The sum of coefficients of integral power of x in the binomial expansion $\left(1 - 2\sqrt{x}\ \right)^{50}$ is :

Options :

A. $\frac{1}{2}\left(3^{50} - 1\right)$

B. $\frac{1}{2}\left(2^{50} + 1\right)$

C. $\frac{1}{2}\left(3^{50} + 1\right)$

D. $\frac{1}{2}\left(3^{50}\right)$

Question Number : 25 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The area (in sq. units) of the quadrilateral formed by the tangents at the end points of the latera recta to the ellipse

$$\frac{x^2}{9}+\frac{y^2}{5}=1$$

, is :

Options :

A. $\frac{27}{2}$

B. 27

C. $\frac{27}{4}$

D. 18

Question Number : 26 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The sum of first 9 terms of the series.

$$\frac{1^3}{1}+\frac{1^3+2^3}{1+3}+\frac{1^3+2^3+3^3}{1+3+5}+.....$$

Options :

A. 142

B. 192

C. 71

D. 96

Question Number : 27 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The normal to the curve, $x^2+2xy-3y^2=0$, at (1,1)

Options :

A. meets the curve again in the third quadrant.

B. meets the curve again in the fourth quadrant.

C. does not meet the curve again.

D. meets the curve again in the second quadrant.

Question Number : 28 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The equation of the plane containing the line

$$2x - 5y + z = 3; x + y + 4z = 5,$$

and parallel to the plane,

$$x + 3y + 6z = 1,$$

is :

Options :

A. $x + 3y + 6z = 7$

B. $2x + 6y + 12z = -13$

C. $2x + 6y + 12z = 13$

D. $x + 3y + 6z = -7$

Question Number : 29 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

If the angles of elevation of the top of a tower from three collinear points A, B and C, on a line leading to the foot of the tower, are 30°, 45° and 60° respectively, then the ratio, $AB : BC$, is :

Options :

A. $1 : \sqrt{3}$

B. $2 : 3$

C. $\sqrt{3} : 1$

D. $\sqrt{3} : \sqrt{2}$

Question Number : 30 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The negation of $\sim s \vee (\sim r \wedge s)$ is equivalent to :

Options :

A. $s \vee (r \vee \sim s)$

B. $s \wedge r$

C. $s \wedge \sim r$

D. $s \wedge (r \wedge \sim s)$

Physics Section A

Section Number :	2
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	30
Number of Questions to be attempted :	30
Section Marks :	120
Maximum Instruction Time :	0
Sub-Section Number :	1
Question Shuffling Allowed :	Yes
Is Section Default? :	No

Question Number : 31 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

As an electron makes a transition from an excited state to the ground state of a hydrogen - like atom/ion :

Options :

A. kinetic energy decreases, potential energy increases but total energy remains same

B. kinetic energy and total energy decrease but potential energy increases

C. its kinetic energy increases but potential energy and total energy decrease

D. kinetic energy, potential energy and total energy decrease

Question Number : 32 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

A red *LED* emits light at 0.1 watt uniformly around it. The amplitude of the electric field of the light at a distance of 1 m from the diode is :

Options :

A. 5.48 V/m

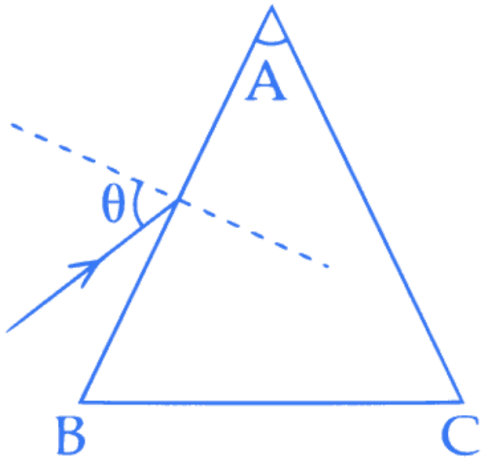
B. 7.75 V/m

C. $1.73 \ V/m$

D. $2.45 \ V/m$

Question Number : 33 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Monochromatic light is incident on a glass prism of angle A. If the refractive index of the material of the prism is μ, a ray, incident at an angle θ. on the face AB would get transmitted through the face AC of the prism provided :



Options :

A. $\theta > \cos^{-1}\left[\mu \sin\left(A + \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$

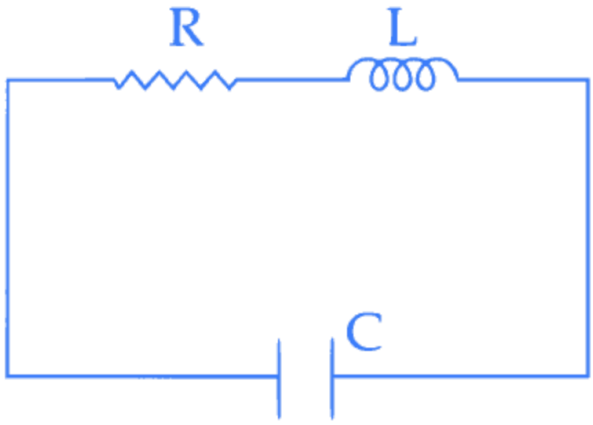
B. $\theta < \cos^{-1}\left[\mu \sin\left(A + \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$

C. $\theta > sin^{-1}\left[\mu \sin\left(A - \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$

D. $\theta < sin^{-1}\left[\mu \sin\left(A - \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$

Question Number : 34 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

An *LCR* circuit is equivalent to a damped pendulum. In an *LCR* circuit the capacitor is charged to Q_0 and then connected to the L and R as shown below :



If a student plots graphs of the square of maximum charge $\left(Q_{Max}^2\right)$ on the capacitor with time(t) for two different values L_1 and L_2

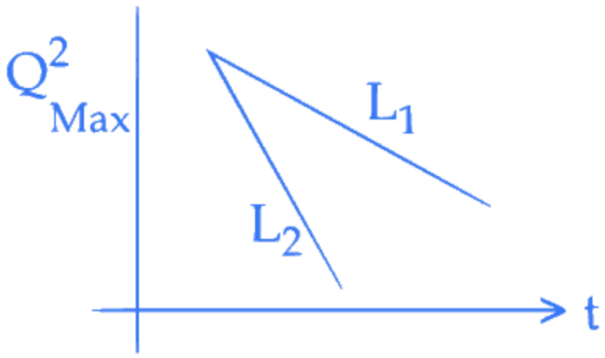
$$\left(L_1 > L_2\right)$$

of L then which of the following represents this graph correctly ?

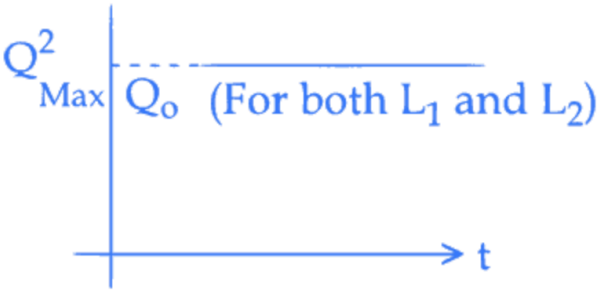
$$\left(\textit{plots are schematic and niot drawn to scale}\right)$$

Options :

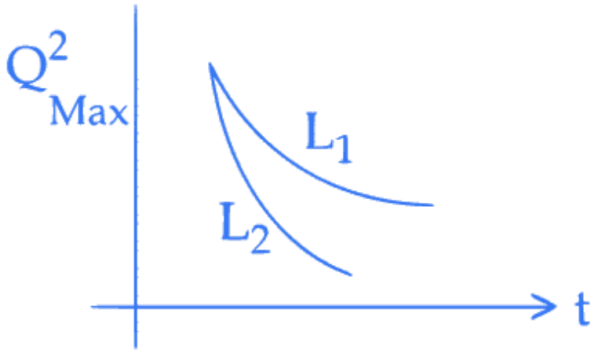
A.



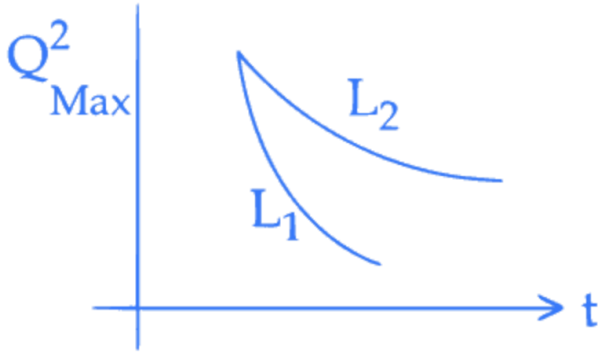
B.



C.



D.



Question Number : 35 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

An inductor

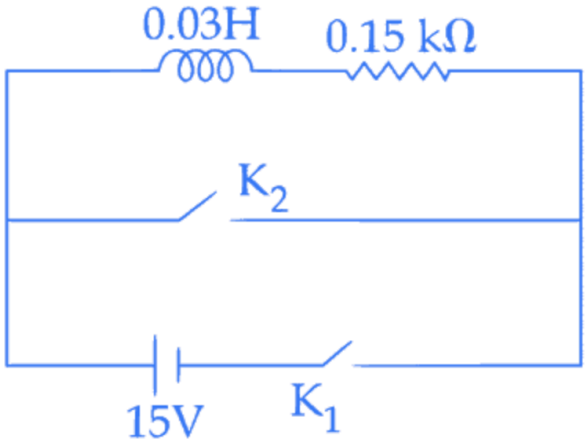
$$(L = 0.03$$

H) and a resistor

$$(R = 0.15\,k\Omega)$$

are connected in series to a battery of $15V$ EMF in a circuit shown below. The key K_1 has been kept closed for a long time. Then at $t = 0$, K_1 is opened and key K_2 is closed simultaneously. At $t = 1\ ms$, the current in the circuit will be :

$$(e^5 \cong 150)$$



Options :

A. $6.7\ mA$

B. $0.67\ mA$

C. $100\ mA$

D. $67\ mA$

Question Number : 36 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

On a hot summer night, the refractive index of air is smallest near the ground and increases with height from the ground. When a light beam is directed horizontally, the Huygens' principle leads us to conclude that as it travels, the light beam :

Options :

A. bends down wards

B. bends upwards

C. becomes narrower

D. goes horizontally without any deflection

Question Number : 37 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Two coaxial solenoids of different radius carry current I in the same direction. $\vec{F_1}$ be the magnetic force on the inner solenoid due to the outer one and $\vec{F_2}$ be the magnetic force on the outer solenoid due to the inner one. Then :

Options :

A. $\vec{F_1}$ is radially in wards and $\vec{F_2} = 0$

B. $\vec{F_1}$ is radially outwards and $\vec{F_2} = 0$

C. $\vec{F_1} = \vec{F_2} = 0$

D. $\vec{F}_1$ is radially inwards and $\vec{F}_2$ is radially outards

Question Number : 38 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Assuming human pupil to have a radius of 0.25 cm and a comfortable viewing distance of 25 cm, the minimum separation between two objects that human eye can resolve at 500 nm wavelength is :

Options :

A. $100\,\mu m$

B. $300\,\mu m$

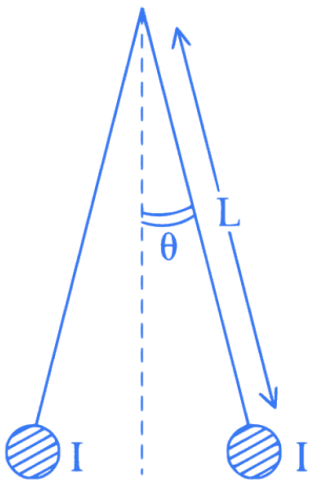
C. $1\,\mu m$

D. $30\,\mu m$

Question Number : 39 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Two long current carrying thin wires, both with current I, are held by insulating threads of length L and are in equilibrium as shown in the figure, with threads making an angle $'\theta'$ with the vertical. If wires have mass λ per unit-length then the value of I is :

($g =$ *gravitational acceleration*)



Options :

A. $2\sqrt{\frac{\pi g L}{\mu_0}\tan\theta}$

B. $\sqrt{\frac{\pi\lambda gL}{\mu_0}\tan\theta}$

C. $\sin\theta\sqrt{\frac{\pi\lambda gL}{\mu_0\cos\theta}}$

D. $2\sin\theta\sqrt{\frac{\pi\lambda gL}{\mu_0\cos\theta}}$

Question Number : 40 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

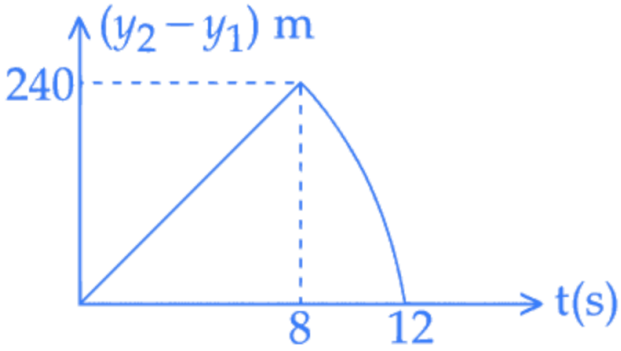
Two stones are thrown up simultaneously from the edge of a cliff 240 m high with initial speed of 10 m/s and 40 m/s respectively. Which of the following graph best represents the time variation of relative position of the second stone with respect to the first ?

(Assume stones do not rebound after hitting the ground and neglect air resistance, take $g = 10m/s^2$)

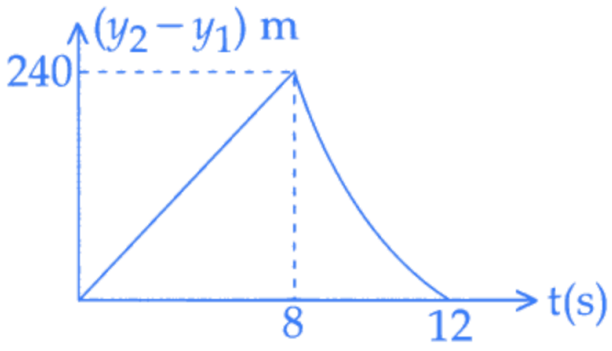
(The figures are schematic and not drawn to scale)

Options :

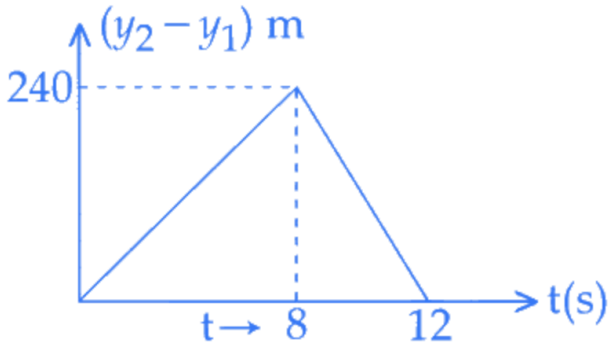
A.



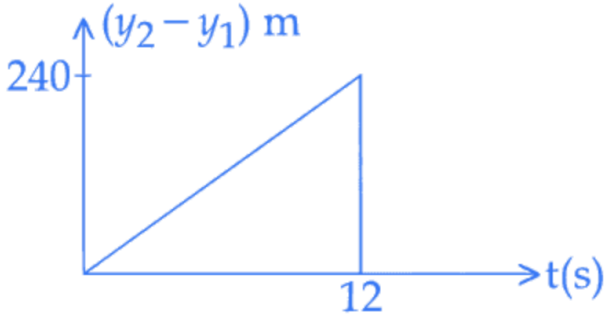
B.



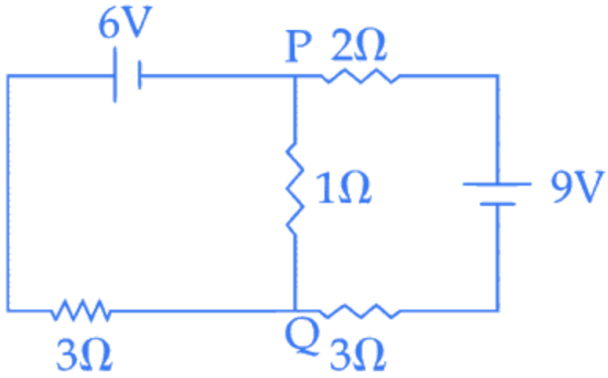
C.



D.



Question Number : 41 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical



In the circuit shown, the current in the 1Ω resistor is :

Options :

A. 0.13 A, from Q to P

B. 0.13 A, from P to Q

C. 1.3A from P to Q

D. 0A

Question Number : 42 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

When 5V potential difference is applied across a wire of length 0.1 m, the drift speed of electrons is 2.5×10^{-4} ms^{-1}. If the electron density in the wire is 8×10^{28} m^{-3}, the resistivity of the material is close to :

Options :

A. $1.6 \times 10^{-6} \Omega m$

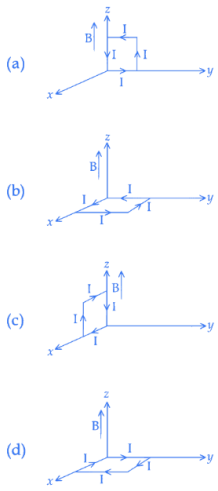
B. $1.6 \times 10^{-5} \Omega m$

C. $1.6 \times 10^{-8} \Omega m$

D. $1.6 \times 10^{-7} \Omega m$

Question Number : 43 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

A rectangular loop of sides 10 cm and 5 cm carrying a current 1 of 12A is placed in different orientations as shown in the figures below :



If there is a uniform magnetic field of 0.3 T in the positive z direction, in which orientations the loop would be in (i) stable equilibrium and (ii) unstable equilibrium ?

Options :

A. (B) and (D), respectively

B. (B) and (C), respectively

C. (A) and (B), respectively

D. (A) and (C), respectively

Question Number : 44 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

A pendulum made of a uniform wire of cross sectional area A has time period T. When an additional mass M is added to its bob, the time period changes to T_M. If the Young's modulus of the material of the wire is Y then

$$\frac{1}{Y}$$

is equal to :

(

$$g = \textit{gravitational acceleration}$$

)

Options :

A. $$\left[1-\left(\frac{T_M}{T}\right)^2\right]\frac{A}{Mg}$$

B. $$\left[1-\left(\frac{T}{T_M}\right)^2\right]\frac{A}{Mg}$$

C. $$\left[\left(\frac{T_M}{T}\right)^2-1\right]\frac{A}{Mg}$$

D. $$\left[\left(\frac{T_M}{T}\right)^2-1\right]\frac{Mg}{A}$$

Question Number : 45 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

A uniformly charged solid sphere of radius R has potential V_0 (measured with respect to ∞) on its surface. For this sphere the equipotential surfaces with potentials

$$\frac{3V_0}{2}, \frac{5V_0}{4}, \frac{3V_0}{4}$$

and $\frac{V_0}{4}$ have radius R_1, R_2, R_3 and R_4 respectively. Then

Options :

A. $R_1 = 0$ and $R_2 < (R_4 - R_3)$

B. $2R < R_4$

C. $R_1 = 0$ and $R_2 > (R_4 - R_3)$

D. $R_1 \neq 0$ and

$$(R_2 - R_1) > (R_4 - R_3)$$

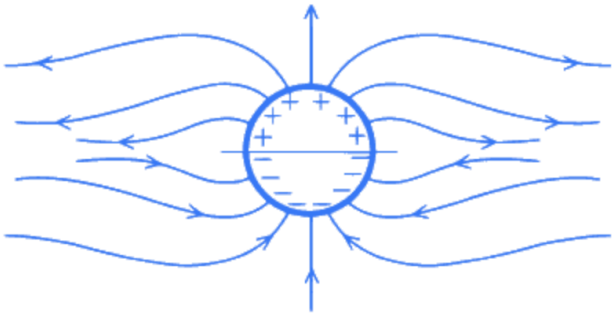
Question Number : 46 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

A long cylindrical shell carries positives surfaces change σ in the upper half and negative surface charge - σ in the lower half. The electric field lines around the cylinder will look like figure given in :

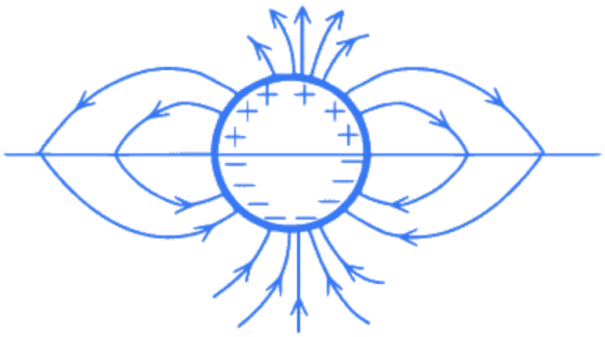
(*figures are schematic and not drawn to scale*)

Options :

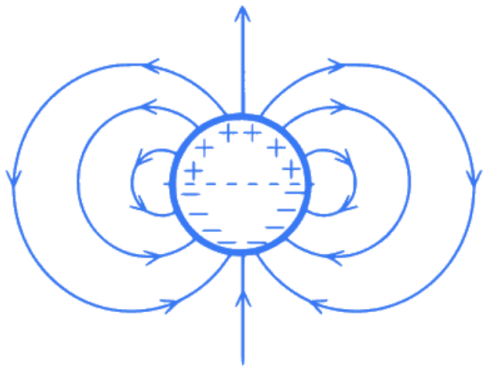
A.



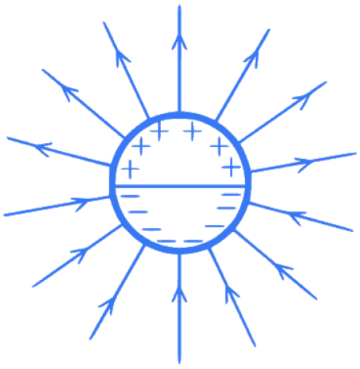
B.



C.



D.



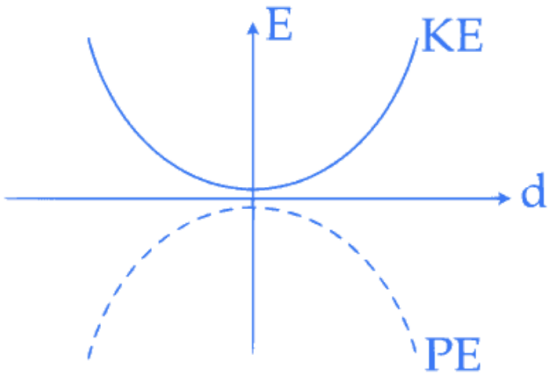
Question Number : 47 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

For a simple pendulum, a graph is plotted between its kinetic energy (*KE*) and potential energy (*PE*) against its displacement *d*. Which one of the following represents these correctly?

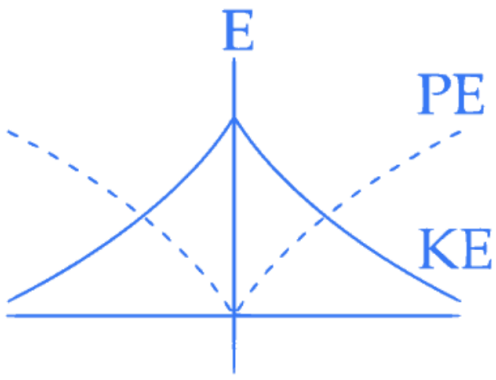
(*graphs are schematic and not drawn to scale*)

Options :

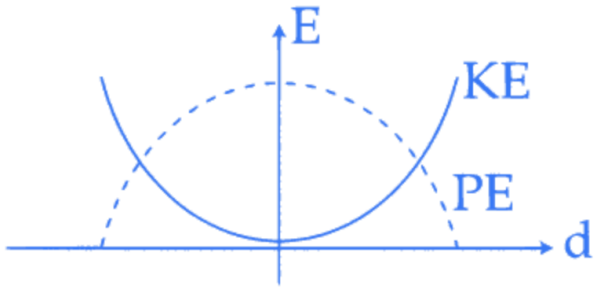
A.



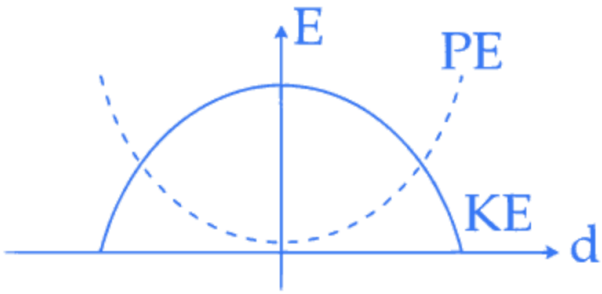
B.



C.



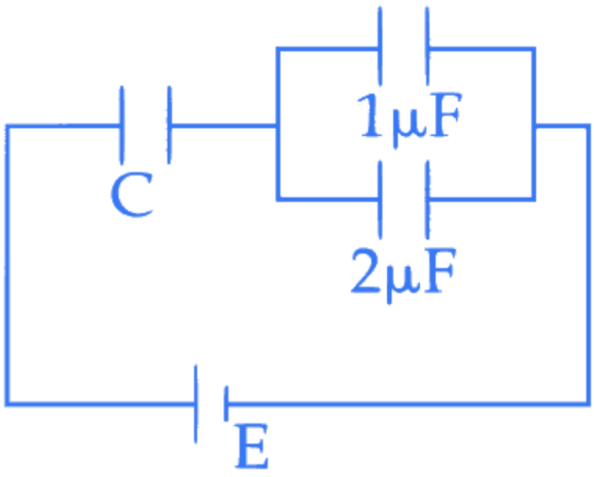
D.



Question Number : 48 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

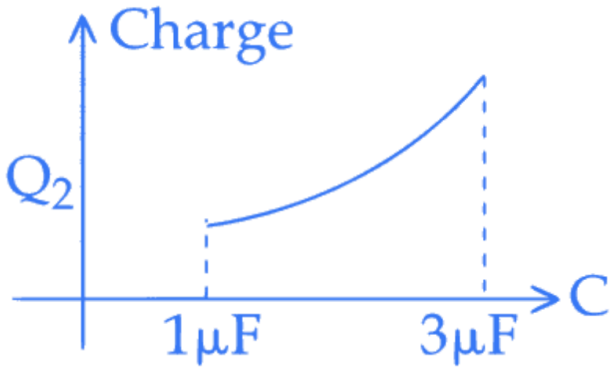
In the given circuit, charges Q_2 on the $2\mu F$ capacitor changes as C is varied from $1\,\mu F$ to $3\mu F$. Q_2 as a function of $'C'$ is given properly by:

$(figures\ are\ drawn\ schematically\ and\ are\ not\ to\ scale)$

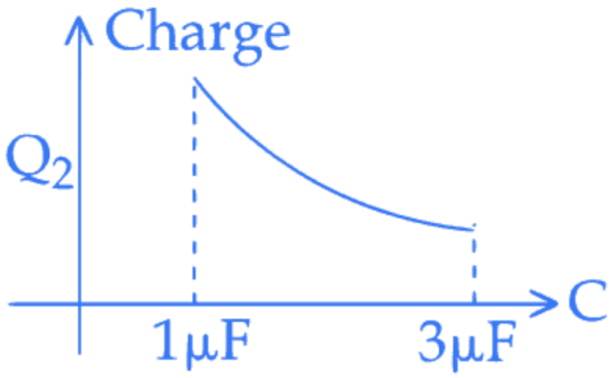


Options :

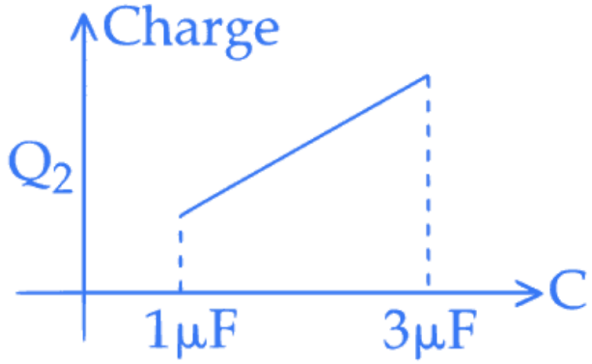
A.



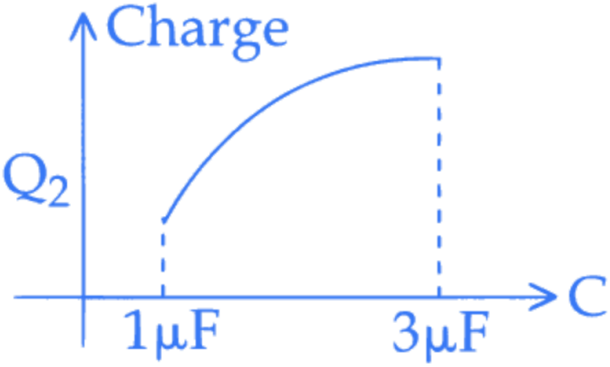
B.



C.



D.



Question Number : 49 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Consider a spherical shell of radius R at temperature T. The black body radiation inside it can be considered as an ideal gas of photons with internal energy per unit volume

$$u = \frac{U}{V} \propto T^4$$

and pressure

$$p = \frac{1}{3}\left(\frac{U}{V}\right)$$

. If the shell now undergoes an adiabatic expansion the relation between T and R is:

Options :

A.

$$T \propto \frac{1}{R}$$

B.

$$T \propto \frac{1}{R^3}$$

C. $T \propto e^{-R}$

D. $T \propto e^{-3R}$

Question Number : 50 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

A solid body of constant heat capacity 1 $J/°C$ is being heated by keeping it in contact with reservoirs in two ways:

(i) Sequentially keeping in contact with 2 reservoirs such that each reservoir supplies same amount of heat.

(ii) Sequentially keeping in contact with 8 reservoirs such that each reservoir supplies same amount of heat.

In both the cases body is brought from initial temperature 100°C to final temperature 200°C. Entropy change of the body in the two cases respectively is :

Options :

A. $ln2, 2ln2$

B. $2ln2, 8ln2$

C. $ln2, 4ln2$

D. $ln2, ln2$

Question Number : 51 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

From a solid sphere of mass M and radius R, a spherical portion of radius $R/2$ is removed, as shown in the figure. Taking gravitational potential $V = 0$ at

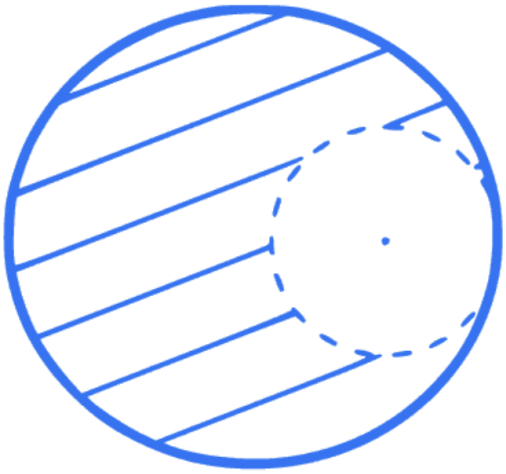
$$r = \infty,$$

the potential at the center of the cavity thus formed is:

(

$$G = gravitational$$

$constant$)



Options :

A. $\frac{-2GM}{3R}$

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

C. $\frac{-GM}{2R}$

D. $\frac{-GM}{R}$

Question Number : 52 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Consider an ideal gas confined in an isolated closed chamber. As the gas undergoes an adiabatic expansion, the average time of collision between molecules increases as V^q, where V is the volume of the gas. The value of q is:

$$\left(\gamma = \frac{C_p}{C_v}\right)$$

Options :

A. $\frac{\gamma + 1}{2}$

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

C. $\frac{3\gamma+5}{6}$

D. $\frac{3\gamma-5}{6}$

Question Number : 53 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

A particle of mass m moving in the x direction with speed $2v$ is hit by another particle of mass $2m$ moving in the y direction with speed v. If the collision is perfectly inelastic, the percentage loss in the energy during the collision is close to:

Options :

A. 56%

B. 62%

C. 44%

D. 50%

Question Number : 54 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

From a solid sphere of mass M and radius R a cube of maximum possible volume is cut. Moment of inertia of cube about an axis passing through its center and perpendicular to one of its face is:

Options :

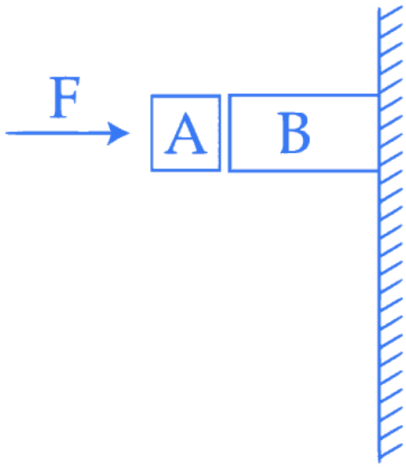
A. $\frac{4MR^2}{9\sqrt{3\pi}}$

B. $\frac{4MR^2}{3\sqrt{3\pi}}$

C. $\frac{MR^2}{32\sqrt{2\pi}}$

D. $\frac{MR^2}{16\sqrt{2\pi}}$

Question Number : 55 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical



Given in the figure are two blocks A and B of weight 20 N and 100 N, respectively. These are being pressed against a wall by a force F as shown. If the coefficient of friction between the blocks is 0.1 and between block B and the wall is 0.15, the frictional force applied by the wall on block B is :

Options :

A. $120\ N$

B. $150\ N$

C. $100\ N$

D. $80\ N$

Question Number : 56 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Distance of the center of mass of a solid uniform cone from its vertex is z_0. If the radius of its base is R and its height is h then z_0 is equal to :

Options :

A. $\frac{5h}{8}$

B. $\frac{3h^2}{8R}$

C. $\frac{h^2}{4R}$

D. $\frac{3h}{4}$

Question Number : 57 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The period of oscillation of a simple pendulum is

$$T = 2\pi\sqrt{\frac{L}{g}}$$

. Measured value of L is 20.0 cm known to 1 mm accuracy and time for 100 oscillations of the pendulum is found to be 90 s using wrist watch of 1 s resolution. The accuracy in the determination of g is:

Options :

A. 1 %

B. 5 %

C. 2 %

D. 3 %

Question Number : 58 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

A train is moving on a straight track with speed 20 ms^{-1}. It is blowing its whistle at the frequency of 1000 Hz . The percentage change in the frequency heard by a person standing near the track as the train passes him is (speed of sound

$$= 320\, ms^{-1}$$

) close to :

Options :

A. 18%

B. 24%

C. 6%

D. 12%

Question Number : 59 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Match **List -** I (Fundamental Experiment) with **List -** II (its conclusion) and select the correct option from the choices given below the list:

List - I		List - II	
A.	Franck-Hertz	(i)	Particle nature of light
B.	Photo-electric	(ii)	Discrete energy levels of atom
C.	Davison-Germer experiment	(iii)	Wave nature of electron
		(iv)	Structure of atom

Options :

A. $A-ii;\ B-i,\ C-iii$

B. $A-iv;\ B-iii,\ C-ii$

C. $A-i;\ B-iv,\ C-iii$

D. $A-ii;\ B-iv,\ C-iii$

Question Number : 60 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

A signal of 5 kHz frequency is amplitude modulated on a carrier wave of frequency 2 MHz. The frequencies of the resultant signal is/are :

Options :

A. 2005 kHz, 2000 kHz and 1995 kHz

B. 2000 kHz and 1995 kHz

C. 2 MHz only

D. 2005 kHz and 1995 kHz

Chemistry Section A

Section Number :	3
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	30
Number of Questions to be attempted :	30
Section Marks :	120
Maximum Instruction Time :	0
Sub-Section Number :	1

Question Shuffling Allowed : Yes
Is Section Default? : No

Question Number : 61 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The vapour pressure of acetone at $20^{o}C$ is 185 torr. When 1.2 g of a non-volatile substance was dissolved in 100 g of acetone at $20^{o}C$, its vapour pressure was 183 torr. The molar mass ($g\ mol^{-1}$) of the substance is:

Options :

A. 64

B. 128

C. 488

D. 32

Question Number : 62 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Which of the following compounds will exhibit geometrical isomerism?

Options :

A. 3-Phenyl-1-butene

B. 2-Phenyl-1-butene

C. 1,1-Diphenyl-1-propane

D. 1-Phenyl-2-butene

Question Number : 63 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

In Carius method of estimation of halogens, 250 mg of an organic compound gave 141 mg of AgBr. The percentage of bromine in the compound is: (at. Mass Ag = 108; Br = 80)

Options :

A. 48

B. 60

C. 36

D. 24

Question Number : 64 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The standard Gibbs energy change at 300 K for the reaction $2A \leftrightharpoons B + C$ is 2494.2 J. At a given time, the composition of the reaction mixture is [A] = 1/2, [B] = 2 and [C] = 1/2. The reaction proceeds in the: [R = 8.314 J/K/mol, e = 2.718]

Options :

A. reverse direction because $Q > K_c$

B. forward direction because $Q < K_c$

C. reverse direction because $Q < K_c$

D. forward direction because $Q > K_c$

Question Number : 65 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The following reaction is performed at 298 K

$2NO(g) + O_2(g) \leftrightharpoons 2NO_2(g)$

The standard free energy of formation of NO(g) is 86.6 kJ/mol at 298 K. What is the standard free energy of formation of $NO_2(g)$ at 298 K? ($KP = 1.6 \times 10^{12}$)

Options :

A. $86600 + R(298)\ln(1.6 \times 10^{12})$

B. $86600 - \frac{ln(1.6 \times 10^{12})}{R(298)}$

C. $0.5[2\times86{,}600 - R(298)\ln(1.6\times10^{12})]$

D. $R(298)\ln(1.6\times10^{12}) - 86600$

Question Number : 66 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The molecular formula of a commercial resin used for exchanging ions in water softening is $C_8H_7SO_3Na$ (Mol. Wt. 206). What would be the maximum uptake of Ca^{2+} ions by the resin when expressed in mole per gram resin?

Options :

A. 2/309

B. 1/412

C. 1/103

D. 1/206

Question Number : 67 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Two Faraday of electricity is passed through a solution of $CuSO_4$. The mass of copper deposited at the cathode is: (at. mass of Cu = 63.5 amu)

Options :

A. 63.5 g

B. 2 g

C. 127 g

D. 0 g

Question Number : 68 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The intermolecular interaction that is dependent on the inverse cube of distance between the molecule is:

Options :

A. ion-dipole interaction

B. London force

C. hydrogen bond

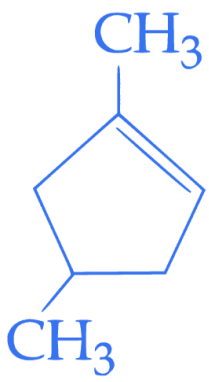
D. ion-ion interaction

Question Number : 69 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

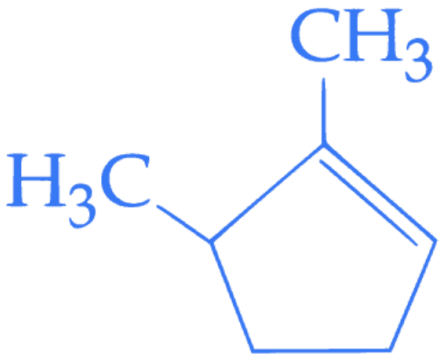
Which compound would give 5 - keto - 2 - methylhexanal upon ozonolysis?

Options :

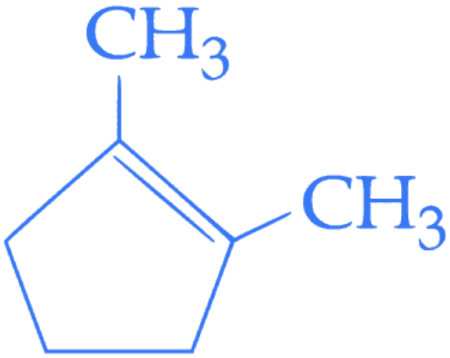
A.



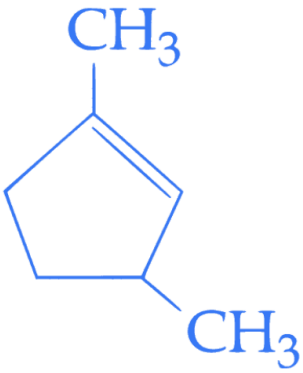
B.



C.

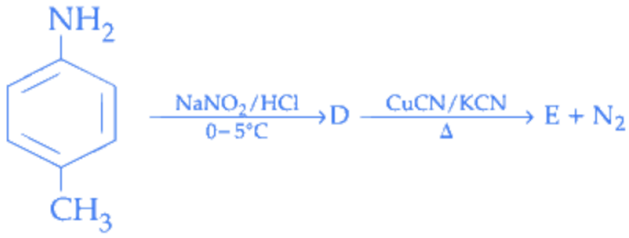


D.



Question Number : 70 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

In the reaction



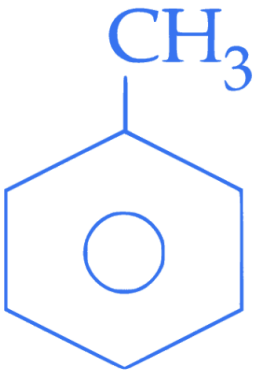
The product *E* is :

Options :

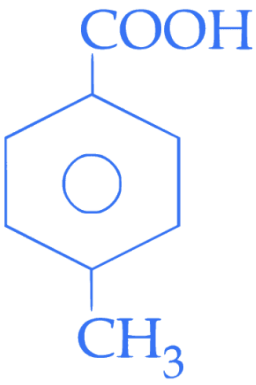
A.



B.



C.



D.



Question Number : 71 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Match the catalysts to the correct processes :

	Catalyst		**Process**
(A)	$TiCl_3$	(i)	Wacker process
(B)	$PdCl_2$	(ii)	Ziegler - Natta polymerization
(C)	$CuCl_2$	(iii)	Contact process
(D)	V_2O_5	(iv)	Deacon's process

Options :

A. $(A)-(ii),\ (B)-(iii),\ (C)-(iv),\ (D)-(i)$

B. $(A)-(iii),\ (B)-(i),\ (C)-(ii),\ (D)-(iv)$

C. $(A)-(iii),\ (B)-(ii),\ (C)-(iv),\ (D)-(i)$

D. $(A)-(ii),\ (B)-(i),\ (C)-(iv),\ (D)-(iii)$

Question Number : 72 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Which of the vitamins given below is water soluble?

Options :

A. Vitamin D

B. Vitamin E

C. Vitamin K

D. Vitamin C

Question Number : 73 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The synthesis of alkyl fluorides is best accomplished by:

Options :

A. Sandmeyer’s reaction

B. Finkelstein reaction

C. Swarts reaction

D. Free radical fluorination

Question Number : 74 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The colour of $KMnO_4$ is due to :

Options :

A. d – d transition

B. L → M charge transfer transition

C. $\sigma - \sigma^*$ transition

D. M → L charge transfer transition

Question Number : 75 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

In the following sequence of reactions:



The product C is

Options :

A. $C_6H_5CH_3$

B. $C_6H_5CH_2OH$

C. C_6H_5CHO

D. C_6H_5COOH

Question Number : 76 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The number of geometric isomers that can exist for square planar [Pt (Cl) (py) (NH_3) (NH_2OH)]+ is (py = pyridine) :

Options :

A. 3

B. 4

C. 6

D. 2

Question Number : 77 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Which of the following compounds is not colored yellow?

Options :

A. $K_3[Co(NO_2)_6]$

B. $(NH_4)_3[As(Mo_3O_{10})_4]$

C. $BaCrO_4$

D. $Zn_2[Fe(CN)_6]$

Question Number : 78 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Higher order (>3) reactions are rare due to

Options :

A. increase in entropy and activation energy as more molecules are involved

B. shifting of equilibrium towards reactants due to elastic collisions

C. loss of active species on collision

D. low probability of simultaneous collision of all the reacting species

Question Number : 79 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Assertion : Nitrogen and Oxygen are the main components in the atmosphere but these do not react to form oxides of nitrogen.

Reason : The reaction between nitrogen and oxygen requires high temperature.

Options :

A. Both assertion and reason are correct, and the reason is the correct explanation for the assertion

B. Both assertion and reason are correct, but the reason is not the correct explanation for the assertion

C. The assertion is incorrect, but the reason is correct

D. Both the assertion and reason are incorrect

Question Number : 80 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Which one has the highest boiling point?

Options :

A. Ne

B. Kr

C. Xe

D. He

Question Number : 81 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

The ionic radii (in Å) of N^{3-}, O^{2-} and F^{-} are respectively:

Options :

A. 1.36, 1.71 and 1.40

B. 1.71, 1.40 and 1.36

C. 1.71, 1.36 and 1.40

D. 1.36, 1.40 and 1.71

Question Number : 82 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Which of the following is the energy of a possible excited state of hydrogen?

Options :

A. –6.8 eV

B. –3.4 eV

C. +6.8 eV

D. +13.6 eV

Question Number : 83 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

3 g of activated charcoal was added to 50 mL of acetic acid solution (0.06N) in a flask. After an hour it was filtered and the strength of the filtrate was found to be 0.042 N. The amount of acetic acid adsorbed (per gram of charcoal) is:

Options :

A. 36 mg

B. 42 mg

C. 54 mg

D. 18 mg

Question Number : 84 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

In the context of the Hall-Heroult process for the extraction of Al, which of the following statements is **false**?

Options :

A. Al_2O_3 is mixed with CaF_2 which lowers the melting point of the mixture and brings conductivity

B. Al^{3+} is reduced at the cathode to form Al

C. Na_3AlF_6 serves as the electrolyte

D. CO and CO_2 are produced in this process

Question Number : 85 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Which of the following compounds is not an antacid?

Options :

A. Cimetidine

B. Ranitidine

C. Phenelzine

D. Aluminium hydroxide

Question Number : 86 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Which one of the following alkaline earth metal sulphates has its hydration enthalpy greater than its lattice enthalpy?

Options :

A. $BeSO_4$

B. $BaSO_4$

C. $SrSO_4$

D. $CaSO_4$

Question Number : 87 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

From the following statements regarding H_2O_2, choose the incorrect statement :

Options :

A. It decomposes on exposure to light

B. It has to be stored in plastic or wax lined glass bottles in dark

C. It has to be kept away from dust

D. It can act only as an oxidizing agent

Question Number : 88 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Which among the following is the most reactive?

Options :

A. Br_2

B. I_2

C. ICl

D. Cl_2

Question Number : 89 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Which polymer is used in the manufacture of paints and lacquers?

Options :

A. Glyptal

B. Polypropene

C. Poly vinyl chloride

D. Bakelite

Question Number : 90 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No Option Orientation : Vertical

Sodium metal crystallizes in a body centred cubic lattice with a unit cell edge of 4.29 Å . The radius of sodium atom is approximately :

Options :

A. 5.72 Å

B. 0.93 Å

C. 1.86 Å

D. 3.22 Å