Question Paper

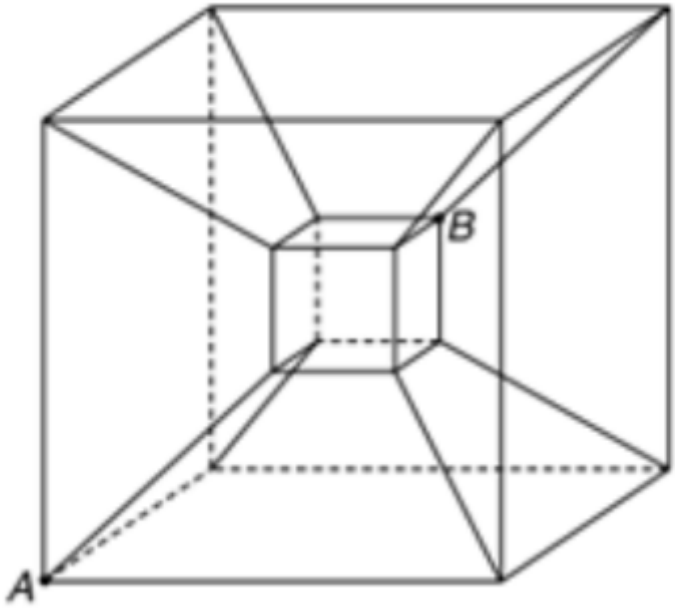
Physics Numerical (Maximum Marks: 24)

Question No. 1

Numerical Type

The answer has to be filled into the input box provided below.

Consider the double cube resistor network shown in fig. Each side of both cubes has resistance R and each of the wires joining the vertices of the two cubes also have same resistance R. Find the equivalent resistance (in Ω) between points A & B if R = 30Ω .

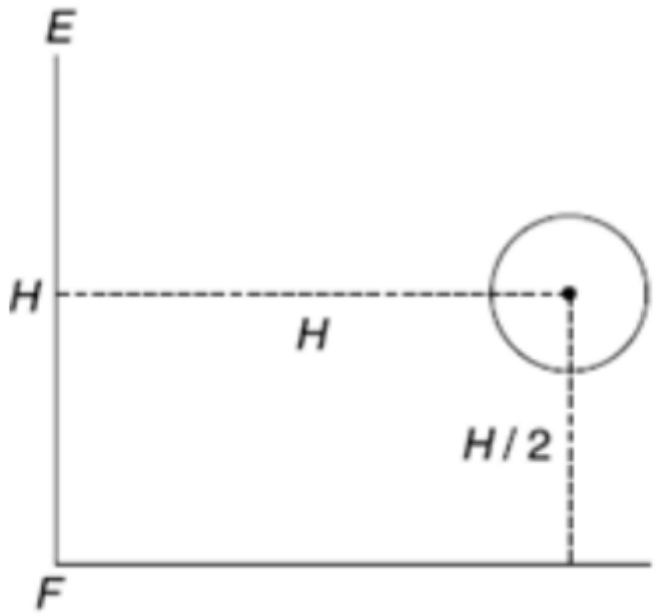


Question No. 2

Numerical Type

The answer has to be filled into the input box provided below.

In the Figure, FE is a man of height H standing on a floor. E is eye of the man and F is his foot. The distance between eye and the head is negligible. A steel ball of radius r is suspended in front of him. The distance of the ball from the man is H and height of the centre of the ball from the floor is $\frac{H}{2}$. It is given that $r << H$. The surface of the ball acts like a mirror and the man sees his image in it. The angle subtended by the image at the eye of the man is $\lambda \frac{r}{H}$. Find the value of λ .

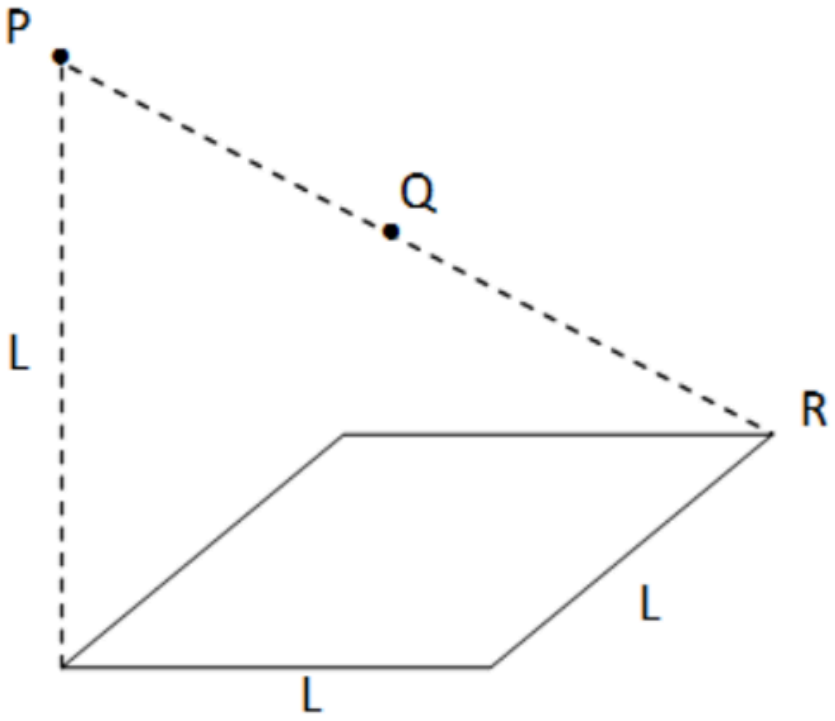


Question No. 3

Numerical Type

The answer has to be filled into the input box provided below.

A square plate of side length L absorbs all radiation incident on it. A point source of light is placed at a point P which is directly above a corner of the plate at a height L. The incident light on the plate produces a force of magnitude F_0 on the plate. The magnitude of force on the plate if the source is moved to a point Q (Q is midpoint of the line PR) is nF_0. Find the value of n.

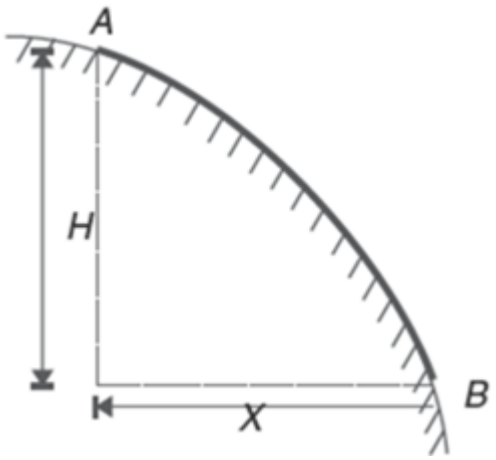


Question No. 4

Numerical Type

The answer has to be filled into the input box provided below.

A uniform rope has been placed on a sloping surface as shown in the figure. The vertical separation and horizontal separation between the end points of the rope are H(H = 4 m) and x(x = 10 m) respectively. The friction coefficient (μ) is just good enough to prevent the rope from sliding down. Find the value of μ.



Question No. 5

Numerical Type

The answer has to be filled into the input box provided below.

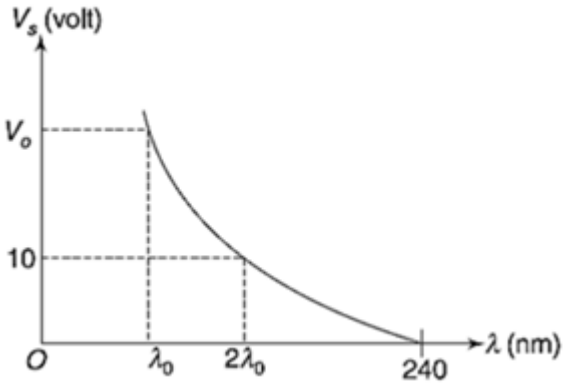
In the determination of Young's modulus by using Searle's method, a wire of length $L = 2\ m$ and diameter $d = 0.5\ mm$ is used. For a load $M = 2.5\ kg$, an extension $\ell = 0.25\ mm$ in the length of the wire is observed. Quantities d and ℓ are measured using a screw gauge and a micrometer, respectively. They have the same pitch of $0.5\ mm$. The number of divisions on their circular scale is 100. The length of wire, acceleration due to gravity and mass M are known exactly. The percentage error in measurement of the Young's modulus is ____.

Question No. 6

Numerical Type

The answer has to be filled into the input box provided below.

In a photoelectric experiment light of different wavelengths are used on a metal surface. For each wavelength the stopping potential difference is recorded. The given graph shows the variation of stopping potential difference (V_s) versus the wavelength (λ) of light used. Find the value of V_0 (in volts) shown in the graph. Given $h = 4 \times 10^{-15}\ eV_s$ and $c = 3 \times 10^8\ ms^{-1}$.



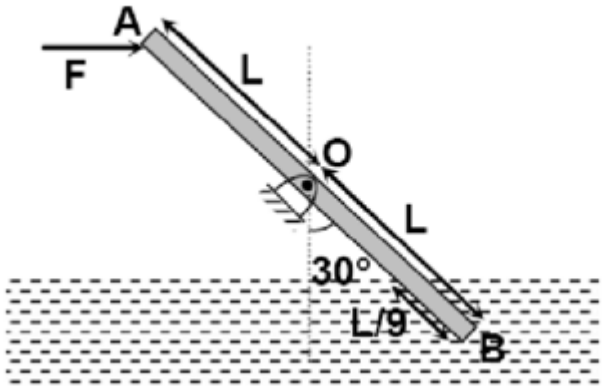
Physics Multiple Correct (Maximum Marks: 24)

Question No. 1

One or More Options Correct Type

The question has multiple options out of which ONE or MORE is/are correct.

A rod of length 2 L and cross section area A_0 is kept in a liquid of density ρ and pivoted at point O in a vertical plane. The rod makes angle 30° with the vertical. The mass density of rod is linearly increases from O on both side as given by equation $\lambda = \lambda_0(1 + \frac{x}{L})$, where λ_0 is constant and x is distance from point O on either side. Rod is held in vertical plane by applying a force at end A in horizontal direction. Then



A. Centre of mass of rod OA is at a distance $\frac{4L}{9}$ from point A.

B. Mass of rod AB is $\frac{3\lambda_0 L}{2}$.

C. Applied force at end A is $\frac{17}{162\sqrt{3}} LA_0\rho g$.

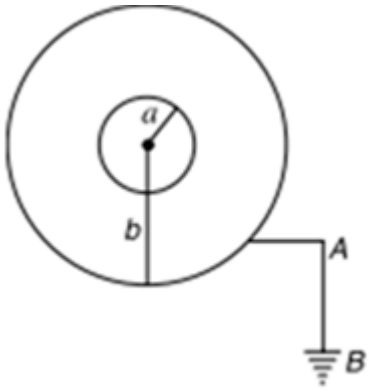
D. Buoyant force will act at the centre of mass of rod inside the liquid.

Question No. 2

One or More Options Correct Type

The question has multiple options out of which ONE or MORE is/are correct.

A β^- active radioactive source is in the form of a conducting sphere of radius a. It is surrounded by a concentric conducting shell of radius $b(> a)$. The shell is grounded. Initially β^- particles are emitted with kinetic energy ranging from E_1 to $E_2(> E_1)$. The final maximum charge on the outer sphere is



A. $\frac{4\pi\in_0 abE_2}{e(b-a)}$

B. $-\frac{4\pi\epsilon_0 abE_1}{e(b-a)}$

C. $\frac{4\pi\epsilon_0 abE_1}{e(b-a)}$

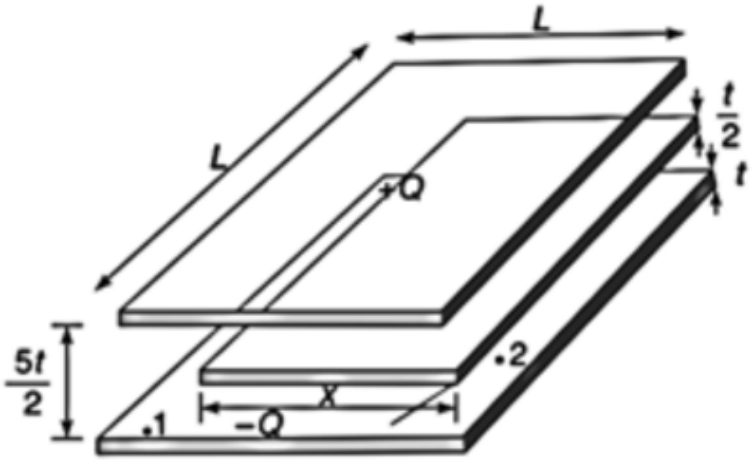
D. $-\frac{4\pi\in_0 abE_2}{e(b-a)}$

Question No. 3

One or More Options Correct Type

The question has multiple options out of which ONE or MORE is/are correct.

Two square metal plates have sides of length L and thickness t(<< L) . They are arranged parallel to each other with their inner faces at a separation of $\frac{5}{2}$ t. One of the plates is given a charge $-Q$ and the other one is given a charge $+Q$. A third rectangular metal plate of sides L and x, having thickness $\frac{t}{2}$ is inserted between the plates as shown. The third plate is equidistant from the two plates and parallel to them. Neglect edge effects choose correct options



A. The ratio of charge density on lower plate at points 1 and 2 (2 is in between the bigger and smaller plates) shown in Figure is 0.8.

B. Potential difference between the upper plate and the middle plate is $\frac{5Qt}{\epsilon_0\ L(4\ L+x)}$.

C. Electric field between the two outer plates in space where the third plate is not present (i.e., at a point above point 1.) is $\frac{4Q}{\epsilon_0\ L(4\ L+x)}$.

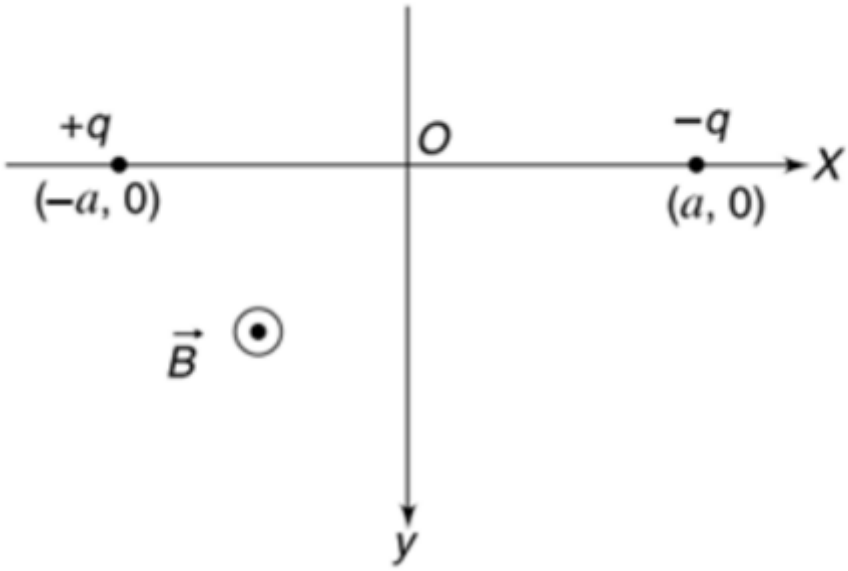
D. The capacitance of the system across two outer plates is $\frac{\epsilon_0\ L(4\ L+x)}{10t}$.

Question No. 4

One or More Options Correct Type

The question has multiple options out of which ONE or MORE is/are correct.

Two particles have equal mass m and electric charge of equal magnitude (q) and opposite sign. The particles are held at rest at co-ordinates $(-a, 0)$ and $(a, 0)$ as shown in the figure. The particles are released simultaneously. Consider only the electrostatic force between the particles and the force applied by the external magnetic field on them. At the moment when the particle is at some point whose coordinates are given as (x, y)



A. The speed of negatively charged particle is $\sqrt{\frac{kq^2}{4\,m}\left[\frac{1}{x}-\frac{1}{a}\right]}$.

B. The speed of negatively charged particle is $\sqrt{\frac{kq^2}{2\,m}\left[\frac{1}{x}-\frac{1}{a}\right]}$.

C. The y component of velocity of the negatively charged particle $\frac{qB}{2m}(a-x)$.

D. The y component of velocity of the negatively charged particle $\frac{qB}{m}(2a-x)$.

Question No. 5

One or More Options Correct Type

The question has multiple options out of which ONE or MORE is/are correct.

A monochromatic light of wavelength 500 nm is used in Young's double slit experiment (YDSE). The separation between the slits is 1 mm and distance between the screen and slits is 1 m. Intensity of one slit is four times the intensity of the other. Choose the correct statement(s) :

A. Distance of the 5^{th} minima from the central maxima on the screen is 2.25 mm

B. At $y = \frac{1}{3}\,mm$, the intensity is four times the lowest intensity

C. If a medium of refractive index $\mu = 2$ is filled between the slits and the screen the 5^{th} minima shifts towards the central maxima

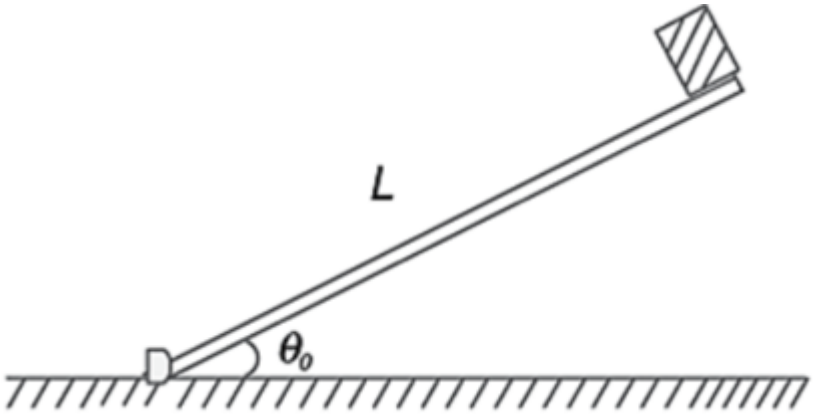
D. Distance of the 3000^{th} maxima from the central maxima is $\sqrt{3}$ m

Question No. 6

One or More Options Correct Type

The question has multiple options out of which ONE or MORE is/are correct.

A uniform stick of length L is pivoted at one end on a horizontal table. The stick is held forming an angle θ_0 with the table. A small block of mass m is placed at the other end of the stick and it remains at rest. The system is released from rest.



A. The stick will hit the table before the block if $\cos\theta_0 \geqslant \sqrt{\frac{2}{3}}$.

B. The contact force between the block and the stick immediately before the system is released if $\theta_0 = \cos^{-1}\left(\sqrt{\frac{2}{3}}\right)$ is mg.

C. The contact force between the block and the stick immediately before the system is released if $\theta_0 = \cos^{-1}\left(\sqrt{\frac{2}{3}}\right)$ is 0.

D. The contact force between the block and the stick immediately before the system is released if $\theta_0 = \cos^{-1}\left(\sqrt{\frac{2}{3}}\right)$ is $\sqrt{\frac{2}{3}}$ mg.

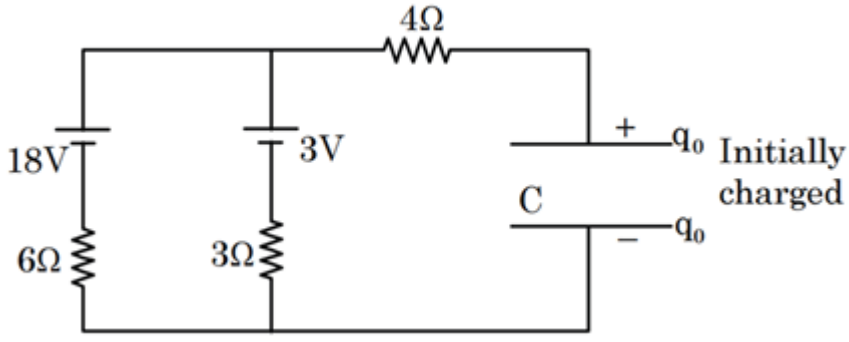
Physics Single Correct (Maximum Marks: 18)

Question No. 1

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

The circuit is completed at t = 0 , then total work done by batteries till the capacitor gets full charged. [$q_0 = 64\mu C$ and $C = 16\mu F$]



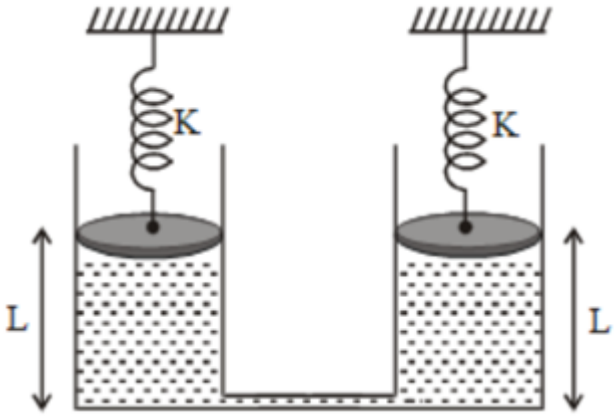
A. $1024\mu J$
B. $512\mu J$
C. $320\mu J$
D. $64\mu J$

Question No. 2

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

The system shown in figure contains mass M of liquid. The pistons are of negligible mass and are free to move without friction. The springs are ideal and have spring constant 'k' each. Find the time period of oscillatory motion of the system (neglect the volume of the connecting tube)



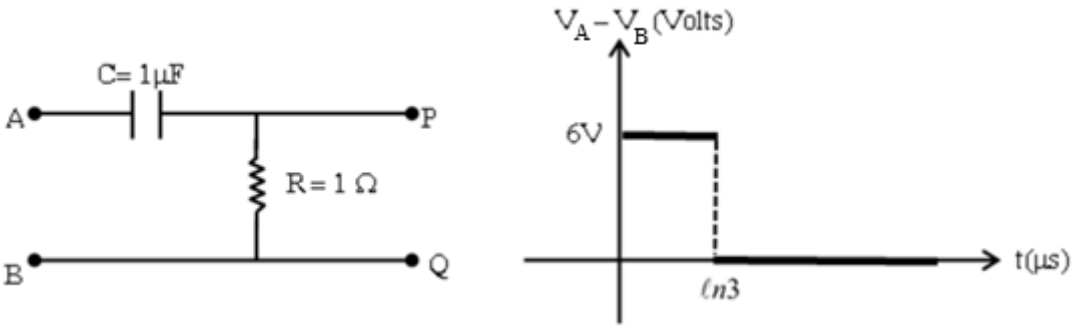
A. $2\pi[\frac{g}{2L}+\frac{k}{M}]^{-1/2}$
B. $2\pi[\frac{g}{2L}+\frac{2k}{M}]^{-1/2}$
C. $2\pi[\frac{g}{L}+\frac{k}{M}]^{-1/2}$
D. $2\pi[\frac{g}{L}+\frac{2k}{M}]^{-1/2}$

Question No. 3

Only One Option Correct Type

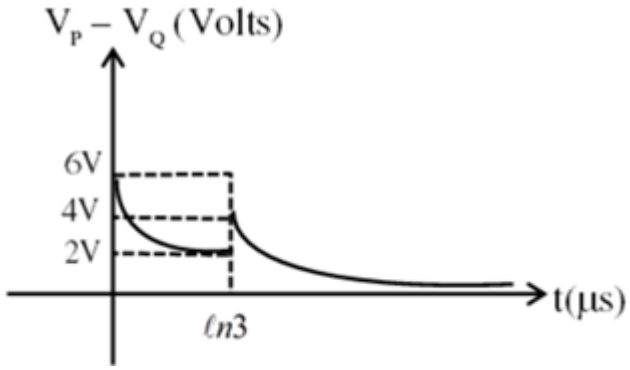
Each question has multiple options out of which ONLY ONE is correct.

The capacitor shown in figure is initially uncharged. A potential difference is applied across ends A & B as represented by the graph, the choose the correct option.



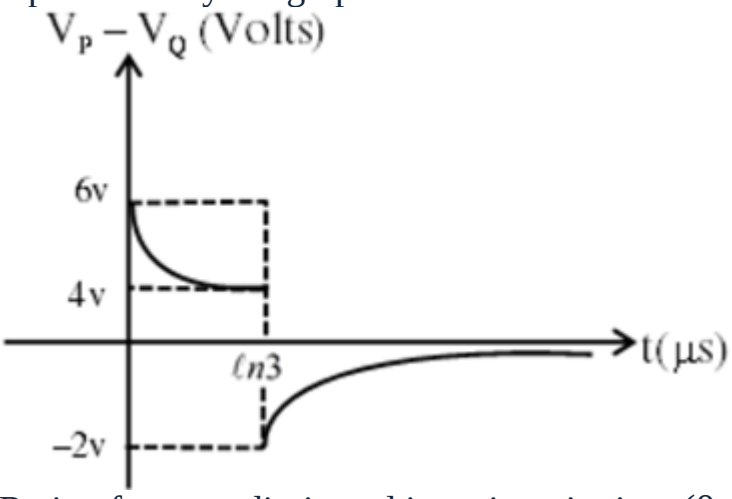
The potential difference $V_p - V_Q$ obtained across ends P & Q will be represented by the graph

A.



The potential difference V_P-V_Q obtained across ends P & Q will be represented by the graph

B.



C. Ratio of energy dissipated in resistor in time $(0 \rightarrow \ln 3)\mu s$ and time $(\ln 3 \rightarrow \infty)\mu s$ is 1 : 1

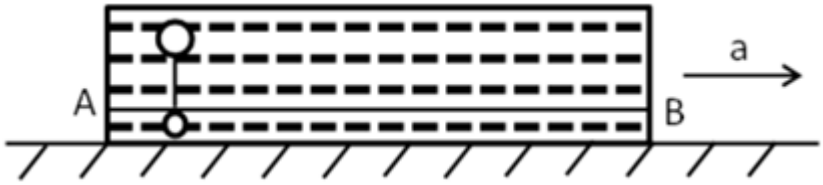
D. Ratio of energy dissipated in resistor in time $(0 \rightarrow \ln 3)\mu s$ and time $(\ln 3 \rightarrow \infty)\mu s$ is 2 : 1

Question No. 4

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

A tubular container contains a homogenous non viscous liquid. Wire AB is attached inside the tubular container. A uniform ball of density ρ is attached to wire AB by means of a cord of negligible mass and a ring. Ring is able to move without friction.



Initially system was at rest and the ball is at left end of the wire. At time $t = 0$ the tubular container is accelerated horizontally with uniform acceleration 'a' towards right. The distance travelled by container in the time ball reaches the end B of the wire is N times length of wire AB, then density of liquid is :-

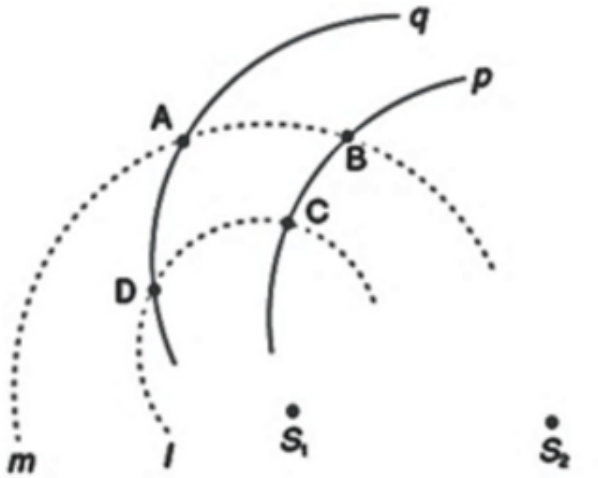
A. $\frac{1+N}{N}\rho$
B. $\left(\frac{1+N}{N}\right)\frac{g}{a}\rho$
C. $\frac{N}{N+1}\rho$
D. $\left(\frac{N}{N+1}\right)\frac{g}{a}\rho$

Question No. 5

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

In the figure shown, S_1 and S_2 are two identical point sources of sound which are coherent 180° out of phase. Taking S_1 as centre, two circular arcs ℓ and m of radii 1 m and 2 m are drawn. Taking S_2 as centres, two circular arcs p and q are drawn having radii 2 m and 4 m respectively. Out of the four intersection points A, B, C and D which point will record maximum intensity and which will record the least intensity of sound respectively? It is given that wavelength of wave produced by each source is 4.0 m.



A. Maximum at C, least at A
B. Maximum at C, least at B

C. Maximum at A, least at B
D. Maximum at D, least at B

Question No. 6

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

Electric and magnetic field are directed as $E_0\hat{i}$ and $B_0\hat{k}$, a particle of mass m and charge +q is released from position $(0, 2, 0)$ from rest. The velocity of that particle at $(x, 5, 0)$ is $(5\hat{i} + 12\hat{j})$ the value of x can be

A. $\frac{169\ m}{2qE_0}$
B. $\frac{25m}{2qE_0}$
C. $\frac{25m}{12qE_0}$
D. $\frac{144\ m}{12qE_0}$

Chemistry Numerical (Maximum Marks: 24)

Question No. 1

Numerical Type

The answer has to be filled into the input box provided below.

The self ionisation constant of pure formic acid is $10^{-6}\ M^2$ at room temperature. The density of formic acid is 1.22 g/cc . The percentage dissociation of formic acid $x \times 10^{-y}\ \%$ then $x + y$ is (where x, y are smaller whole numbers)

Question No. 2

Numerical Type

The answer has to be filled into the input box provided below.

For isothermal expansion of an ideal gas into vacuum, among the following how many are zero $\Delta E, \Delta H, \Delta T, q, P_{ext}, \Delta S_{sys}, \Delta S_{sur}, \Delta S_{total}, \Delta G_{sys}$

Question No. 3

Numerical Type

The answer has to be filled into the input box provided below.

How many of the following reagents reduce nitrobenzene into azobenzene?

$LiAlH_4$, Sn/HCl, Zn + NaOH/MeOH, $NaBH_4$, NH_4SH

Question No. 4

Numerical Type

The answer has to be filled into the input box provided below.

In an experiment a stream of dry air is passed over an aqueous solution, solvent, anhydrous $CaCl_2$ setup in one go, if mass loss in solvent is $2.5gm$ and mass gain in anhydrous $CaCl_2$ is 5 gm, then molality of this very dilute solution is

Question No. 5

Numerical Type

The answer has to be filled into the input box provided below.

How many compounds liberate NH_3 on heating from the following?

A) $(NH_4)_2SO_4$

B) $(NH_4)_2CO_3$

C) NH_4Cl

D) NH_4NO_3

E) $(NH_4)_2Cr_2O_7$

Question No. 6

Numerical Type

The answer has to be filled into the input box provided below.

How many of the following compounds are amphoteric in nature?

$PbO, PbO_2, SnO, SnO_2, Al_2O_3, ZnO, BeO, Ga_2O_3, B_2O_3.$

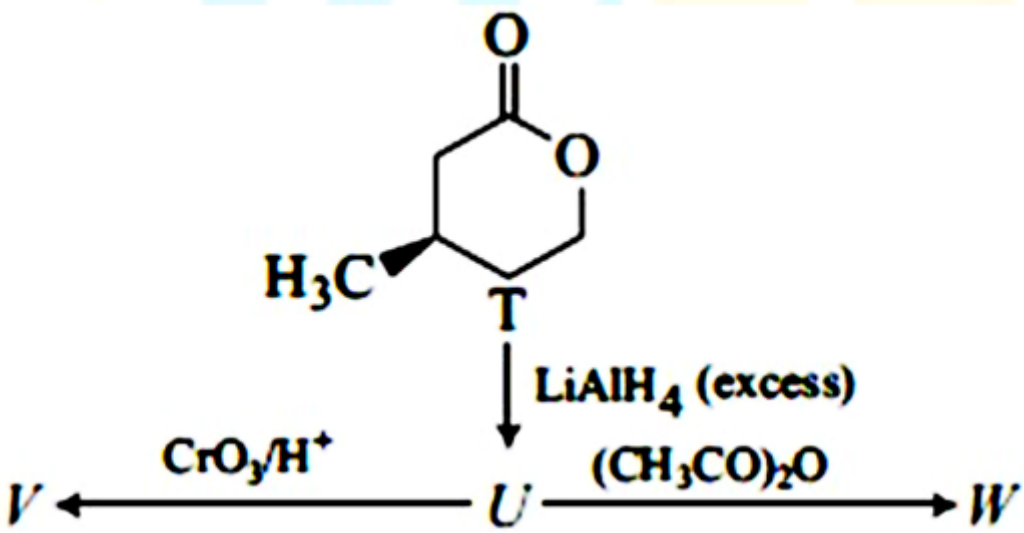
Chemistry Multiple Correct (Maximum Marks: 24)

Question No. 1

One or More Options Correct Type

The question has multiple options out of which ONE or MORE is/are correct.

With reference to the scheme given, which of the given statement(s) about T, U, V and W is/are correct?



A. T is soluble is hot aqueous NaOH
B. U is optically active
C. Molecular formula of W is $C_{10}H_{18}O_4$
D. V gives effervescence on treatment with aqueous $NaHCO_3$

Question No. 2

One or More Options Correct Type

The question has multiple options out of which ONE or MORE is/are correct.

The highest occupied MO in N_2 and O_2^+ respectively are (take x-axis as inter nuclear axis)

A. $\sigma 2px, \pi * 2py$
B. $\sigma 2py, \pi 2pz$
C. $\sigma 2px, \sigma 2px$
D. $\pi * 2py, \pi * 2pz$

Question No. 3

One or More Options Correct Type

The question has multiple options out of which ONE or MORE is/are correct.

A colorless aqueous solution contains nitrates of two metals, **X** and **Y**. When it was added to an aqueous solution of NaCl, a white precipitate was formed. This precipitate was found to be partly soluble in hot water to give a residue **P** and a solution **Q**. The residue **P** was soluble in aq. NH_3 and also in excess sodium thiosulfate. The hot solution **Q** gave a yellow precipitate with KI. The metals **X** and **Y**, respectively, can be

A. Ag and Pb
B. Ag and Cd
C. Cd and Pb

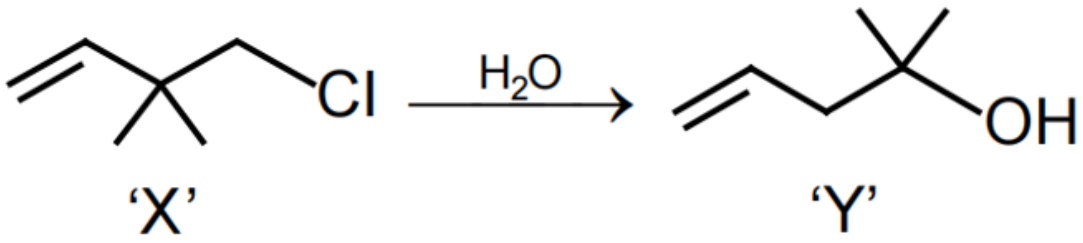
D. Cd and Zn

Question No. 4

One or More Options Correct Type

The question has multiple options out of which ONE or MORE is/are correct.

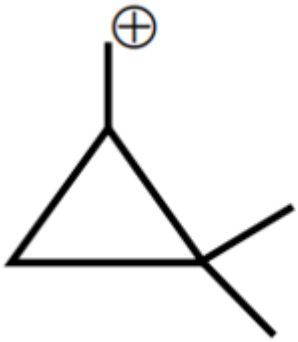
It has been observed that hydrolysis of ' X ' occurs much faster than primary chlorides and it gives mainly ' Y '



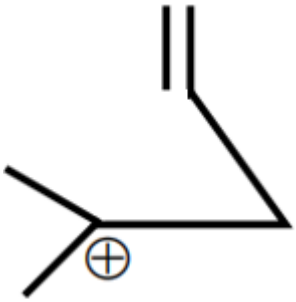
'X' 'Y'

Which of the following intermediate/s is/are involved in the above reaction?

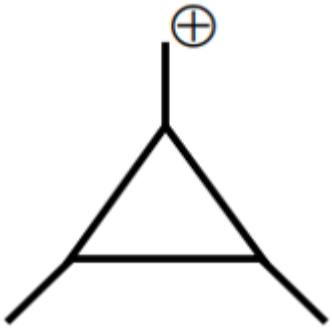
A.



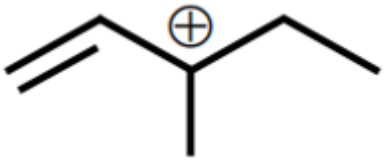
B.



C.



D.

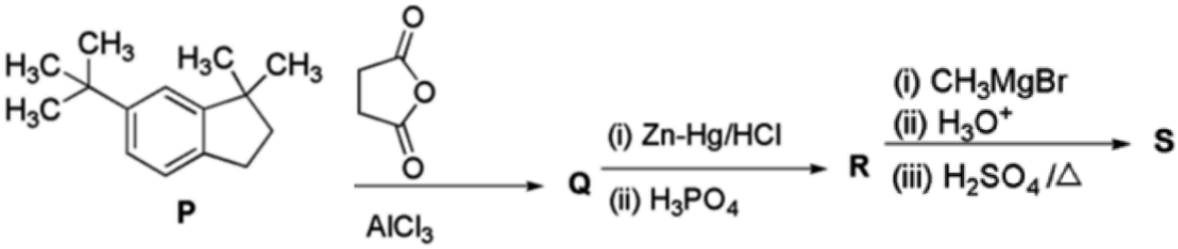


Question No. 5

One or More Options Correct Type

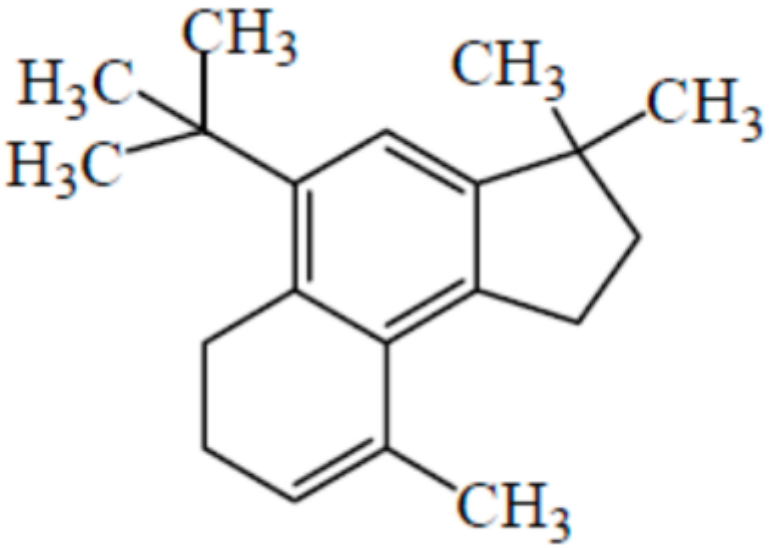
The question has multiple options out of which ONE or MORE is/are correct.

In the reaction scheme shown below **Q**, **R** and **S** are the major products.

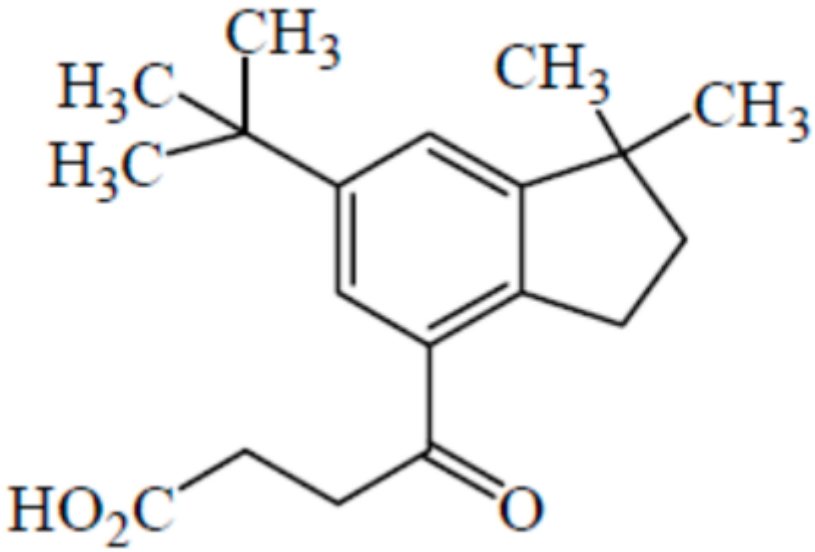


The correct structure of

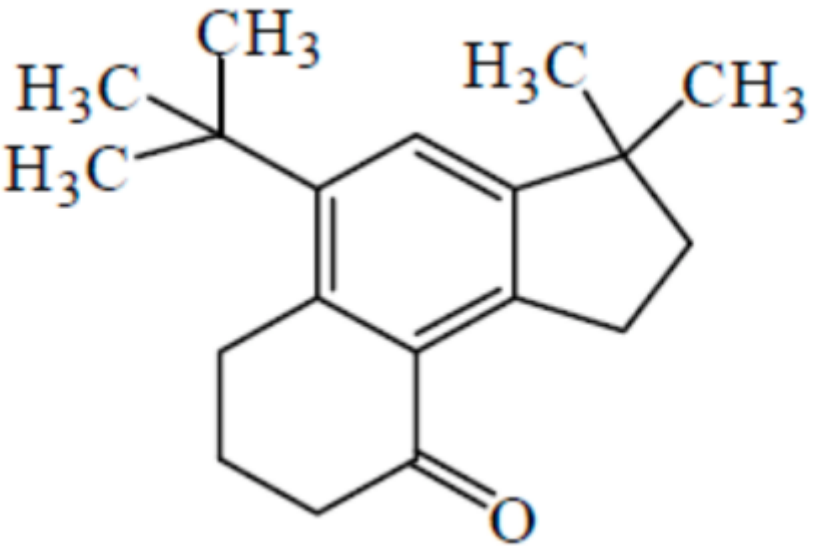
A. **S** is



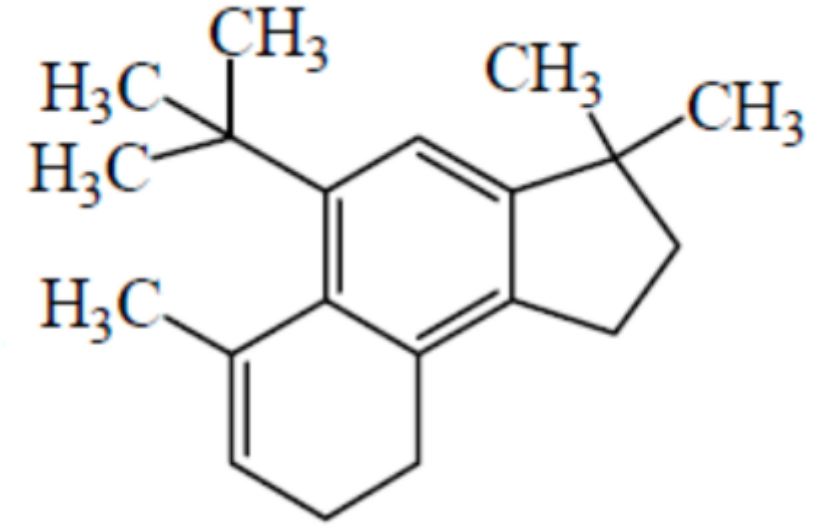
B. **Q** is



C. **R** is



D. **S** is

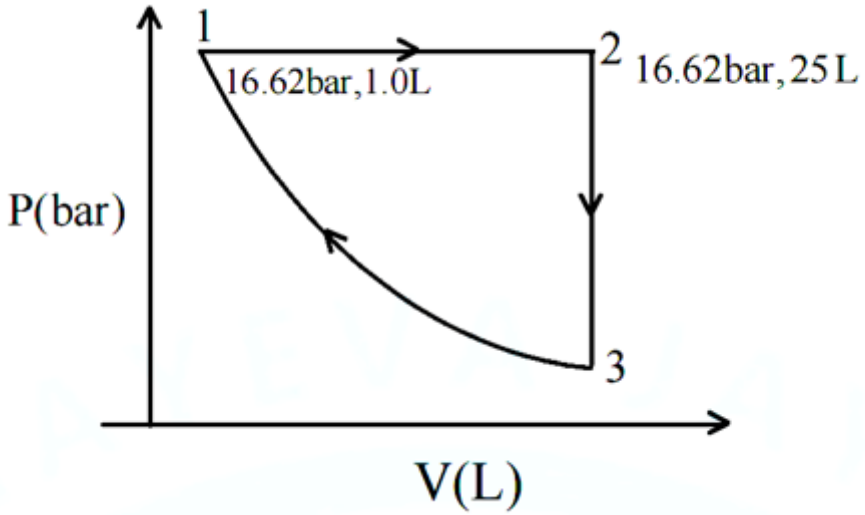


Question No. 6

One or More Options Correct Type

The question has multiple options out of which ONE or MORE is/are correct.

A system containing 2.50 mol of an ideal gas for which $C_{v,m} = 20.8\ J\ mol^{-1}\ K^{-1}$ is taken through the cycle in the following diagram in the direction indicated by the arrows. The curved path corresponds to $PV = nRT$ where $T = T_1 = T_3$.



Which of the following is(are) correct statement(s) for the given system?

(Given: $\ln 5 = 1.6, 2.5 \times 8.314 = 20.785$)

A. The temperature at $2(T_2)$ is 25 times of the temperature at $1(T_1)$.
B. The internal energy change in $(2 \rightarrow 3)$ is -99.8 kJ .
C. $\Delta H_{2\rightarrow 3} = -\Delta H_{1\rightarrow 2}$.
D. The heat exchanged in the step $(1 \rightarrow 3)$ is $+5.32$ kJ .

Chemistry Single Correct (Maximum Marks: 18)

Question No. 1

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

Dissolution of solids in water can be exothermic or endothermic process but gases dissolve in water always with the evolution of heat. Dissolution of a substance in water can be either because ion dipole interactions or by hydrogen bond formation. Pressure plays a significant role on the solubility to gases in water. Solubility of a gas in terms of mol fraction (X_B) is related to pressure (P) according to the mathematical relation $P = K_H X_B$

On the basic of above paragraph answer the following questions.

When a pinch of salt (NaCl) is added to a freshly opened bottle of cocacola or limca, a lot of effervescence occurs with evolution of a colourless gas

A. The gas evolved is O_2
B. The gas evolved is HCl

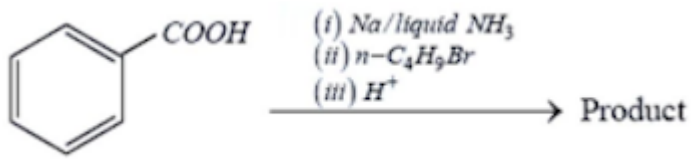
C. There is no evolution of gas only decomposition of $NaCl$ occurs
D. CO_2 is evolved due to its displacement from aerated soft drink

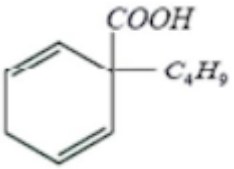
Question No. 2

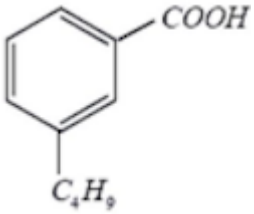
Only One Option Correct Type

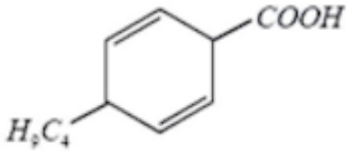
Each question has multiple options out of which ONLY ONE is correct.

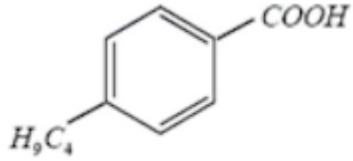
The major product formed in the following reaction is



A. 

B. 

C. 

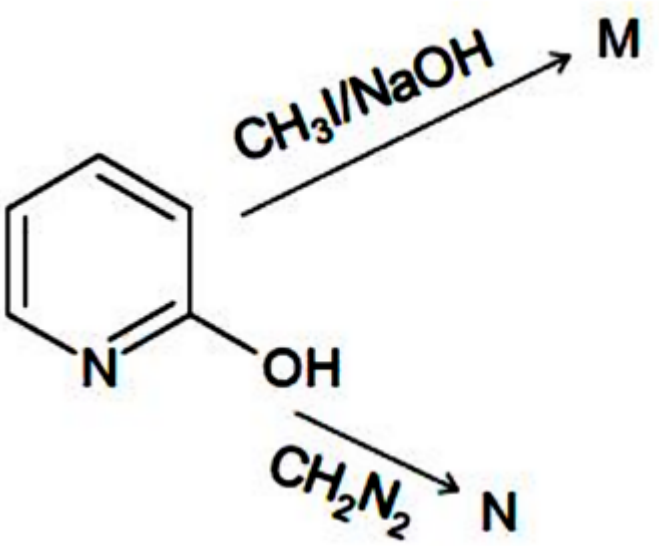
D. 

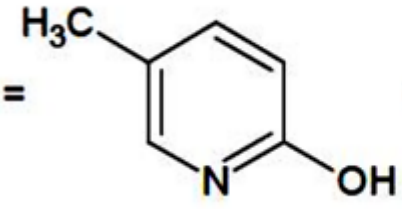
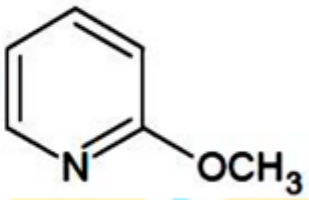
Question No. 3

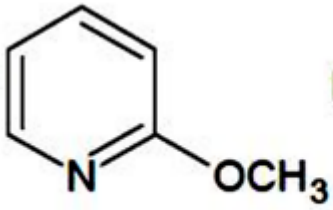
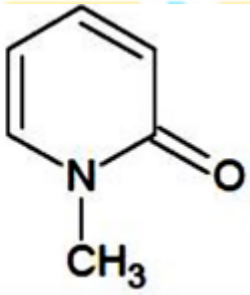
Only One Option Correct Type

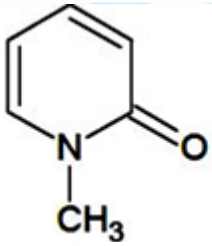
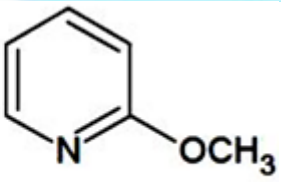
Each question has multiple options out of which ONLY ONE is correct.

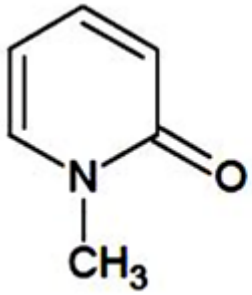
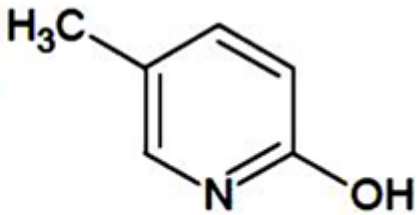
The major products M and N formed in the following reactions are:-



A. M =  N = 

B. M =  N = 

C. M =  N = 

D. M =  N = 

Question No. 4

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

An aqueous solution of X is added slowly to an aqueous solution of Y as shown in List I. The variation in conductivity of these reactions is given in List II. Match list I with list II and select the correct answer using the code given below the lists:

LIST-I		LIST-II	
P)	$(C_2H_5)_3N + CH_3COOH$ $X \quad Y$	1)	Conductivity decreases and then increases
Q)	$KI(0.1M) + AgNO_3(0.01M)$ $X \quad Y$	2)	Conductivity decreases and then does not change much
R)	$CH_3COOH + KOH$ $X \quad Y$	3)	Conductivity increases and then does not change much
S)	$NaOH + HI$ $X \quad Y$	4)	Conductivity does not change much and then increases

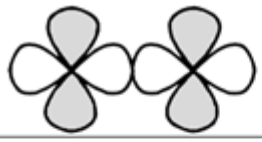
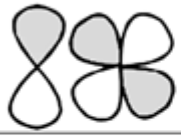
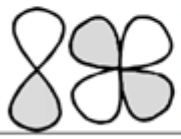
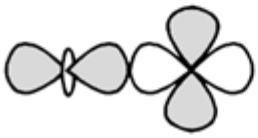
A. P-3, Q-4, R-2, S-1
B. P-4, Q-3, R-2, S-1
C. P-2, Q-3, R-4, S-1
D. P-1, Q-4, R-3, S-2

Question No. 5

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

Match the orbital overlap figures shown in List-I with the description given in List-II and select the correct answer using the code given below the lists

Column-I		Column-II	
P)		1)	$p-d\pi$ anti bonding
Q)		2)	$d-d\sigma$ bonding
R)		3)	$p-d\pi$ bonding
S)		4)	$d-d\sigma$ antibonding

A. P-2, Q-1, R-3, S-4
B. P-4, Q-3, R-1, S-2

C. P-2, Q-3, R-1, S-4
D. P-4, Q-1, R-3, S-2

Question No. 6

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

Consider the molecules in Column I and match them with their stereo chemical properties from Column II.

Column-I		Column-II	
A)	$CH_3-CH=CH-\underset{\displaystyle OH}{\overset{\displaystyle |}{C}}H-CH=CH-CH_3$	P)	Have only three stereoisomers
B)	$CH_3-\underset{\displaystyle OH}{\overset{\displaystyle |}{C}}H-\underset{\displaystyle OH}{\overset{\displaystyle |}{C}}H-CH_3$	Q)	Have four stereoisomers
C)	$CH_3-CH_2-\underset{\displaystyle OH}{\overset{\displaystyle |}{C}}H-\underset{\displaystyle OH}{\overset{\displaystyle |}{C}}H-CH_3$	R)	Have only two optically active isomers.
D)	$CH_3-\underset{\displaystyle OH}{\overset{\displaystyle |}{C}}H-CH=CH-Cl$	S)	Have more than two pairs of diastereomers.

A. A-QRS; B-PR; C-QS; D-QS
B. A-P; B-P; C-R; D-S
C. A-PQ; B-QS; C-R; D-Q
D. A-PQR; B-RS; C-QR; D-PQ

Mathematics Numerical (Maximum Marks: 24)

Question No. 1

Numerical Type

The answer has to be filled into the input box provided below.

Let $p(x) = x^5 + x^2 + 1$ have roots x_1, x_2, x_3, x_4 and $x_5, g(x) = x^2 - 2$, then the value of $g(x_1)g(x_2)g(x_3)g(x_4)g(x_5) - 30g(x_1x_2x_3x_4x_5)$, is

Question No. 2

Numerical Type

The answer has to be filled into the input box provided below.

Two sides of a triangle are in the ratio $3:5$ and the third side is 16 . If Δ is the largest possible area of the triangle, then $\frac{\Delta}{20} = \ldots\ldots$.

Question No. 3

Numerical Type

The answer has to be filled into the input box provided below.

$\lim_{x\to\infty} \frac{d}{dx}\left(\frac{8x^2+bx+c}{4x+f}\right) = 2m,$ then $\lim_{x\to m^+} 2^{-2^{\frac{1}{(1-x)}}} =$

Question No. 4

Numerical Type

The answer has to be filled into the input box provided below.

If $I_1 = \int_0^1 (1-(1-x^3)^{\sqrt{2}})^{\sqrt{3}} x^2 dx$ and

$I_2 = \int_0^1 (1-(1-x^3)^{\sqrt{2}})^{\sqrt{3}+1} x^2 dx$, then $\frac{\frac{I_1}{I_2} - \frac{\sqrt{3}-1}{2\sqrt{2}} + 0.2}{10}$ is equal to

Question No. 5

Numerical Type

The answer has to be filled into the input box provided below.

Let P be a point in the first octant, whose image Q in the plane $x + y = 3$ (that is, the line segment PQ is perpendicular to the plane $x + y = 3$ and the mid-point of PQ lies in the plane $x + y = 3$) lies on the z-axis. Let the distance of P from the x-axis be 5 . If R is the image of P in the xy-plane, then the length of PR is

Question No. 6

Numerical Type

The answer has to be filled into the input box provided below.

A straight line cuts the x-axis at point $A(1, 0)$, and y-axis at point B, such that $\angle OAB = \alpha(\alpha > \frac{\pi}{4})$ (O is origin). C is middle point of AB and B' is a mirror image of point B with respect to line OC and C' is a mirror image of point C with respect to line BB' , then the ratio of the areas of triangles ABB' and $BB'C'$ is equal to

Mathematics Multiple Correct (Maximum Marks: 24)

Question No. 1

One or More Options Correct Type

The question has multiple options out of which ONE or MORE is/are correct.

If α, β, γ are roots of $x^3 + 2x^2 - 3x + 1 = 0$, then value of $\frac{\alpha\beta}{\alpha+\beta} + \frac{\alpha\gamma}{\alpha+\gamma} + \frac{\beta\gamma}{\beta+\gamma}$ is less than

A. 2
B. 3
C. 4
D. 5

Question No. 2

One or More Options Correct Type

The question has multiple options out of which ONE or MORE is/are correct.

If H_n denotes the number of ways in which n horses participating in a race can reach the finishing line, when one or more horses can reach the finishing line at the same time, then

A. $H_2 = 3$
B. $H_3 = 13$
C. $H_4 = 75$
D. $H_3 = 10$

Question No. 3

One or More Options Correct Type

The question has multiple options out of which ONE or MORE is/are correct.

If $\lim_{n\to\infty} \left(\frac{1}{1^2} + \frac{1}{2^2} + \ldots\ldots + \frac{1}{n^2}\right) = \frac{\pi^2}{6}$ and

$S = \lim_{n\to\infty} \left(\frac{1}{1^3\cdot 2^3} + \frac{1}{2^3\cdot 3^3} + \frac{1}{3^3\cdot 4^3} + \ldots\ldots + \frac{1}{n^3\cdot(n+1)^3}\right)$, then $S + \pi^2$ is equal to

A. a non-integral number
B. a rational number
C. a transcendental number
D. an integer

Question No. 4

One or More Options Correct Type

The question has multiple options out of which ONE or MORE is/are correct.

A curve of the differential equation $(x^2 + xy + 6x + 3y + 9)\frac{dy}{dx} - y^2 = 0$ passes through the point $(1, 1)$ then the solution curve:

A. Intersects $y = x + 3$ exactly at one point
B. Intersects $y = x + 3$ exactly at two points

C. Intersect $y = (x + 3)^2$

D. Does not intersect $y = (x + 3)^2$

Question No. 5

One or More Options Correct Type

The question has multiple options out of which ONE or MORE is/are correct.

Vertices A, B and C of a tetrahedron $ABCD$ are $(1, 1, 1), (1, 0, 0), (3, 0, 0)$ respectively. The altitude from vertex D to the opposite face ABC meets the median line through A of the $\triangle ABC$ at a point E. If the length of side AD is 4 and volume of the tetrahedron is $\frac{2\sqrt{2}}{3}$, then the correct statements is/are

A. the altitude from vertex D is 2

B. there is exactly one position for the point E

C. there can be two possible positions for the point E

D. vector $\hat{j} - \hat{k}$ is normal to the plane ABC

Question No. 6

One or More Options Correct Type

The question has multiple options out of which ONE or MORE is/are correct.

Chord of parabola $y^2 = 4ax$ joining $A(at_1^2, 2at_1)$ and $B(at_2^2, 2at t_2)$ is normal at A. If AB is of minimum possible length for a given "a", then

A. $t_1^2 = 2$

B. $t_1^2 = 8$

C. $t_2^2 = 8$

D. $AB = 6\sqrt{3}a$

Mathematics Single Correct (Maximum Marks: 18)

Question No. 1

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

A is a non-singular matrix of order $n \times n$ such that $3ABA^{-1} + A = 2A^{-1}BA$ then

A. A \& B both are identity matrices

B. $|A + B| = 0$

C. $ABA^{-1} - A^{-1}BA$ is not a singular matrix

D. $A + B$ is singular matrix

Question No. 2

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

Let A be the area between co-ordinate axis, $y^2 = x - 1, x^2 = y - 1$ and the line which makes the shortest distance between two parabolas and A' be the area between $x = 0, x^2 = y - 1, x = y$ and the shortest distance between $y^2 = x - 1$ and $x^2 = y - 1$, then

A. $A = A'$

B. $A = (A')^{1/2}$

C. $A = 2A'$

D. can't say anything

Question No. 3

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

Coordinates of the vertices B and C of a triangle ABC are $(2, 0)$ and $(8, 0)$ respectively. The vertex A is varying in such a way that $4 \tan \frac{B}{2} \tan \frac{C}{2} = 1$ then locus of A is $\frac{(x-5)^2}{25} + \frac{y^2}{k^2} = 1$, then k is

A. 1

B. 2

C. 3

D. 4

Question No. 4

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

Let a three-dimensional vector $\vec{V}$ satisfy the condition, $2\vec{V} + \vec{V} \times (\hat{i} + 2\hat{j}) = 2\hat{i} + \hat{k}$. If $3|\vec{V}| = \sqrt{m}$. Then the value of m is.

A. 4

B. 5

C. 6

D. 7

Question No. 5

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

Number of complex numbers z such that $|z| = 1$ and $\left|\frac{z}{\bar{z}} + \frac{\bar{z}}{z}\right| = 1$ is

A. 0
B. 2
C. 4
D. 8

Question No. 6

Only One Option Correct Type

Each question has multiple options out of which ONLY ONE is correct.

The area bounded by the curve $f(x) = \| \tan x + \cot x| - |\tan x - \cot x\|$ between the lines $x = 0, x = \frac{\pi}{2}$ and the x-axis, is:

A. $\ln \sqrt{2}$
B. $3 \ln 2$
C. $\ln 4$
D. $\sqrt{2} \ln 2$