Question Paper

Physics Multiple Correct (Maximum Marks: 32)

Question No. 1

One or More Options Correct Type

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

$50gm$ ice at $-10^{\circ}C$ is mixed with $20gm$ steam at $100^{\circ}C$. When the mixture finally reaches its steady state inside a calorimeter of water equivalent $1.5gm$ then : [Assume calorimeter was initially at $0^{\circ}C$, Take latent heat of vaporization of water = $540cal/gm$, Latent heat of fusion of water = $80cal/gm$, specific heat capacity of water = $1cal/gm\ ^{\circ}C$, specific heat capacity of ice = $0.5cal/\ gm^{\circ}C$]

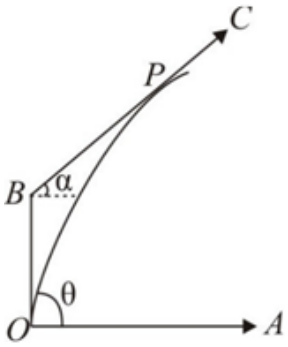
A. Mass of water remaining is : $67.4gm$
B. Mass of water remaining is : $67.87gm$
C. Mass of steam remaining is : $2.6gm$
D. Mass of steam remaining is : $2.13gm$

Question No. 2

One or More Options Correct Type

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

A particle is projected from a point O in a horizontal surface OA with speed v and angle of projection θ. It just grazes the plane BC which make an angle α with the horizontal as shown in figure. The time taken by the projectile to reach P from the instant of projection is:



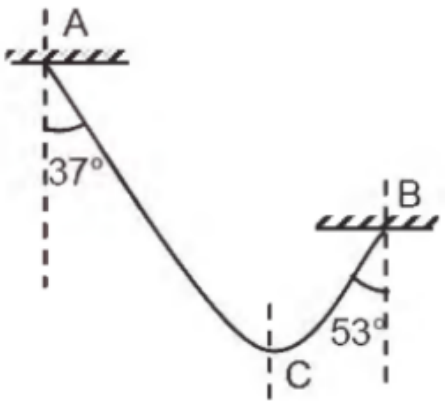
A. $\frac{2u\sin\theta}{g\cos\alpha}$
B. $\frac{u\sin\theta}{g\cos\alpha}$
C. $\frac{u\sin(\theta-\alpha)}{g\cos\alpha}$
D. $\frac{u\cos(\alpha-\theta)}{g\cos\alpha}$

Question No. 3

One or More Options Correct Type

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

A uniform massive string of mass m, length ℓ is fixed between two rigid supports. Angles made by the tangents on the string at points of suspension are shown in the figure. The point C is the lower most point of the string. Then choose the correct option(s).



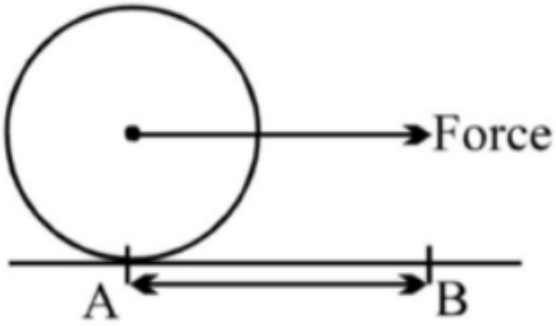
A. Length of string left of the point C is $\frac{16\ell}{25}$
B. Tension in the string at point C is $\frac{12mg}{5}$
C. Tension in the string at Point A is $\frac{4mg}{5}$.
D. Tension in the string at point B is $\frac{3mg}{5}$

Question No. 4

One or More Options Correct Type

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

A disc of circumference s is at rest at a point A on a horizontal surface when a constant horizontal force begins to act on its centre. Between A and B there is sufficient friction to prevent slipping, and the surface is smooth to the right of B. AB = s . The disc moves from A to B in time T. To the right of B,



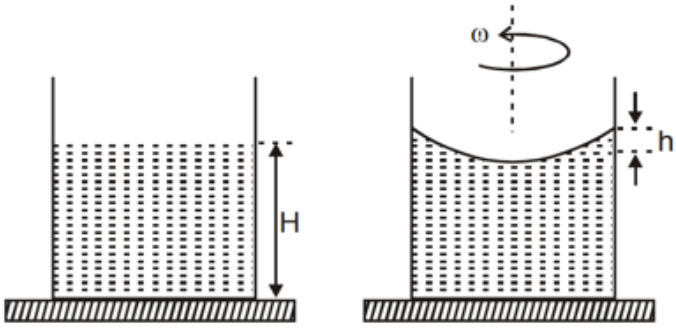
the angular acceleration of the disc will disappear, linear acceleration will remain
A. unchanged
B. linear acceleration of the disc will increase
C. the disc will make one rotation in time T/2
D. the disc will cover a distance greater than s in further time T.

Question No. 5

One or More Options Correct Type

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

A beaker of radius r is filled with water (refractive index $\frac{4}{3}$) up to a height H as shown in the figure on the left. The beaker is kept on a horizontal table rotating with angular speed ω. This makes the water surface curved so that the difference in the height of water level at the center and at the circumference of the beaker is h(h << H, h << r) , as shown in the figure on the right. Take this surface to be approximately spherical with a radius of curvature R. Which of the following is/are correct ? (g is the acceleration due to gravity)



A. $R = \frac{h^2+r^2}{2h}$

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

C. Apparent depth of the bottom of the beaker is close to $\frac{3H}{2}\left(1+\frac{\omega^2 H}{2g}\right)^{-1}$

D. Apparent depth of the bottom of the beaker is close to $\frac{3H}{4}\left(1+\frac{\omega^2 H}{4g}\right)^{-1}$

Question No. 6

One or More Options Correct Type

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

An alpha particle and a deuteron, after being accelerated through the same potential difference, enter a uniform magnetic field whose direction is perpendicular to their velocities. If r_α and r_d are the radii of the circular paths of the alpha particle and the deuteron respectively and v_α and v_d are their respective frequency of revolution, then:

A. $r_\alpha = 2r_d$

B. $r_\alpha = r_d$

C. $v_\alpha = \frac{v_d}{2}$

D. $v_\alpha = v_d$

Question No. 7

One or More Options Correct Type

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

The number of radioactive nuclei of a radioactive substance is x and its radioactivity is y. Half-life of radioactive substance is T. Then

A. $\frac{x}{y}$ is constant throughout

B. $\frac{x}{y} > T$

C. Value of xy gets halved every one half-life

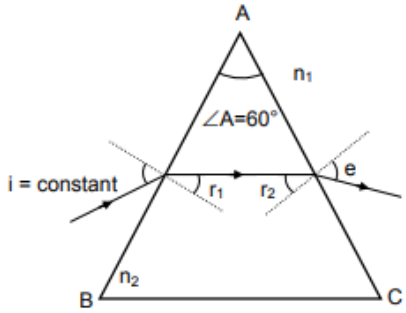
D. value of xy gets one fourth after one half-life

Question No. 8

One or More Options Correct Type

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

A prism of prism angle $(A = 60^\circ)$ and refractive index n_2 is placed in a liquid of refractive index n_1. A light ray is incident on face AB at constant angle of incidence i and it emerges at surface AC at angle of emergent e. Some how n_1 is increasing at rate N_1 and n_2 is increasing at rate N_2. Choose the correct option(s)



A. If $\frac{N_1}{N_2} > \frac{n_1}{n_2}$ then e is increasing

B. If $\frac{N_1}{N_2} < \frac{n_1}{n_2}$ then e is increasing

C. If $\frac{N_1}{N_2} > \frac{n_1}{n_2}$ then e is decreasing

D. If $\frac{N_1}{N_2} = \frac{n_1}{n_2}$ then e is decreasing

Physics Numerical (Maximum Marks: 24)

Question No. 1

Numerical Type

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

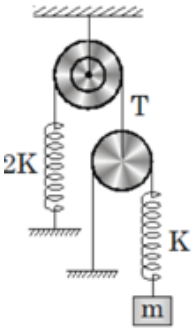
A nonconducting disc of radius R and uniform positive surface charge density σ is placed on the ground with its axis vertical. A particle of specific charge $\frac{q}{m} = \frac{4\epsilon_0 g}{\sigma}$ is dropped along the axis of the disc from a height h. The value of h if the particle just reaches the disc is $(2\sqrt{\frac{R}{3}})$ m. Determine the value of m.

Question No. 2

Numerical Type

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

If the block shown in figure is displaced slightly and released, find the time period of oscillations of the block is found to be $2\pi\sqrt{\frac{Pm}{K}}$. Find P.

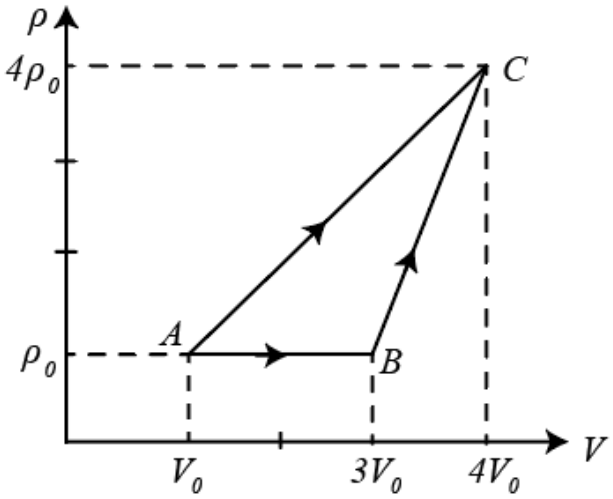


Question No. 3

Numerical Type

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

A certain quantity of ideal gas takes up 56 J of heat in the process AB and 360 J in the process AC. What is the number of degree of freedom of the gas?



Question No. 4

Numerical Type

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

A vertical capillary tube with inside radius 0.25 mm is submerged into water so that the length of its part protruding over the water surface is equal to 25 mm. Surface tension of water is 73×10^{-3} N/m and angle of contact is zero degree for glass and water, acceleration due to gravity is 9.8 m/s^2. Then value of 10R approximately (in mm) is (where R is radius of meniscus and h is height of water in capillary tube)

Question No. 5

Numerical Type

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

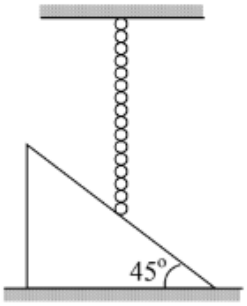
A transparent lift A is going upwards with velocity $20\ \text{ms}^{-1}$ and retarding at the rate of $8\ \text{ms}^{-2}$. Second transparent lift B is located in front of it and is going down at $10\ \text{ms}^{-1}$ with retardation of $2\ \text{ms}^{-2}$. At the same instant a bolt from the ceiling of lift A drops inside lift A. If height of car of lift A is $16\ \text{m}$ then find the distance travelled by bolt as observed by a person in lift B till the time it collides with floor of lift A.

Question No. 6

Numerical Type

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

A thin flexible uniform chain of mass m and length ℓ is suspended so that its lower end just touches a smooth inelastic plane inclined at 45°. When it is released,



Question:

The total impulse on the plane while the chain falls is $m(gL)^{\frac{1}{K}}$, find integral value of K.

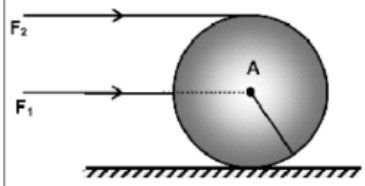
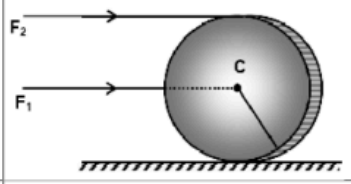
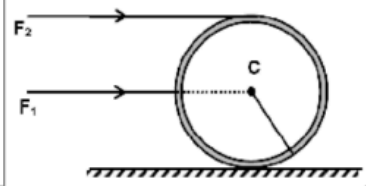
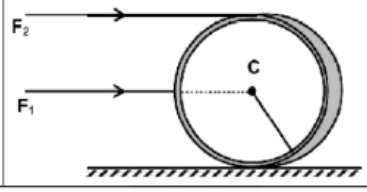
Physics Paragraph Type (Maximum Marks: 12)

Question No. 1

Only One Option Correct Type

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

A sphere, a cylinder, a spherical shell and a cylindrical shell are kept on a horizontal smooth surface. Two forces F_1 and F_2 are acting on each object. F_1 passes through centre of mass and F_2 acts on the top most point. All objects starts from rest on a smooth horizontal surface.

	Column-I		Column-II		Column-III
(I)	Uniform solid sphere of mass m, radius R 	(i)	$F_1 = F_2 = F$	(P)	Object will roll without sliding
(II)	Uniform solid cylinder of mass m, radius R 	(ii)	$F_2 = 2F_1 = 2F$	(Q)	Object will roll on the horizontal surface with $a_{cm} < R\alpha$
(III)	Uniform thin spherical shell of mass m, radius R 	(iii)	$F_1 = 0, F_2 = F$	(R)	Object will roll on the horizontal surface with $2R\alpha > a_{cm} > R\alpha$
(IV)	Uniform thin cylinder shell of mass m, radius R 	(iv)	$F_1 = \frac{3F_2}{2} = \frac{3F}{2}$	(S)	Object will roll on the horizontal surface with $a_{cm} \geq 2R\alpha$

Mark the correct statement.

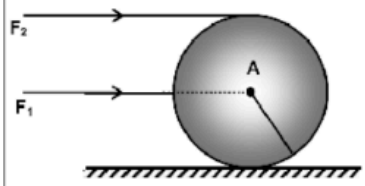
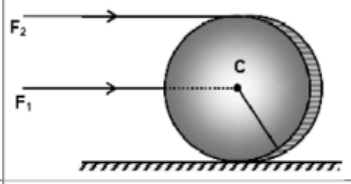
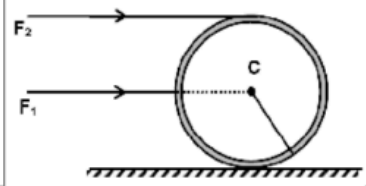
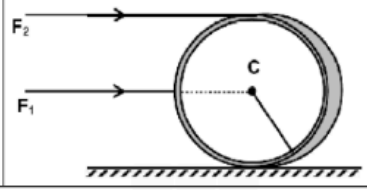
A. (I) (i) (P)
B. (II) (ii) (Q)
C. (III) (ii) (R)
D. (IV) (iii) (S)

Question No. 2

Only One Option Correct Type

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

A sphere, a cylinder, a spherical shell and a cylindrical shell are kept on a horizontal smooth surface. Two forces F_1 and F_2 are acting on each object. F_1 passes through centre of mass and F_2 acts on the top most point. All objects starts from rest on a smooth horizontal surface.

	Column-I		Column-II		Column-III
(I)	Uniform solid sphere of mass m, radius R 	(i)	$F_1 = F_2 = F$	(P)	Object will roll without sliding
(II)	Uniform solid cylinder of mass m, radius R 	(ii)	$F_2 = 2F_1 = 2F$	(Q)	Object will roll on the horizontal surface with $a_{cm} < R\alpha$
(III)	Uniform thin spherical shell of mass m, radius R 	(iii)	$F_1 = 0, F_2 = F$	(R)	Object will roll on the horizontal surface with $2R\alpha > a_{cm} > R\alpha$
(IV)	Uniform thin cylinder shell of mass m, radius R 	(iv)	$F_1 = \frac{3F_2}{2} = \frac{3F}{2}$	(S)	Object will roll on the horizontal surface with $a_{cm} \geq 2R\alpha$

Mark the incorrect statement.

A. (I) (ii) (Q)
B. (II) (i) (P)
C. (III) (iv) (R)
D. (IV) (iii) (S)

Question No. 3

Only One Option Correct Type

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

Paragraph:

A string of length 'L' is tied between two rigid walls. The string is sustaining a standing wave and the tension in string is T. List-I gives the equation of standing wave and list-II gives different physical quantities for the standing waves in this string.

	List-I		List-II
(I)	$y = a\sin\left(\frac{\pi x}{L}\right)\cos\omega t$	(P)	Zero
(II)	$y = a\sin\left(\frac{\pi x}{L}\right)\sin\omega t$	(Q)	$\frac{a}{2}$
(III)	$y = a\sin\left(\frac{2\pi x}{L}\right)\sin\omega t$	(R)	$\frac{\pi^2 T a^2}{8L}$
(IV)	$y = a\sin\left(\frac{2\pi x}{L}\right)\cos\omega t$	(S)	a
		(T)	$\frac{L}{4}$
		(U)	$\frac{\pi^2 T a^2}{4L}$

Question:

The kinetic energy of the entire string at $t = 0$ is matched correctly in the following option.

A. I → R
B. I → U
C. II → U
D. II → P

Question No. 4

Only One Option Correct Type

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

Paragraph:

A string of length ' L ' is tied between two rigid walls. The string is sustaining a standing wave and the tension in string is T. List-I gives the equation of standing wave and list-II gives different physical quantities for the standing waves in this string.

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(III)	$y = a\sin\left(\frac{2\pi x}{L}\right)\sin\omega t$	(R)	$\frac{\pi^2 T a^2}{8L}$
(IV)	$y = a\sin\left(\frac{2\pi x}{L}\right)\cos\omega t$	(S)	a
		(T)	$\frac{L}{4}$
		(U)	$\frac{\pi^2 T a^2}{4L}$

Question:

The transverse displacement of the particle at a distance of $\frac{L}{12}$ from left end at time $t = 0$ is matched correctly in.

A. I $\rightarrow$ S
B. IV $\rightarrow$ Q
C. III $\rightarrow$ Q
D. IV $\rightarrow$ S

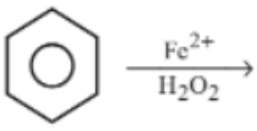
Chemistry Multiple Correct (Maximum Marks: 32)

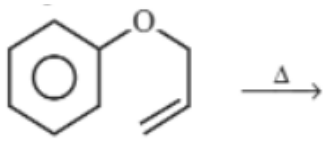
Question No. 1

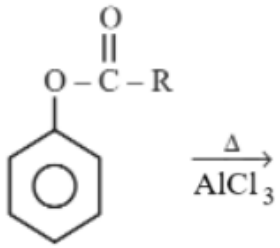
One or More Options Correct Type

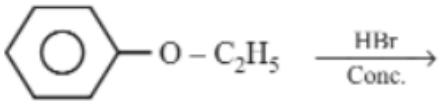
The question has multiple options out of which ONE or MORE is/are correct.

Which of the following will produce phenol or substituted phenol?

A. 

B. 

C. 

D. 

Question No. 2

One or More Options Correct Type

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

$$Zn\left|Zn^{2+}(1M)\right|\left|Cu^{2+}(1M)\right|Cu$$

$$E^{\circ}_{Zn^{2+}/Zn} = -0.76\ V;\ \frac{2.303RT}{F} = 0.059$$

Above cell is connected with an external battery with $E > 1.1\ V$, if a current of 10 A is passed through the cell for 9650sec by using battery. E_{cell} after passing current will be :

(Take $\log 2 = 0.3, \log 3 = 0.5, \log 4 = 0.6$)

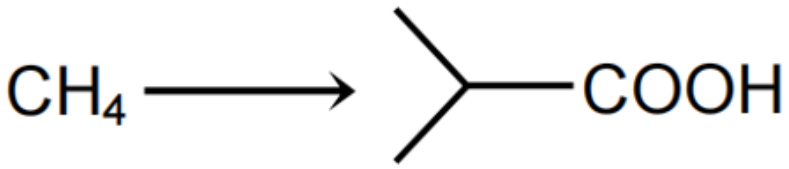
A. 1.085
B. 1.115
C. 1.13
D. 1.07

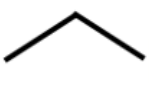
Question No. 3

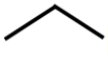
One or More Options Correct Type

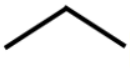
The question has multiple options out of which ONE or MORE is/are correct.

Which of the following is the correct option/s of reagent for the given conversion



A. $Br_2/h\nu(1eq.)$,  $MgCl$, $Br_2/h\nu(1eq.)$, $HCOOH$

B. $Br_2/h\nu(1eq.)$,  $MgCl$, $Br_2/h\nu(1eq.)$, Mg/dry ether, $CO_2/H_3O^{\oplus}$

C. $Cl_2/h\nu(1eq.)$,  $MgCl$, $Br_2/h\nu(1eq.)$, $KCN/H_3O^{\oplus}$

D. $Cl_2/h\nu(1eq.)$,$CH_3–MgBr$, $Br_2/h\nu(1eq.)$, $CH_3–COOH$

Question No. 4

One or More Options Correct Type

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

Which among the following statement(s) is(are) true for the extraction of aluminium from bauxite?

A. Hydrated Al_2O_3 precipitates, when CO_2 is bubbled through a solution of sodium aluminate.
B. Addition of Na_3AlF_6 lowers the melting point of alumina.
C. CO_2 is evolved at the anode during electrolysis.
D. The cathode is a steel vessel with a lining of carbon.

Question No. 5

One or More Options Correct Type

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

Choose the INCORRECT statement(s) :

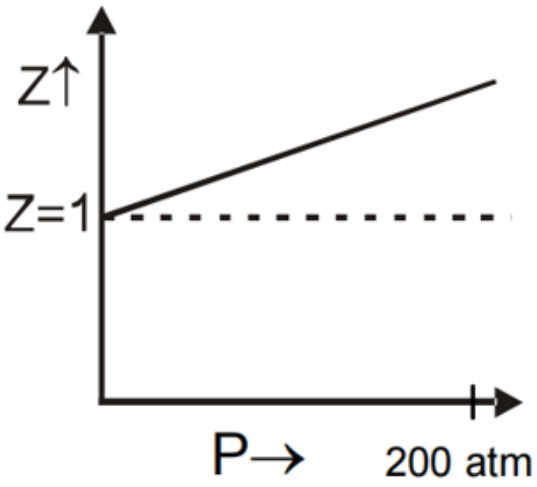
A. HBr is prepared by action of concentrated H_2SO_4 on KBr
B. NH_3 gas can be dried over anhydrous $CaCl_2$
C. $Na_2S_2O_3$ can be used as antichlor.
D. Due to intermolecular hydrogen bonding, H_2SO_4 is highly volatile liquid.

Question No. 6

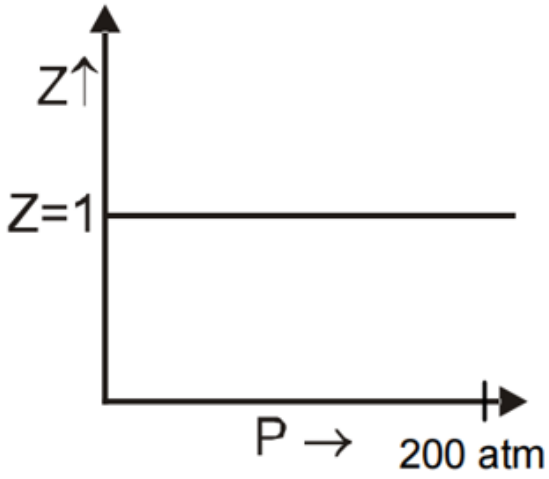
One or More Options Correct Type

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

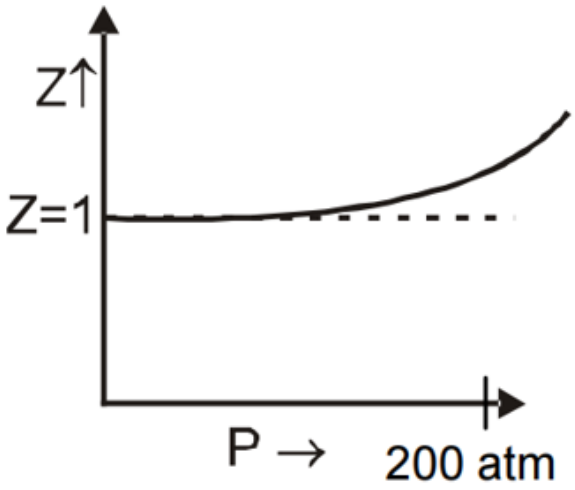
At Boyle's temperature, the graph of Z v/s P is drawn for H_2. Select incorrect graph(s) :

A. 

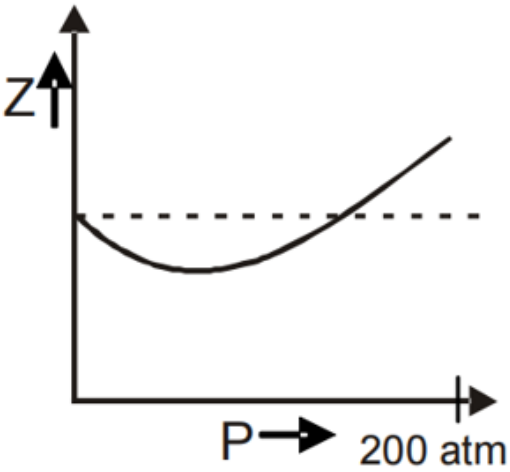
B.



C.



D.

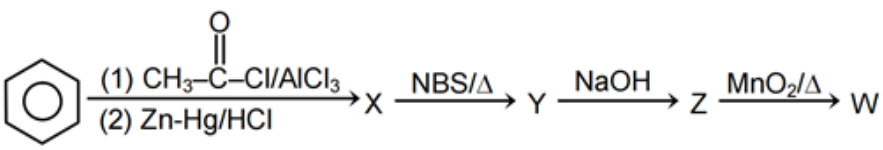


Question No. 7

One or More Options Correct Type

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

Observe the following reaction



Choose the correct options

A. W gives + ve test with 2,4-DNP
B. W gives +ve test with tollens reagent
C. W gives iodoform with I_2/NaOH
D. W is acetophenone

Question No. 8

One or More Options Correct Type

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

The solubility of $Fe(OH)_3$ in a buffer solution of $pH = 4$ is 4.32×10^{-2} mol/L . How many times is this solubility greater than its solubility in pure water. (Ignore the hydrolysis of Fe^{3+} ions) Given: $4.32/\sqrt{0.4} = 6.83$

A. 10^9
B. 6.83×10^6
C. 2.16×10^9
D. none of these

Chemistry Numerical (Maximum Marks: 24)

Question No. 1

Numerical Type

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

The sum of number of unpaired electrons in each of the following species is

$B_2, XeF, [Fe(H_2O)_5(NO)]SO_4, K_3CrO_8, Ba(O_2)_2$

Question No. 2

Numerical Type

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

The existence of coordination compounds with the same formula but different arrangements (Isomers) is crucial in the development of coordination chemistry. There are two main forms of isomerism in coordination compound structural isomerism and stereoisomerism (spatial isomerism). Find total possible isomeric compound for complex ion $[Pt(Br)(NO_2)(NO_3)(SCN)]^{2-}$

Question No. 3

Numerical Type

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

Total number of metal nitrates from given below which produce precipitate on addition of dil. HCl.

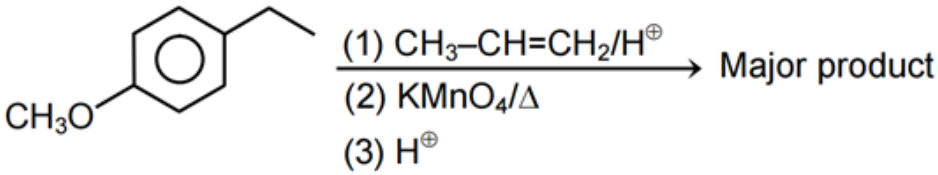
$AgNO_3, Cu(NO_3)_2, Ba(NO_3)_2, Hg_2(NO_3)_2, Pb(NO_3)_2, Sn(NO_3)_2$

Question No. 4

Numerical Type

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

Observe the following reaction



Number of $-COOH$ functional groups are present in major product

Question No. 5

Numerical Type

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

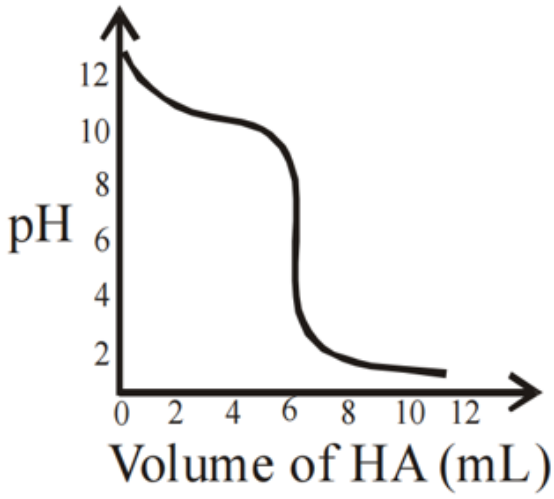
The number of electron that can be present in sub-shells having m_s value of $\frac{-1}{2}$, for n up to 3 .

Question No. 6

Numerical Type

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

A solution of $0.1M$ weak base (B) is titrated with $0.1M$ of a strong acid (HA). The variation of pH of the solution with the volume of HA added is shown in the figure below. What is the pK_b of the base? The neutralization reaction is given by $B + HA \rightarrow BH^+ + A^-$.



Chemistry Paragraph Type (Maximum Marks: 12)

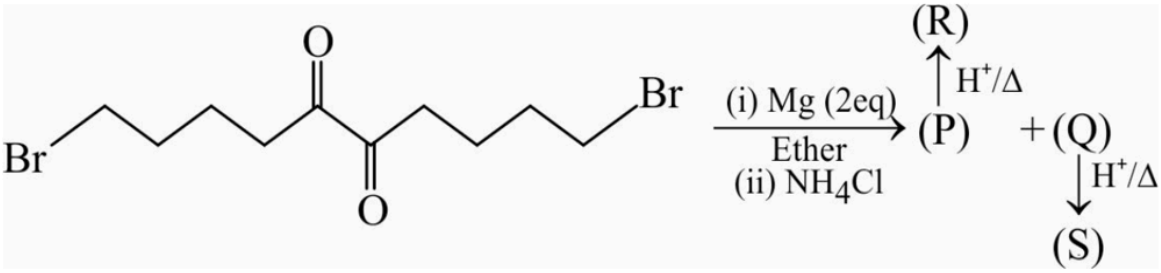
Question No. 1

Only One Option Correct Type

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

Paragraph:

In the following reaction sequence, if (P) can show stereoisomerism.



Question:

Relation between (R) and (S) is :

A. Homomers
B. Enantiomers
C. Diastereomers
D. Structural Isomers

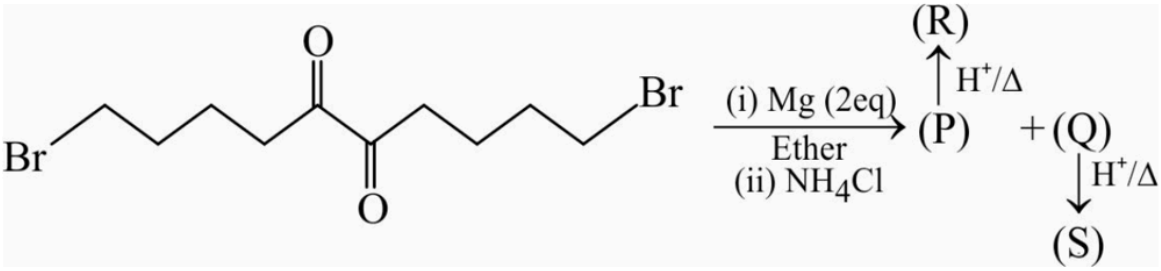
Question No. 2

Only One Option Correct Type

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

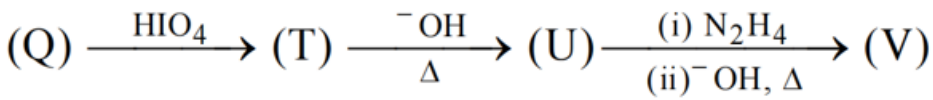
Paragraph:

In the following reaction sequence, if (P) can show stereoisomerism.

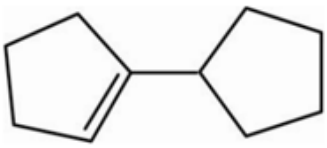


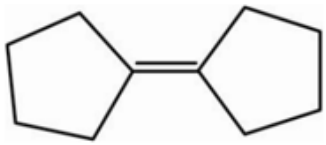
Question:

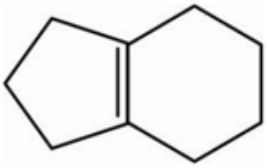
The product (V) is :



A. 

B. 

C. 

D. 

Question No. 3

Only One Option Correct Type

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

Paragraph:

The corrosion of iron is an electrochemical process that involves the standard reduction potential given here at 25°C.

$Fe^{2+}(ag) + 2e^- \longrightarrow Fe(s)$ $\quad E^\circ = -0.44$ V

$O_2(g) + 4H^+(ag) + 4e^- \longrightarrow 2H_2O(\ell)$ $\quad E^\circ = +1.23$ V

Question:

The voltage if the reaction occurs at pH = 4.0 but all other concentration are maintained as they were in the standard cell. (Given : 2.303RT/F = 0.06 V)

A. 1.43 V
B. 1.67 V
C. −0.44 V
D. none

Question No. 4

Only One Option Correct Type

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

Paragraph:

The corrosion of iron is an electrochemical process that involves the standard reduction potential given here at 25°C.

$Fe^{2+}(ag) + 2e^- \longrightarrow Fe(s)$ $\quad E^\circ = -0.44$ V

$O_2(g) + 4H^+(ag) + 4e^- \longrightarrow 2H_2O(\ell)$ $\quad E^\circ = +1.23$ V

Question:

For the reaction $Fe(OH)_2(s) + 2e^- \longrightarrow Fe(s) + 2OH^-(aq)$

$E^\circ = -0.88$ V . Use this information with one of the given standard potential to calculate the ℓnK_{sp} of $Fe(OH)_2$ at 25°C. (Given : 2.303RT/F = 0.06 V)

A. -28.76
B. -33.77
C. -20.67
D. None of these

Mathematics Multiple Correct (Maximum Marks: 32)

Question No. 1

One or More Options Correct Type

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

Let P_1 denotes the equation of the plane to which the vector $(\hat{i} + \hat{j})$ is normal and which contains the line $'L'$ whose equation is $\vec{r} = (\hat{i} + \hat{j} + \hat{k}) + \lambda(\hat{i} - \hat{j} - \hat{k}), P_2$ denotes the equation of the plane containing the line $'L'$ and a point with position vector $\hat{j}$. Then which of the following is/are not true :

A. Equation of P_1 is $x + y = 2$
B. Equation of P_2 is $\vec{r} \cdot (\hat{i} + 2\hat{j} - \hat{k}) = 2$
C. The acute angle between P_1 and P_2 is $\cot^{-1}(\sqrt{3})$
D. The angle between the plane P_2 and the line $'L'$ is $\tan^{-1}\sqrt{3}$

Question No. 2

One or More Options Correct Type

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

Let $y = y(x), y(1) = 1$ and $y(e) = e^2$. Consider
$J = \int \frac{x+y}{xy}\, dy, I = \int \frac{x+y}{x^2}\, dx, J - I = g(x)$ and $g(1) = 1$, then the value of g(e) is -

A. $3e + 1$
B. $e + 1$
C. $e^2 - e + 2$
D. $e^2 + e - 2$

Question No. 3

One or More Options Correct Type

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

Let $f : R \to R$ and $f(x) = \sin^{-1}\left(\frac{2}{|\cos x - 1| + |\cos x + 1|}\right)$, then-

A. $f(x)$ is continuous for all x
B. $f(x)$ is many one function
C. $f(x)$ has removable discontinuity at $x = \frac{\pi}{3}$
D. $f(x) = f(|x|)$ for all x

Question No. 4

One or More Options Correct Type

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

Ten passengers get into an elevator on the ground floor which stops at 20- different floors above ground floor then the probability that they will all get out at different floors is

A. $\frac{20!}{10!(20)^{10}}$
B. $\frac{1.3.5\ldots17.19}{10^{10}}$
C. $\frac{19!}{10!(20)^{9}}$
D. $\frac{10!}{(10)^{20}}$

Question No. 5

One or More Options Correct Type

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

If the equation $x^5 - 10a^3x^2 + b^4x + c^5 = 0$ has three equal roots, then

A. $2b^2 - 10a^3b^2 + c^5 = 0$
B. $6a^5 + c^5 = 0$
C. $2c^5 - 10a^3b^2 + b^4c^5 = 0$
D. $b^4 = 15a^4$

Question No. 6

One or More Options Correct Type

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

If a_1, a_2, a_3, a_4, a_5 are distinct positive terms in AP having common difference d, then -

A. $5a_3^2 > 4\ d^2$
B. sum of all terms = $5a_3$
C. $a_1 + 5a_5, 3a_3, 2a_2 + 4a_4$ are in A.P.
D. $a_1a_5 < a_2a_4$

Question No. 7

One or More Options Correct Type

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

$\vec{a}, \vec{b}, \vec{c}$ are unit vectors such that $\vec{a}$ and $\vec{b}$ are mutually perpendicular and $\vec{c}$ is equally inclined to $\vec{a}$ and $\vec{b}$ at an angle ' θ '. If $\vec{c} = x\vec{a} + y\vec{b} + z(\vec{a} \times \vec{b})$ then :

A. $z^2 = 1 - 2y^2$
B. $z^2 = 1 - x^2 - y^2$
C. $z^2 = 1 - 2x^2$
D. $x^2 = y^2$

Question No. 8

One or More Options Correct Type

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

Let $I_n = \int_0^{\pi/2} \frac{1-\cos 2n\theta}{1-\cos 2\theta}\, d\theta; n \in N$ and $\Delta = \begin{vmatrix} I_4 & I_5 & I_6 \\ I_7 & I_8 & I_9 \\ I_{21} & I_{22} & I_{23} \end{vmatrix}$ Then Δ is divisible by

A. 3
B. 5
C. 7
D. 13

Mathematics Numerical (Maximum Marks: 24)

Question No. 1

Numerical Type

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

Let $f(x) = a_0 + a_1x + a_2x^2 + a_3x^3 + a_4x^4 + a_5x^5$ be a polynomial to degree 5 which increases in the interval $(-\infty, 1]$ and $[3, \infty)$ and decreases in the interval $(1, 3)$. Given that $f(0) = 2, f(1) = \frac{88}{15}$ and $f'(2) = 0$, then a_5 is equal to

Question No. 2

Numerical Type

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

Let $\vec{a} = \hat{i} + \hat{j} + \hat{k}, \vec{b} = x_1\hat{i} + x_2\hat{j} + x_3\hat{k}$, where $x_1, x_2, x_3 \in \{-3, -2, -1, 0, 1, 2\}$. Number of possible vectors $\vec{b}$ such that $\vec{a}$ and $\vec{b}$ are mutually perpendicular is n^2 then value of n is

Question No. 3

Numerical Type

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

Let $f(x)$ is defined only for $x \in (0, 5)$ and defined as $f^2(x) = 1 \forall x \in (0, 5)$. Function $f(x)$ is continuous for all $x \in (0, 5) - \{1, 2, 3, 4\}$ (at $x = 1, 2, 3, 4 f(x)$ may or may not be continuous). The number of possible function $f(x)$ if it is discontinuous at two and three integral points in $(0, 5)$ are a and b respectively, then $a + b$ is equal to

Question No. 4

Numerical Type

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

The parabola $y = x^2$ is reflected in the line $y = 3$ producing a new parabola. This new parabola is reflected in the line $x = 2$, producing $y = -x^2 + bx + c$. Find the value of $2b + c$.

Question No. 5

Numerical Type

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

In the complex plane, consider the parallelogram formed by the points 0, z, $\frac{1}{z}$ and z + $\frac{1}{z}$ having area $\frac{12}{13}$ sq. units and the real part of ' z ' is positive. If the smallest possible value of $\left|z+\frac{1}{z}\right|$ is ' p ' then $\frac{13p^2}{4}$ equal to

Question No. 6

Numerical Type

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

If the value of definite integral $\int_0^1 {}^{207}C_7 x^{200} \cdot (1-x)^7 dx$ is equal to $\frac{1}{k}$ where $k \in N$, then value of $\frac{k}{26}$ is ?

Mathematics Paragraph Type (Maximum Marks: 12)

Question No. 1

Only One Option Correct Type

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

Paragraph:

Let $A = [a_{ij}]$ be a square matrix of order 3 whose elements are distinct integers from $1, 2, \ldots\ldots, 9$, the matrix is formed so that the sum of numbers in every row, every column \& diagonal is a multiple of 9.

Question:

The element a_{22} must be a multiple of

A. 2
B. 3
C. 4
D. 9

Question No. 2

Only One Option Correct Type

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

Paragraph:

Let $A = [a_{ij}]$ be a square matrix of order 3 whose elements are distinct integers from $1, 2, \ldots\ldots, 9$, the matrix is formed so that the sum of numbers in every row, every column \& diagonal is a multiple of 9.

Question:

The maximum value of the sum of diagonal principal element of the matrix A is:

A. 18
B. 19
C. 12
D. None

Question No. 3

Only One Option Correct Type

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

Paragraph:

Match the following

List–I		List–II	
(I)	If $\vec{a}=\hat{i}+\hat{j}+\hat{k}, \vec{b}=\hat{i}-\hat{j}+\hat{k}, \vec{c}=\hat{i}+2\hat{j}-\hat{k}$, then the value of $\begin{vmatrix} \vec{a}.\vec{a} & \vec{a}.\vec{b} & \vec{a}.\vec{c} \\ \vec{b}.\vec{a} & \vec{b}.\vec{b} & \vec{b}.\vec{c} \\ \vec{c}.\vec{a} & \vec{c}.\vec{b} & \vec{c}.\vec{c} \end{vmatrix}$ is divisible by	(P)	6
(II)	If points P, Q and R have position vectors, $\vec{r}_1=3\hat{i}-2\hat{j}-\hat{k}, \vec{r}_2=\hat{i}+3\hat{j}+4\hat{k}$ and $\vec{r}_3=2\hat{i}+\hat{j}-2\hat{k}$ respectively, relative to an origin O, then the value of distance of P from the plane OQR, divides.....	(Q)	28
(III)	A line with direction ratios (2, 1, 2) intersects the lines, $\vec{r}=-\hat{j}+\lambda\left(\hat{i}+\hat{j}+\hat{k}\right)$ and $\vec{r}=-\hat{i}+\mu\left(2\hat{i}+\hat{j}+\hat{k}\right)$ at A and B, then the value of length (AB) divides.....	(R)	16
(IV)	In a regular tetrahedron, the centres of the four faces are the vertices of a smaller tetrahedron. The ratio of the volume of the smaller tetrahedron to that larger is $\frac{m}{n}$, where m and n are relatively prime positive integers. The value of (m + n) is	(S)	3
		(T)	8
		(U)	10

Question:

Which of the following is the only correct combination?

A. III → R, T
B. IV → T
C. III → P,S
D. IV → R

Question No. 4

Only One Option Correct Type

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

Paragraph:

Match the following

List–I		List–II	
(I)	If $\vec{a}=\hat{i}+\hat{j}+\hat{k}, \vec{b}=\hat{i}-\hat{j}+\hat{k}, \vec{c}=\hat{i}+2\hat{j}-\hat{k}$, then the value of $\begin{vmatrix} \vec{a}.\vec{a} & \vec{a}.\vec{b} & \vec{a}.\vec{c} \\ \vec{b}.\vec{a} & \vec{b}.\vec{b} & \vec{b}.\vec{c} \\ \vec{c}.\vec{a} & \vec{c}.\vec{b} & \vec{c}.\vec{c} \end{vmatrix}$ is divisible by	(P)	6
(II)	If points P, Q and R have position vectors, $\vec{r}_1=3\hat{i}-2\hat{j}-\hat{k}, \vec{r}_2=\hat{i}+3\hat{j}+4\hat{k}$ and $\vec{r}_3=2\hat{i}+\hat{j}-2\hat{k}$ respectively, relative to an origin O, then the value of distance of P from the plane OQR, divides.....	(Q)	28
(III)	A line with direction ratios (2, 1, 2) intersects the lines, $\vec{r}=-\hat{j}+\lambda\left(\hat{i}+\hat{j}+\hat{k}\right)$ and $\vec{r}=-\hat{i}+\mu\left(2\hat{i}+\hat{j}+\hat{k}\right)$ at A and B, then the value of length (AB) divides.....	(R)	16
(IV)	In a regular tetrahedron, the centres of the four faces are the vertices of a smaller tetrahedron. The ratio of the volume of the smaller tetrahedron to that larger is $\frac{m}{n}$, where m and n are relatively prime positive integers. The value of (m + n) is	(S)	3
		(T)	8
		(U)	10

Question:

Which of the following is the only correct combination?

A. I $\rightarrow$ R, T
B. II $\rightarrow$ R, T
C. I $\rightarrow$ Q, T
D. II $\rightarrow$ P, T