

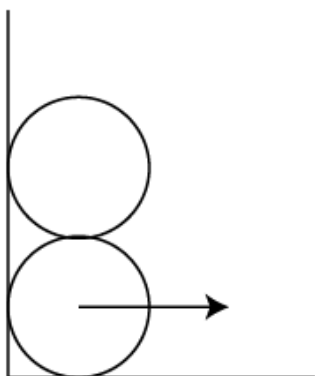
Physics Multiple Correct (Maximum Marks: 32)

Question No. 1

One or More Options Correct Type

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

Two identical uniform cylinders of radius R each are placed on top of each other next to a wall as shown. After a disturbance, the bottom cylinder slightly moves to the right and the system comes into motion. Neglect friction between all surfaces.



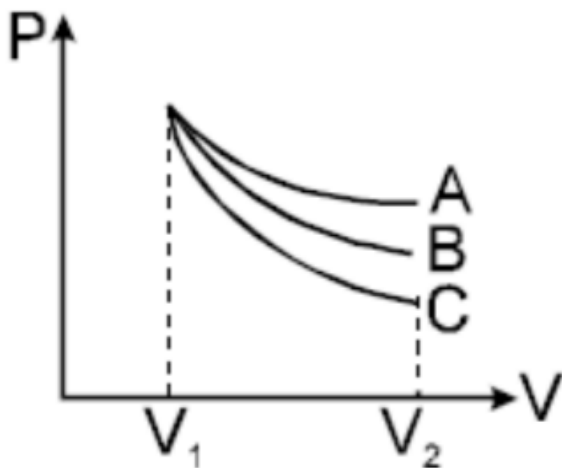
- A. The top cylinder will have maximum acceleration g .
- B. The speed of the bottom cylinder will first increase then decrease.
- C. Minimum acceleration of the bottom cylinder is zero.
- D. Maximum speed of the bottom cylinder is $\frac{2}{3} \sqrt{gR}$

Question No. 2

One or More Options Correct Type

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

An ideal gas undergoes an expansion from a state with temperature T_1 and volume V_1 to V_2 through three different polytropic process A, B and C as shown in the $P - V$ diagram. If $|\Delta E_A|$, $|\Delta E_B|$ and $|\Delta E_C|$ be the magnitude of changes in internal energy along the three paths respectively, then:



- A. $|\Delta E_A| < |\Delta E_B| < |\Delta E_C|$ if temperature in every process decreases
- B. $|\Delta E_A| > |\Delta E_B| > |\Delta E_C|$ if temperature in every process decreases
- C. $|\Delta E_A| > |\Delta E_B| > |\Delta E_C|$ if temperature in every process increases

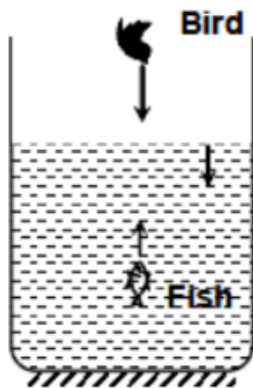
D. $|\Delta E_A| < |\Delta E_B| < |\Delta E_C|$ if temperature in every process increases

Question No. 3

One or More Options Correct Type

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

A bird is flying downward with constant velocity 6 cm/s towards a fixed transparent container filled with a liquid of refractive index $\frac{4}{3}$. A fish is moving upward with constant speed 4 cm/s towards the surface of liquid. Surface of liquid is also moving downward with constant velocity 2 cm/s as shown in the figure. The bottom of container is silvered. Then



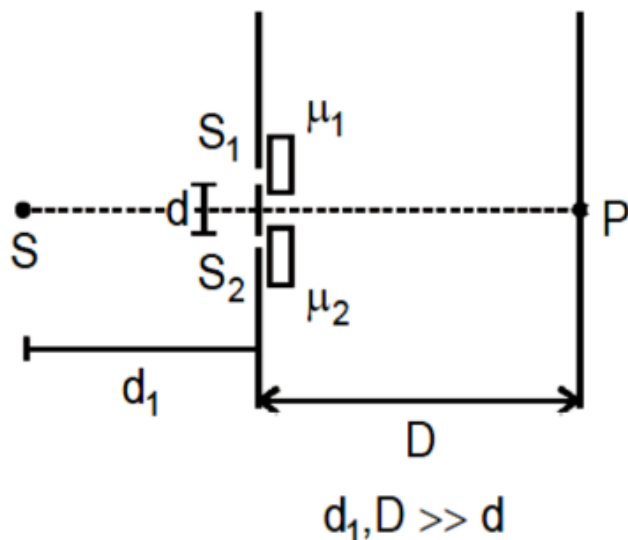
- A. Speed of fish as seen by bird only after refraction is 9 cm/sec
- B. Speed of fish as seen by bird only after refraction is 8.5 cm/sec
- C. Speed of fish as seen by bird after reflection and the refraction is 3 cm/sec
- D. Speed of fish as seen by bird after reflection and then refraction is 2.5 cm/sec

Question No. 4

One or More Options Correct Type

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

In young's experiment, the upper slit is covered by a thin glass plate of refractive index $\frac{4}{3}$ and of thickness 9λ , where λ is the wavelength of light [in air] used in the experiment. The lower slit is also covered by another glass plate of thickness 2λ & refractive index $\frac{3}{2}$, as shown in figure. If I_0 is the intensity at point P due to slits S_1 & S_2 each, then:



- A. Intensity at point P is $4I_0$

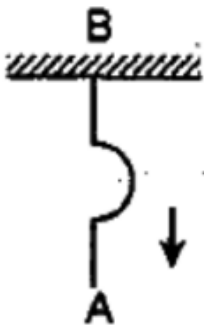
- Two fringes have been shifted in upward direction after insertion of both the glass plates
- B. together
- C. Optical path difference between the waves from S_1 & S_2 at point P is 2λ .
- If the source S is shifted upwards by a small distance d_2 then the fringe originally at P
- D. after inserting the plates, shifts downwards by $D(\frac{d_2}{d_1})$

Question No. 5

One or More Options Correct Type

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

A heavy string of length L is suspended from the ceiling as shown in figure. A transverse pulse is generated at the fixed end B of the string and it has a velocity v_0 at the end B. Choose the correct statement(s) related to motion of the pulse.



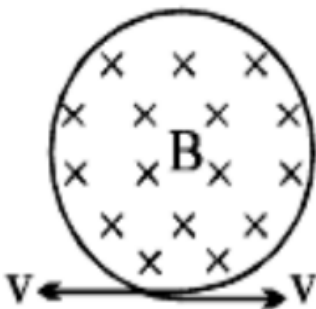
- A. as the pulse move downward its velocity increases
- B. as the pulse move down ward, its velocity decreases.
- C. the velocity of the pulse at a distance x from the end B is $v_0 \sqrt{\frac{x}{L}}$.
- D. the velocity of the pulse at a distance x from the end B is $v_0 \sqrt{\frac{(L-x)}{L}}$.

Question No. 6

One or More Options Correct Type

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

A circular conducting loop of radius r_0 and having resistance per unit length λ as shown in the figure is placed in a magnetic field B which is constant in space and time. The ends of the loop are crossed and pulled in opposite directions with a velocity v such that the loop always remains circular and the radius of the loop goes on decreasing, then



- A. Radius of the loop changes with time as $r = r_0 - vt/\pi$
- B. EMF induced in the loop as a function of time is $e = 2Bv[r_0 - vt/\pi]$
- C. Current induced in the loop is $I = \frac{Bv}{2\pi\lambda}$

D. Current induced in the loop is $I = \frac{Bv}{\pi\lambda}$

Question No. 7

One or More Options Correct Type

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

A uniform rigid body of radius ' R ' (which can roll) having mass ' M ' and radius of gyration ' K ' rolling on a rough horizontal surface with linear speed ' V ' collides elastically with fixed, smooth vertical wall. Then choose the correct statements.....

The rigid body starts to pure rolling in time $\frac{2v}{\mu g(1 + \frac{R^2}{K^2})}$ (μ = coefficient friction

A. between horizontal surface and rigid body)

The speed of rigid body after it has started pure rolling in the backward direction is

B. $v\{\frac{R^2 - K^2}{R^2 + K^2}\}$

C. The rigid body starts to pure rolling in time $\frac{v}{\mu g(1 + \frac{K^2}{R^2})}$

The speed of rigid body after it has started pure rolling in the backward direction is

D. $v\{\frac{R^2 + K^2}{R^2 - K^2}\}$

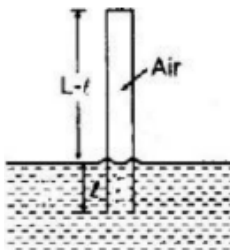
Question No. 8

One or More Options Correct Type

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

A glass capillary sealed at the upper end is of length 0.11 m and internal diameter 2×10^{-5} m . The tube is immersed vertically into a liquid of specific gravity 0.75 and surface tension $5 \times 10^{-2} \text{ Nm}^{-1}$. Atmospheric pressure is $1 \times 10^5 \text{ Nm}^{-2}$.

(Assume angle of contact is zero).



The length to which the capillary has to be immersed inside the liquid so that the liquid

A. level inside and outside the capillary becomes same is 1 cm

B. Now if the seal is broken liquid level inside the capillary will rise.

C. If the seal is broken liquid level inside the capillary remains unchanged.

If the capillary is lifted outward (after seal is broken and liquid level inside it has stabilized), no liquid will spill out of capillary and lower surface is concave when seen

D. from below.

Physics Numerical (Maximum Marks: 24)

Question No. 1

Numerical Type

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

A solid sphere of density ' ρ ', specific heat capacity ' C ' and radius ' R ' is at an initial temperature 300 K. On allowing it to cool under the process of radiation then the time taken for it to cool to 100 K is found to be $\frac{26R\rho C}{81 K\sigma}$, micro second. If ' σ ' is Stefan's constant, then find the value of ' K '. Assume the surrounding temperature to be extremely small and emissivity of the outer surface of the sphere to be unity.

Question No. 2

Numerical Type

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

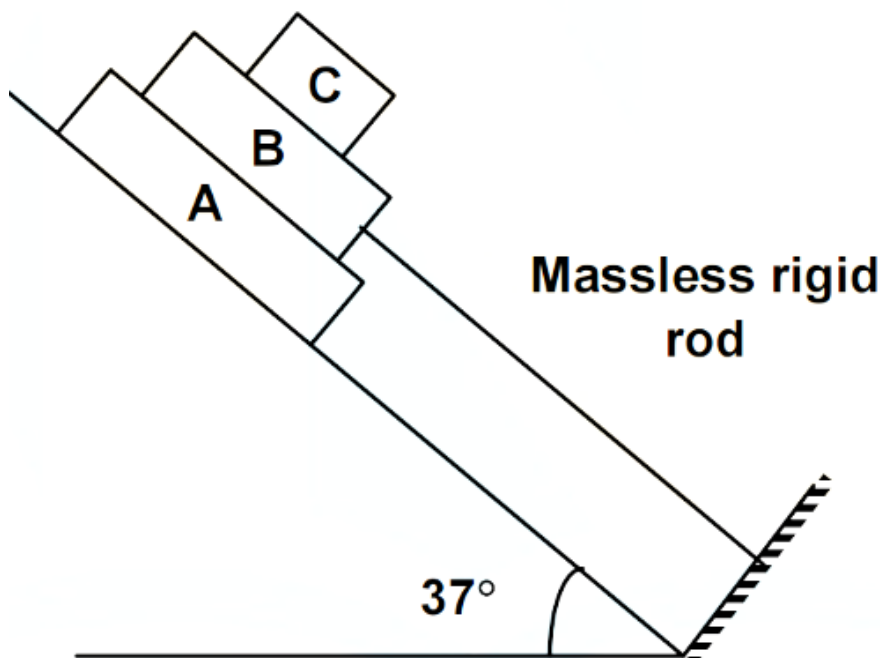
Imagine an atoms made up of a proton and a hypothetical particle of triple the mass of the electron but having the same charge as the electron. Apply the Bohr atom model and consider all possible transitions to the first excited level. The longest wavelength photon that will be emitted has wavelength λ given by $\frac{2x}{5R}$, where ' R ' is the Rydberg's constant. Find the value of ' x '.

Question No. 3

Numerical Type

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

In the shown figure m_A , m_B and m_C are the masses of the three blocks, the incline is frictionless $m_A = 5$ kg, $m_B = 10$ kg, $m_C = 2$ kg. coefficient of friction between A and B is 0.2 and between B and C is 0.1. The frictional force on block A is 6 K Newton at the instant shown. Find the value of K. (Take $g = 10$ m/s²)



Question No. 4

Numerical Type

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

A source of sonic oscillations with frequency $f_0 = 1800 \text{ Hz}$ and a receiver are located at the same point. At the moment $t = 0$ the source starts receding from the receiver with constant acceleration $a = 10.0 \text{ m/s}^2$. Assuming the velocity of sound to be equal to $v = 350 \text{ m/s}$. The oscillation frequency registered by the stationary receiver at $t = 7.7 \text{ s}$ after the start of motion is $300n\text{Hz}$. find n .

Question No. 5

Numerical Type

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

A hydrogen atom is in $n = 5$ state makes a transition to it's ground state. Assuming, H-atom is initially at rest, find the recoil speed of H-atom.

Question No. 6

Numerical Type

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

A binary star is a system of two stars moving around the centre of inertia of the system due to mutual gravitational force. If the total mass of two stars $= M_0$ and the period of revolution is T . Find the distance in km between stars? (Take $GM_0 = 8 \times 10^6$ and $T = 2\pi \times 10^3$ seconds).

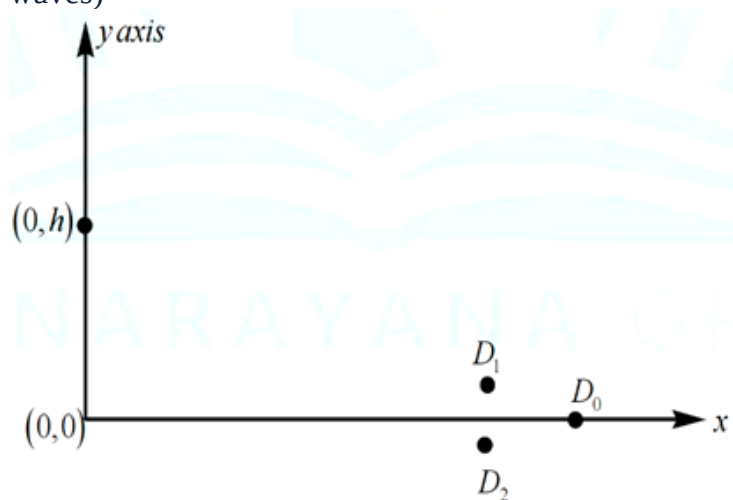
Physics Paragraph Type (Maximum Marks: 12)

Question No. 1

Only One Option Correct Type

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

There is a point source of sound placed at $(0, h)$ as shown in figure. The detectors D_1 and D_2 are placed at positions $(D, d/2)$ and $(D, -d/2)$ respectively. Take $h \ll D$. The source emitted a sound pulse at a certain time. Assuming velocity of sound in the surrounding medium as V . (Assume that the waves reaching the detectors D_1, D_2 are plane progressive waves)



The time gap between the recordings made by the detectors will approximately be

A. $\frac{hd}{2DV}$

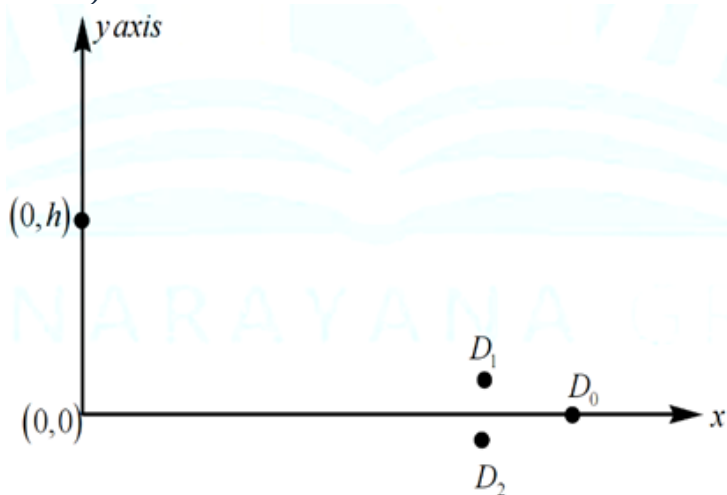
- B. $\frac{2hd}{DV}$
- C. $\frac{hd}{DV}$
- D. $\frac{4hd}{DV}$

Question No. 2

Only One Option Correct Type

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

There is a point source of sound placed at $(0, h)$ as shown in figure. The detectors D_1 and D_2 are placed at positions $(D, d/2)$ and $(D, -d/2)$ respectively. Take $h \ll D$. The source emitted a sound pulse at a certain time. Assuming velocity of sound in the surrounding medium as V . (Assume that the waves reaching the detectors D_1, D_2 are plane progressive waves)



If the source emits continuous waves, and the pressure recorded by the two detectors are superposed at every instant in detector D_0 (which is equidistant from D_1 & D_2) the resultant pressure amplitude will be maximum if the minimum frequency of the source is

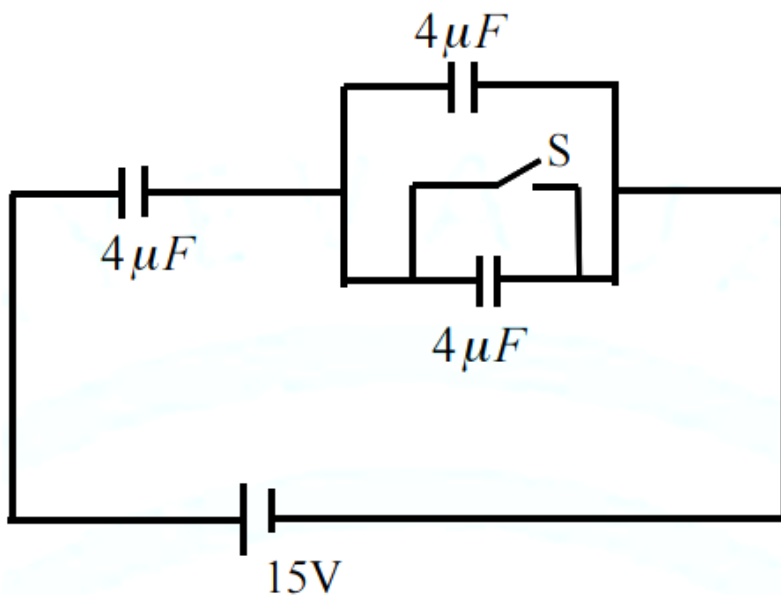
- A. $\frac{VD}{2dh}$
- B. $\frac{2VD}{dh}$
- C. $\frac{3VD}{2dh}$
- D. $\frac{VD}{dh}$

Question No. 3

Only One Option Correct Type

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

Consider the circuit shown in figure, after switch S is closed



What amount of charge will flow through the battery?

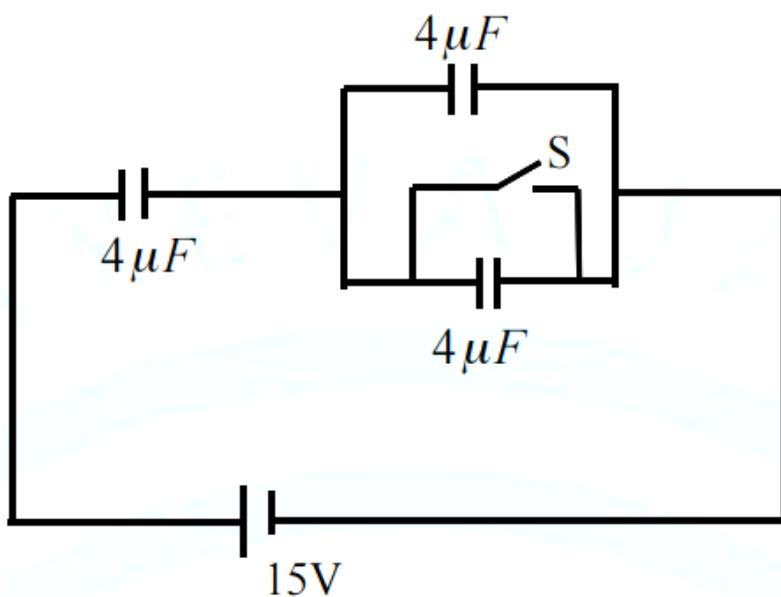
- A. $20\mu C$
- B. $60\mu C$
- C. $40\mu C$
- D. No charge will flow

Question No. 4

Only One Option Correct Type

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

Consider the circuit shown in figure, after switch S is closed



What amount of charge will flow through the switch?

- A. $20\mu C$
- B. $60\mu C$
- C. $40\mu C$

D. No charge will flow

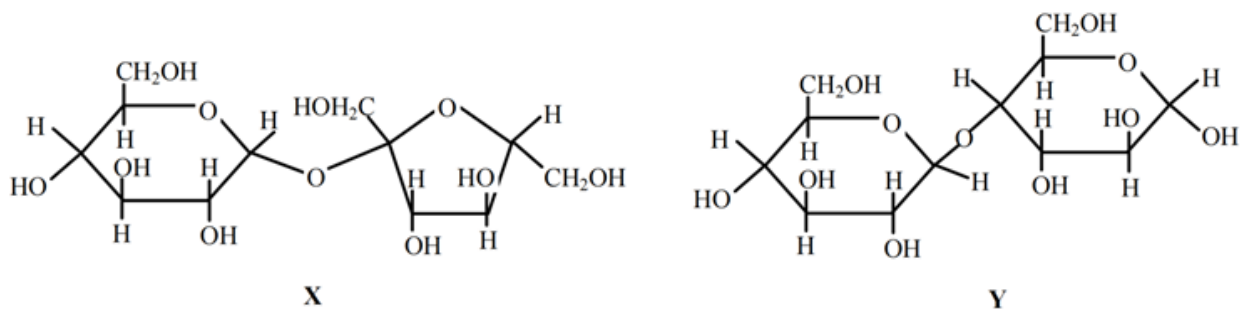
Chemistry Multiple Correct (Maximum Marks: 32)

Question No. 1

One or More Options Correct Type

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

The correct statement(s) about the following sugars **X** and **Y** is(are) :



- A. **X** is a reducing sugar and **Y** is a non-reducing sugar
- B. **X** is a non-reducing sugar and **Y** is a reducing sugar
- C. The glycosidic linkages in **X** and **Y** are α and β , respectively
- D. The glycosidic linkages in **X** and **Y** are β and α , respectively

Question No. 2

One or More Options Correct Type

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

Propan-1-ol can be prepared from propene by treating it with :

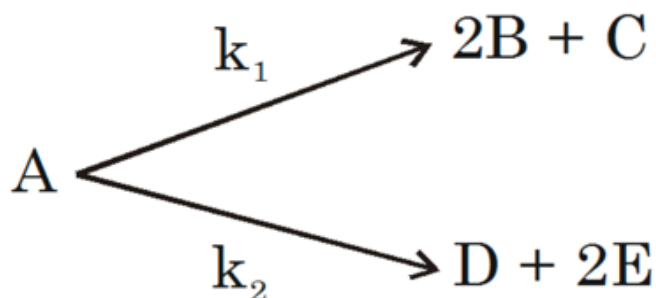
- A. H_2O in presence of H_2SO_4
- B. $\text{Hg}(\text{OAc})_2$ and water and subsequently with NaBH_4
- C. H_2O in presence of HgSO_4 and H_2SO_4
- D. B_2H_6 in THF and subsequently with H_2O_2 and NaOH

Question No. 3

One or More Options Correct Type

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

If an optically active compound 'A' decompose through given parallel 1st order kinetics.



Initial mole of A is 2 ($k_1 = 0.0693 \text{ sec}^{-1}$, $k_2 = 0.1386 \text{ sec}^{-1}$). If only A, B & D are optically active compounds and their angle of rotation per mole are 60° , 30° , -90° respectively, then which of the following is/are correct -

- A. Total angle of rotation of mixture after time $(10/3)$ sec is 20°
- B. Mixture is levorotatory after 75% decomposition of A
- C. Overall $t_{1/2}$ of A is $10/3$ sec .
- D. Percentage of C formed in the product is 11.11%

Question No. 4

One or More Options Correct Type

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

Consider the addition of MgF_2 and CaF_2 in water as given in (a) and (b)

(a) 4.96mg of MgF_2 in 125 mL of pure water K_{sp} of $\text{MgF}_2 = 3.2 \times 10^{-8}$

(b) 3.9mg of CaF_2 in 100 mL of pure water, K_{sp} of $\text{CaF}_2 = 4 \times 10^{-12}$.

Choose the correct statement(s) from amongst the following.

- A. MgF_2 will completely dissolve
- B. MgF_2 solution will have 32% saturation.
- C. CaF_2 will not completely dissolve
- D. CaF_2 solution will have 100% saturation.

Question No. 5

One or More Options Correct Type

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

138 g of N_2O_4 (g) is placed in 8.2 L container at 300 K. The equilibrium vapour density of mixture is found to be 30.67. Then ($R = 0.082 \text{ L} \cdot \text{atm} \cdot \text{mol}^{-1} \text{ K}^{-1}$)

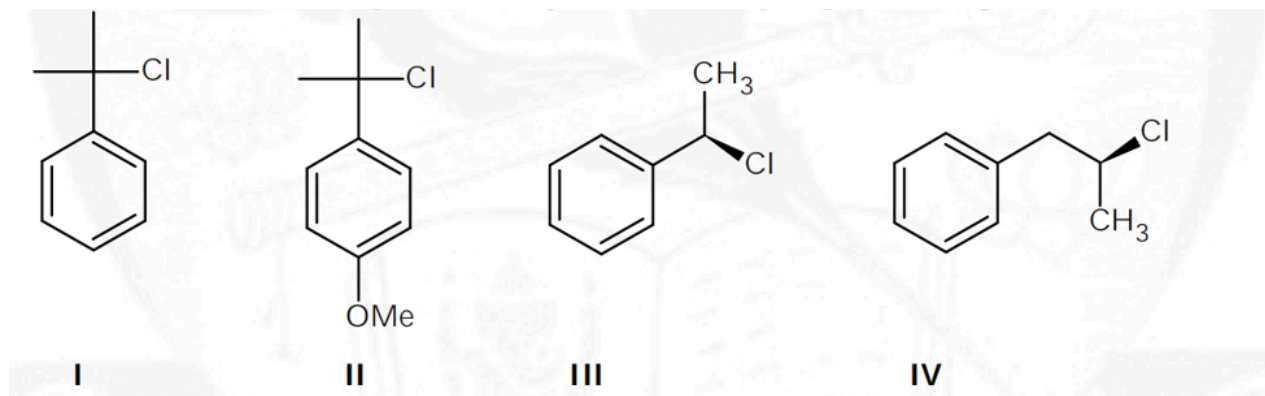
- A. Degree of dissociation of $\text{N}_2\text{O}_4 = 0.25$
- B. K_p of $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$ is 9 atm .
- C. Total pressure at equilibrium = 6.75 atm .
- D. The density of equilibrium mixture is 16.83 g/L .

Question No. 6

One or More Options Correct Type

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

Consider the following four halogen containing organic compounds:



Choose the correct statement(s) among the following regarding the reactions of these compounds.

- A. II is more reactive than I towards methanol.
- B. IV is more reactive than III towards PhSNa .
- On heating with EtONa/EtOH II gives single alkene while IV gives three isomeric
- C. alkene.
- On nucleophilic substitution by aqueous NaSH , IV gives an optically pure primary thiol
- D. as the major product.

Question No. 7

One or More Options Correct Type

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

Which of the following are having same colour and exist in precipitate form?

- A. Ag_2S , BiI_3
- B. CuO , PbS
- C. ZnS , PbSO_4
- D. CdS , $\text{K}_3[\text{Co}(\text{NO}_2)_6]$

Question No. 8

One or More Options Correct Type

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

The correct statements among the following is/are

- A. Pure FeI_2 can be prepared but pure FeI_3 cannot be prepared
- B. Iron with Cl_2 gives FeCl_3 but with HCl gives FeCl_2
- C. CuCl_2 on heating liberates chlorine gas
- D. CuCl_2 exist in polymeric form in its aqueous solution

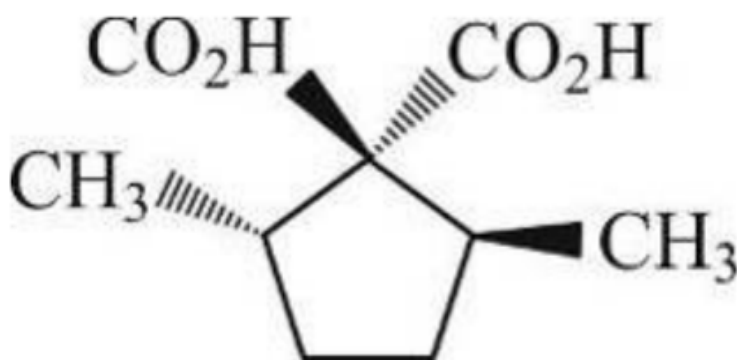
Chemistry Numerical (Maximum Marks: 24)

Question No. 1

Numerical Type

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

How many product will be formed when above compound undergo De-carboxylation?



Question No. 2

Numerical Type

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

100ml solution containing $0.1\text{MNa}_2\text{S}_2\text{O}_3$ & 0.2MIO_4^- is titrated with I_2 according to following reaction.



Calculate millimoles of I_2 consumed ?

Question No. 3

Numerical Type

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

Liquids **A** and **B** form ideal solution for all compositions of **A** and **B** at 25°C . Two such solutions with 0.25 and 0.50 mole fractions of **A** have the total vapor pressures of 0.3 and 0.4 bar, respectively. What is the vapor pressure of pure liquid B in bar?

Question No. 4

Numerical Type

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

An acidified solution of 0.05M Zn^{2+} is saturated with $0.1\text{M H}_2\text{S}$. What is the minimum molar concentration (M) of H^+ required to prevent the precipitation of ZnS ?

Use $K_{\text{sp}}(\text{ZnS}) = 1.25 \times 10^{-22}$ and overall dissociation constant of H_2S , $K_{\text{NET}} = K_1 K_2 = 1 \times 10^{-21}$

Question No. 5

Numerical Type

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

The 1st, 2nd and the 3rd ionization enthalpies, I_1 , I_2 and I_3 , of four atoms with atomic numbers n , $n + 1$, $n + 2$ and $n + 3$, where $n < 10$, are tabulated below. What is the value of n ?

Atomic number	Ionization Enthalpy (kJ/mol)		
	I_1	I_2	I_3
n	1681	3374	6050
$n + 1$	2081	3952	6122
$n + 2$	496	4562	6910
$n + 3$	738	1451	7733

Question No. 6

Numerical Type

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

The maximum work done in expanding 16gm of oxygen at 300K and Occupying a volume of 5dm^3 isothermally until the volume become 25dm^3 is $-2.01 \times 10^x J$ value of x is

Chemistry Paragraph Type (Maximum Marks: 12)

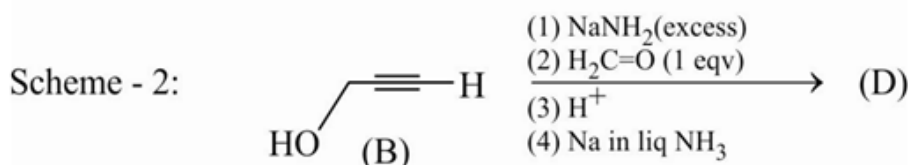
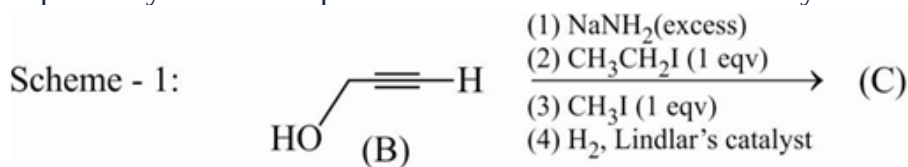
Question No. 1

Only One Option Correct Type

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

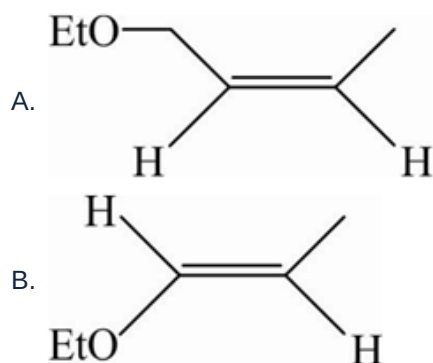
Paragraph:

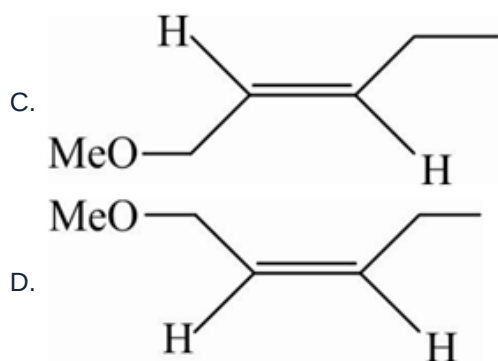
Schemes 1 and 2 describe sequential transformation of an alkyne (B) to (C) & (D) respectively. In each step of the transformation consider only the major product formed.



Question:

The product (C) would be :





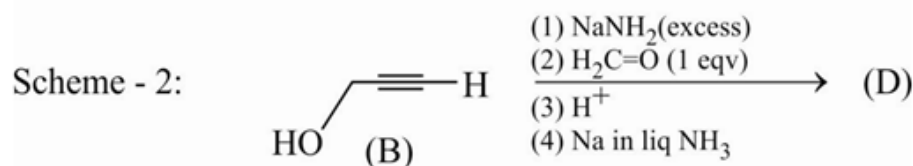
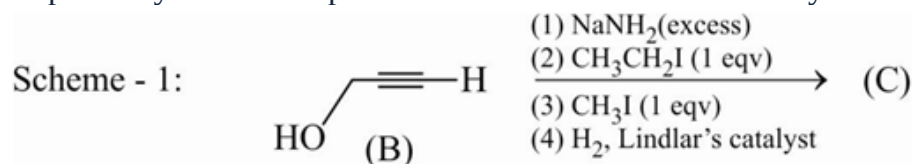
Question No. 2

Only One Option Correct Type

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

Paragraph:

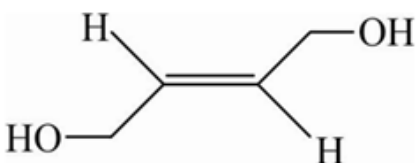
Schemes 1 and 2 describe sequential transformation of an alkyne (B) to (C) & (D) respectively. In each step of the transformation consider only the major product formed.



Question:

The incorrect statement with respect to product (D) is :

A. It is identical to product (C) in scheme-1.

B. The product (D) is 

C. The product (D) on oxidative ozonolysis gives 2 moles of $\text{HO}_2\text{CCH}_2\text{OH}$

D. The product (D) on reaction with D_2 in presence of Ni gives a racemic mixture

Question No. 3

Only One Option Correct Type

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

Paragraph:



Compounds (A) and (B) are:

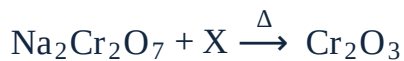
- A. Na_2CrO_4 , H_2SO_4
- B. $\text{Na}_2\text{Cr}_2\text{O}_7$, HCl
- C. Na_2CrO_5 , H_2SO_4
- D. $\text{Na}_4[\text{Fe}(\text{OH})_6]$, H_2SO_4

Question No. 4

Only One Option Correct Type

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

Paragraph:



(X) and (Y) are:

- A. C and Al
- B. Al and C
- C. C in both
- D. Al in both

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.

For equation $2 \sin x = |x| + a$, which of following is true?

- A. Equation has no solution if $a \in \left(\frac{3\sqrt{3}-\pi}{3}, \infty\right)$
- B. Equation has two solutions if $a = 0$
- C. Equation has minimum two solutions if $a < 0$
- D. None of these

Question No. 2

One or More Options Correct Type

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

Which of the following statement is (are) true?

- From any point on the directrix of an ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 (a > b)$, a pair of tangents are drawn to the auxiliary circle of the ellipse. The chord of contact will pass through the
- A. corresponding focus of the ellipse.
- If two tangents to a parabola $y^2 = 4ax$ intersect on the line $x = a$ then their chord of
- B. contact always passes through the foot of directrix.
- If $P(x, y)$ is such that it moves on a hyperbola
- $$\left| \sqrt{(x-3)^2 + (y-4)^2} - \sqrt{x^2 + y^2} \right| = k^2 + 1$$
- , then number of possible integral
- C. values of k is equal to 3.
- A circle passing through 3 co-normal points on the parabola $y^2 = 4x$ also passes
- D. through $(1, 0)$.

Question No. 3

One or More Options Correct Type

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

If the maximum and minimum values of the area of the Δ formed by x-axis, tangent and normal at a point of the parabola $y = x^2 + 1$, (where $1 \leq x \leq 3$) be A_1 and A_2 respectively, then:

- A. $3A_1 + A_2 = 930$
- B. $A_2 = 5$
- C. $A_1 = 925/6$
- D. None of these

Question No. 4

One or More Options Correct Type

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

An acute angle triangle ABC is inscribed in a circle of unit radius and x_1, x_2, x_3 are distances of orthocentre from A, B, C respectively, then

- A. maximum value of $x_1 x_2 x_3$ is 1
- B. maximum value of $\frac{dx_1}{dA} + \frac{dx_2}{dB} + \frac{dx_3}{dC}$ is $-3\sqrt{3}$
- C. maximum value of $x_1 BC + x_2 CA + x_3 AB$ is $3\sqrt{3}$
- D. value of $\frac{dx_1}{d(\cos A)} + \frac{dx_2}{d(\cos B)} + \frac{dx_3}{d(\cos C)}$ is 6

Question No. 5

One or More Options Correct Type

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

Let $f : (0, \infty) \rightarrow (0, \infty)$ be a differentiable onto function and $F(x)$ is the primitive of $f(x)$ such that $2(F(x) - f(x)) = f^2(x)$ for any real positive x .

- A. f is strictly increasing
- B. $\lim_{x \rightarrow \infty} \frac{f(x)}{x} = 1$
- C. f is strictly decreasing

D. f is non monotonic

Question No. 6

One or More Options Correct Type

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

A box contains n coins. Let $P(E_i)$ be the probability that exactly ' i ' out of n coins are biased. If $P(E_i)$ is directly proportional to $i(i+1)$; $1 \leq i \leq n$.

Which of the following is (are) correct?

- A. Proportionality constant k is equal to $\frac{3}{n(n^2+1)}$
- B. Proportionality constant k is equal to $\frac{3}{n(n+1)(n+2)}$
- C. If P be the probability that a coin selected at random is biased then $\lim_{n \rightarrow \infty} P$ is $\frac{3}{4}$
- D. If P be the probability that a coin selected at random is biased then $\lim_{n \rightarrow \infty} P$ is $\frac{3}{5}$

Question No. 7

One or More Options Correct Type

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

Let PQ be a chord of parabola $x^2 = 16y$ such that mid-point of PQ is $(2, 4)$, tangents at the end points of PQ to the parabola $x^2 = 16y$ intersect at $R(\alpha, \beta)$ then :

- A. $3\alpha + 2\beta = 1$
- B. $3\alpha + 2\beta = -1$
- C. Distance between R and PQ is $\frac{30}{\sqrt{17}}$
- D. Distance between R and PQ is $\frac{2}{\sqrt{17}}$

Question No. 8

One or More Options Correct Type

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

If $a, b, c, d \in \mathbb{R}, a \neq 0$ and all three roots of $az^3 + bz^2 + cz + d = 0$ have negative real part, then :

- A. a, b have same sign
- B. a, c have same sign
- C. b, d have same sign
- D. a, d have same sign

Mathematics Numerical (Maximum Marks: 24)

Question No. 1

Numerical Type

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

If $z \neq 0$ and $2 + \cos \theta + i \sin \theta = 3/z$, then the value of $2(z + \bar{z}) - |z|^2$ is

Question No. 2

Numerical Type

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

The total number of seven digit numbers $x_1x_2x_3x_4x_5x_6x_7$ having the property that $x_1 \leq x_2 < x_3 < x_4 \leq x_5 < x_6 < x_7$ is nC_r then sum of digits of nC_r is

Question No. 3

Numerical Type

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

Let $A_n, (n \in \mathbb{N})$ be a matrix of order $(2n-1) \times (2n-1)$, such that $a_{ij} = 0 \forall i \neq j$ and $a_{ij} = n^2 + i + 1 - 2n \forall i = j$ where a_{ij} denotes the element of i^{th} row and j^{th} column of A_n . Let $T_n = (-1)^n \times (\text{sum of all the elements of } A_n)$. Find the value of $\left[\frac{\sum_{n=1}^{102} T_n}{520200} \right]$,
greatest integer function).

Question No. 4

Numerical Type

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

Let slope of sides AB and BC of a $\triangle ABC$ are roots of the equation $x^2 - 4x + 1 = 0$, ($\triangle ABC$ lying in the first quadrant and B is origin) and inradius of the triangle is 1 unit. If co-ordinates of its incentre is (a, b) , then find $(a^2 + b^4)$

Question No. 5

Numerical Type

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

If $A = \begin{pmatrix} 1 & 2 & 2 \\ 2 & 1 & 2 \\ 2 & 2 & 1 \end{pmatrix}$ and $A^2 - 4A - 5I = O$ where I and O are the unit matrix and the null matrix of order 3 respectively. If $15A^{-1} = \lambda \begin{bmatrix} -3 & 2 & 2 \\ 2 & -3 & 2 \\ 2 & 2 & -3 \end{bmatrix}$ then the value of λ is

Question No. 6

Numerical Type

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

A plane P contains the line $\vec{r} = 2\hat{i} + t(\hat{j} - \hat{k})$ and is perpendicular to the plane $\vec{r} \cdot (\hat{i} + \hat{k}) = 3$. The position vector of the point where the plane P meets the line $\vec{r} = t(2\hat{i} + 3\hat{j} + \hat{k})$ is $-(2\hat{i} + \lambda\hat{j} + \hat{k})$ then λ 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 us define a function $g(x) = \begin{cases} x^2 & ; 0 \leq x < 1/2 \\ (x-1)^2; & \frac{1}{2} \leq x \leq 1 \end{cases}$ and another function $f(x)$ such that the Area enclosed by curves $g(x)$ and x -axis between the ordinates $x = \beta$ and $x = \beta + f(\beta)$ is half the area enclosed by $g(x)$ and x -axis. (where $0 < \beta < \frac{1}{2}$ and $\frac{1}{2} < \beta + f(\beta) < 1$).

Question:

The value of $\lim_{x \rightarrow \frac{1}{2}} \frac{(f(x)+x-1)^3}{(x-\frac{1}{2})}$, is :

- A. $\frac{3}{4}$
- B. $\frac{1}{2}$
- C. $\frac{1}{4}$
- D. 1

Question No. 2

Only One Option Correct Type

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

Paragraph:

Let us define a function $g(x) = \begin{cases} x^2 & ; 0 \leq x < 1/2 \\ (x-1)^2; & \frac{1}{2} \leq x \leq 1 \end{cases}$ and another function $f(x)$ such that the Area enclosed by curves $g(x)$ and x -axis between the ordinates $x = \beta$ and $x = \beta + f(\beta)$ is half the area enclosed by $g(x)$ and x -axis. (where $0 < \beta < \frac{1}{2}$ and $\frac{1}{2} < \beta + f(\beta) < 1$).

Question:

Let at $x = \alpha$, $f(x)$ has a local extremum, then the value of α^3 , is :

- A. 16
- B. 8
- C. 4
- D. 1

Question No. 3

Only One Option Correct Type

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

Paragraph:

Let A, B, C represent the vertices of a triangle, where A is the origin and B and C have position vectors \vec{b} and \vec{c} respectively. Points M, N and P are taken on sides AB, BC and CA respectively such that $\frac{AM}{AB} = \frac{BN}{BC} = \frac{CP}{CA} = \alpha, (\alpha \in R - \{0\})$

Question:

Which of the following is not correct?

- A. Position vector of N is $(1 - \alpha)\vec{b} + \alpha\vec{c}$
- B. Position vector of P is $(1 - \alpha)\vec{c}$
- C. $\vec{AN} + \vec{BP} + \vec{CM} = \alpha(\vec{b} + \vec{c})$
- D. $\vec{AN} + \vec{BP} + \vec{CM} = \vec{0}$

Question No. 4

Only One Option Correct Type

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

Paragraph:

Let A, B, C represent the vertices of a triangle, where A is the origin and B and C have position vectors \vec{b} and \vec{c} respectively. Points M, N and P are taken on sides AB, BC and CA respectively such that $\frac{AM}{AB} = \frac{BN}{BC} = \frac{CP}{CA} = \alpha, (\alpha \in R - \{0\})$

Question:

Which of the following is (are) correct?

- A. The area of triangle enclosed by $\vec{AN}, \vec{BP}, \vec{CM}$ is $\frac{|\vec{b} \times \vec{c}|}{2} (\alpha^2 + \alpha + 1)$
- B. The area of triangle enclosed by $\vec{AN}, \vec{BP}, \vec{CM}$ is $\frac{|\vec{b} \times \vec{c}|}{2} (\alpha^2 - \alpha + 1)$
- C. The area of triangle enclosed by $\vec{AN}, \vec{BP}, \vec{CM}$ is least when $\alpha = \frac{1}{2}$
- D. Option 2 and 3