

PHYSICS, CHEMISTRY & MATHEMATICS**CPT - 1****CODE: 120672****PAPER - 1****Time Allotted: 3 Hours****Maximum Marks: 210**

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.
- You are not allowed to leave the Examination Hall before the end of the test.

INSTRUCTIONS

Caution: Question Paper CODE as given above MUST be correctly marked in the answer OMR sheet before attempting the paper. Wrong CODE or no CODE will give wrong results.

A. General Instructions

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains **Three Sections**.
3. **Section-I** is Physics, **Section-II** is Chemistry and **Section-III** is Mathematics.
4. Each **Section** is further divided into **Two Parts: Part-A & C**
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

B. Filling of OMR Sheet

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with HB pencil for each character of your Enrolment No. and write in ink your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.

C. Marking Scheme For All Two Parts.

- (i) **PART-A (01 – 10)** contains 10 Multiple Choice Questions which have **One or More Correct** answer.

For each question in the group **Q. 1 – 10 of PART – A** you will be awarded

Full Marks: +4 If only the bubble(s) corresponding to all the correct option(s) is (are) darkened.

Partial Marks: +1 For darkening a bubble corresponding to **each correct option**, provided NO incorrect option is darkened.

Zero Marks: 0 If none of the bubbles is darkened.

Negative Marks: -2 In all other cases.

For example, if **(A), (C) and (D)** are all the correct options for a question, darkening all these three will result in **+4 marks**; darkening only **(A) and (D)** will result in **+2 marks**; and darkening **(A) and (B)** will result in **-2 marks**, as a wrong option is also darkened.

- (ii) **PART-B** valid for this paper as matrix match is not there.

- (iii) **PART-C (01 – 10)** contains 10 Numerical Based questions with Single Digit Integer as answer, ranging from 0 to 9 and each question carries **+3 marks** for correct answer and **- 1 mark** for wrong answer.

Name of the Candidate : _____

Batch : _____ Date of Examination : _____

Enrolment Number : _____

SECTION-1 : PHYSICS

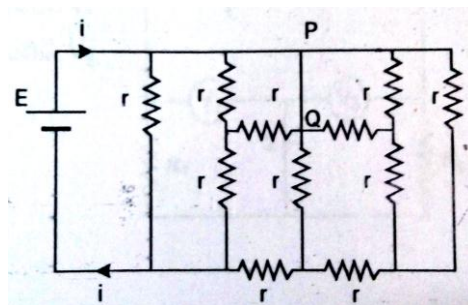
PART – A

(Multi Correct Choice Type)

This section contains 10 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

1. The electric field strength in a region is given as $\vec{E} = \frac{x\hat{i} + y\hat{j}}{x^2 + y^2}$. Then select the correct option(s).
- (A) The net charge inside a sphere of radius 'a' with its centre at origin will be $2\pi\epsilon_0 a$
 (B) The net charge inside a sphere of radius 'a' with its centre at origin will be $4\pi\epsilon_0 a$
 (C) The net charge inside a sphere of radius '2a' with its centre at origin will be $4\pi\epsilon_0 a$
 (D) The net charge inside a sphere of radius '2a' with its centre at origin will be $8\pi\epsilon_0 a$
2. A solution contains a mixture of two isotopes A (half life = 10 days) and B (half life = 5 days). Total activity of the mixture is 10^{10} disintegrations per second at time $t = 0$, the activity reduces to 20% in 20 days. Then select correct option(s).
- (A) Initial activity of A is 0.73×10^{10} dps.
 (B) Initial activity of B is 0.27×10^{10} dps.
 (C) The ratio of initial number of their nuclei is $N_A : N_B$ is 5.4
 (D) None of these

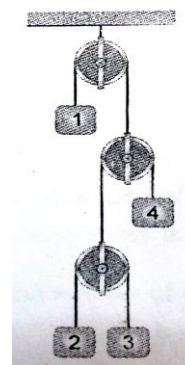
3. If $r = 1 \Omega$ and $E = 10 V$ in the network shown in figure. Then answer the following:
- (A) The value of current I is 22.85 A.
 (B) The value of current I is 42.85 A.
 (C) The current in branch PQ is 7.62 A.
 (D) The current in branch PQ is 3.8 A.



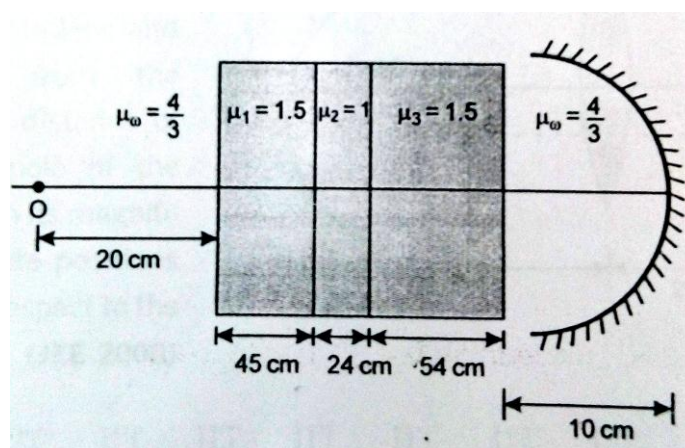
4. An aluminium wire of cross-sectional area $10^{-6} m^2$ is joined to a steel wire of the same cross-sectional area. This compound wire is stretched on a sonometer pulled by a weight of 10 kg. The total length of the compound wire between the bridges is 1.5 m of which the aluminium wire is 0.6 m and the rest is steel wire. Transverse vibrations are set up in the wire by using an external source of variable frequency. The density of aluminium is $2.6 \times 10^3 kg/m^3$ and that of steel is $1.04 \times 10^4 kg/m^3$. ($g = 10 m/s^2$)
- (A) The lowest frequency of excitation for which standing waves are formed such that joint of wires is a node is nearly 82 Hz.
 (B) The lowest frequency of excitation for which standing waves are formed such that joint of wires is a node is nearly 164 Hz.
 (C) A total of 4 nodes are formed on composite wire.
 (D) A total of 5 nodes are formed on composite wire.

space for rough work

5. In the arrangement shown in figure, all pulleys are smooth and massless. When the system is released from rest, accelerations of blocks 2 and 3 relative to 1 are 1 m/s^2 downwards and 5 m/s^2 downwards. Acceleration of block 3 relative to 4 is zero. Then
- (A) The absolute acceleration of block 1 is 2 m/s^2 upward.
 (B) The absolute acceleration of block 2 is 1 m/s^2 downward.
 (C) The absolute acceleration of block 3 is 3 m/s^2 downward.
 (D) The absolute acceleration of block 4 is 3 m/s^2 downward.



6. A composite slab consisting of different media is placed in front of a concave mirror of radius of curvature 150 cm . The whole arrangement is placed in water ($\mu_w = 4/3$). An object O is placed at a distance 20 cm from the slab. The refractive indices are $\mu_1 = 1.5$, $\mu_2 = 1$, $\mu_3 = 1.5$. The position of final image formed is



- (A) 130 cm on left of mirror
 (B) 153 cm on left of mirror
 (C) Final image is real
 (D) Final image is virtual
7. Two identical soap bubbles each of radius 1 cm come close to each other and join together maintaining a common surface between them.
- (A) Their common surface will be curved.
 (B) Their common surface will be flat.
 (C) Area of their common surface will be $\frac{3\pi}{2} \text{ cm}^2$
 (D) Area of their common surface will be $\frac{3\pi}{4} \text{ cm}^2$

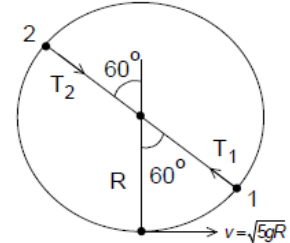
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8. An object of mass m is thrown vertically upwards in air with an initial speed v_0 . The air applies a drag force which is proportional to the instantaneous velocity of the particle in the opposite direction of the motion of ball. Then the time it takes to reach maximum height above ground is $[V_T = mg/c]$
 $[\vec{F} = -c(\vec{v})]$

(A) $\frac{V_T}{g} \ln \left[1 - \frac{v_0}{g} \right]$ (B) $\frac{V_T}{g} \ln \left[1 + \frac{v_0}{V_T} \right]$ (C) $\frac{V_T}{2g} \ln \left[1 + \frac{2v_0}{V_T} \right]$ (D) $\frac{V_T}{g} \ln \left[1 + \frac{2v_0}{V_T} \right]$

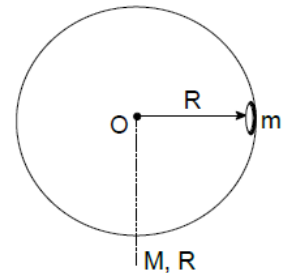
9. A ball of mass m is swinging in a vertical circle with its initial velocity at bottom as $v = \sqrt{5gR}$. Then select correct options for tensions T_1 and T_2 in string

- (A) $T_1 + T_2 = 4 mg$
 (B) $T_1 + T_2 = 6 mg$
 (C) $T_1 - T_2 = 2 mg$
 (D) $T_1 - T_2 = 3 mg$



10. A uniform circular ring of mass 'M' and radius 'R = 10 cm' is placed on a smooth horizontal surface at rest. An insect of mass $m (=M/2)$ initially sitting on the circumference of the ring starts moving with a velocity $v_0 = 2$ m/s relative to the ring along its circumference. Then choose the correct option(s).

- (A) The angular velocity of the ring about its centre is 5 rad/s.
 (B) The angular velocity of the ring about its centre is 10 rad/s.
 (C) The velocity of the centre of mass of the ring relative to ground is 0.5 m/s.
 (D) The velocity of the insect relative to ground is 1 m/s.



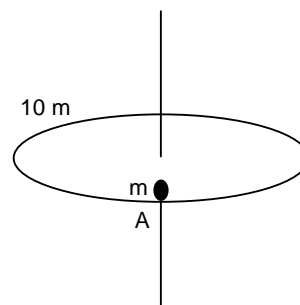
PART – C (Integer Type)

This section contains 10 **questions**. The answer to each question is a **single-digit integer**, ranging from 0 to 9. The correct digit below the question number in the ORS is to be bubbled.

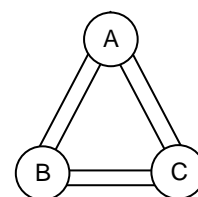
1. A satellite is moving in a circular orbit around earth. Suddenly, it's direction of motion is changed by angle $\theta = \cos^{-1} \left(\frac{3}{5} \right)$ away from earth without changing it's speed, due to which its path becomes elliptical around earth. During subsequent motion of satellite, ratio of its maximum distance to minimum distance from centre of earth is

space for rough work

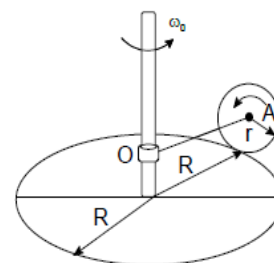
2. A man of mass m stands on periphery of a disc of mass $10m$ which is free to rotate about its own axis and is hinged there. If man moves along periphery of disc and reaches back to same point A of disc, it is observed that during this process, disc rotates by angle $\frac{2\pi}{n}$. Find the value of 'n'.



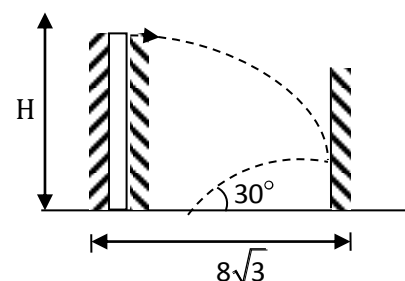
3. A metallic sphere (work function 4.2 eV) is suspended in a vacuum chamber by an insulating thread. Ultraviolet light of wavelength $0.2 \mu\text{m}$ strike on the sphere. Find the maximum electric potential (in volt) of the sphere
4. A thin wire of area of cross-section $A = 10^{-2} \text{ m}^2$ is used to make a ring of radius $r = 10^{-1} \text{ m}$. This ring is placed on a smooth horizontal floor & is given angular velocity $\omega = 2 \text{ rad/s}$ about its centre. Find out stress in the ring (mass per unit length of wire $\lambda = 1 \text{ kg/m}$)
5. Three metallic blocks A, B and C have masses m , m and $2m$ respectively. Specific heat of A, B and C are C , $2C$ and C respectively. Initial temperature of A, B and C are 10°C , 5°C and 5°C respectively. Now the blocks are connected by 3-identical rods as shown. Find the final temperature of block A on Celsius scale (Neglect any heat loss due to radiation, you can round off the answer to nearest integer).



6. A disc of radius $r = 2 \text{ cm}$ attached with a horizontal axle OA, is rolling without sliding on a circular track of radius $R = 10 \text{ cm}$ as shown. In the process, the centre of the disc moves with a constant speed $v = 10 \text{ cm/s}$. Find the angular acceleration (in rad/s^2) of the disc.



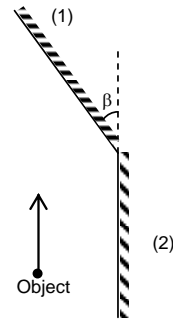
7. A ball is thrown horizontally from the top of a tower of unknown height. Ball strikes a vertical wall whose plane is normal to the plane of motion of ball. Collision is elastic and ball falls on ground at mid-point between tower and wall. Ball strikes the ground at angle of 30° with horizontal. The height of tower is.



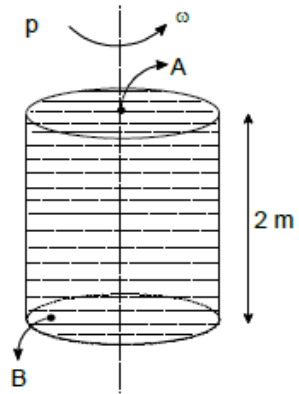
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8. A 50 Hz 20V source is connected to a resistance of 100Ω an inductance of 1 H and a capacitance of $10 \mu\text{F}$ all in series. Calculate approximate time (in sec) which the resistance (thermal capacity $2\text{J}/^\circ\text{C}$) will get heated by 10°C .

9. In the diagram shown all velocities are w.r.t. ground. The relative velocity of image in mirror(1) w.r.t. image in mirror(2) is $nv \sin \beta$ then $n = ?$



10. A closed tank of water is rotating about a vertical axis as shown in figure and at same time the entire tank is accelerated upward at 4 m/s^2 . If the rate of rotation is 10 rad/sec . The difference in pressure between points A and B is equal to $(10 \times a.01) \text{ kPa}$. There is a point B at the bottom of the tank at a radial distance of 0.5 m from the axis of rotation and point A is at the top on the axis of rotation. Find the value of a. (take $g = 9.8 \text{ m/s}^2$)



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SECTION-2 : CHEMISTRY

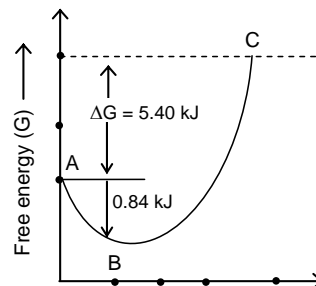
PART – A

(Multi Correct Choice Type)

This section contains 10 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

1. Following the graph, which of the statement/s is/are correct?

- (A) The complete conversion of N_2O_4 into NO_2 ($N_2O_4 \longrightarrow 2NO_2$) is spontaneous
- (B) At point B, free energy of the system becomes constant with time
- (C) In the region between A and B reaction has tendency to move in forward direction
- (D) In the region between B and C, ΔG for the reaction ($N_2O_4 \rightleftharpoons 2NO_2$) is greater than zero.



A = Standard free energy of 1 mol of N_2O_4

C = Standard free energy of 2 mol of NO_2

B = Equilibrium point

2. $H_2O_2 + H^+ + I^- \longrightarrow I_2 + H_2O$

On investigation of the above reaction, the following results were obtained.

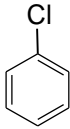
Initial conc. of reactant in M			Initial rate of formation of I_2 in $mol\ dm^{-3}\ s^{-1}$
$[H_2O_2]$	$[I^-]$	$[H^+]$	
0.01	0.01	0.30	2×10^{-6}
0.03	0.01	0.30	6×10^{-6}
0.03	0.02	0.10	1.2×10^{-5}
0.03	0.02	0.20	1.2×10^{-5}

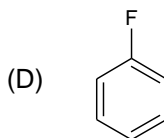
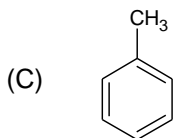
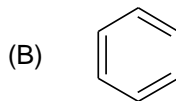
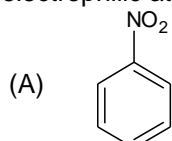
Choose the correct statement(s)

- (A) The rate equation for the reaction is $Rate = k[H_2O_2][I^-]$.
- (B) The reaction is zero order with respect to acid.
- (C) The reaction is termolecular.
- (D) The rate constant is $2 \times 10^{-1}\ mol^{-2}\ dm^6\ s^{-1}$.
3. Which of the following resonating structure is most stable?

- (A) $\overset{\oplus}{CH_2} - CH = CH - \overset{\ominus}{CH_2}$
- (B) $CH_2 = CH - \overset{\oplus}{CH} - \overset{\ominus}{CH_2}$
- (C) $\overset{\oplus}{CH_2} - \overset{\ominus}{CH} - CH = CH_2$
- (D) $\overset{\ominus}{CH_2} - \overset{\oplus}{CH} - \overset{\ominus}{CH} - \overset{\oplus}{CH_2}$

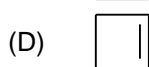
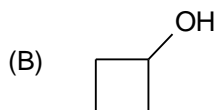
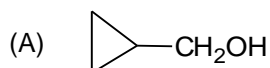
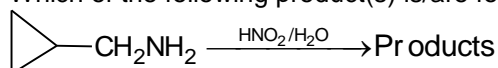
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4. Which of the following compound(s) is/are more reactive than chlorobenzene  towards electrophilic attack?



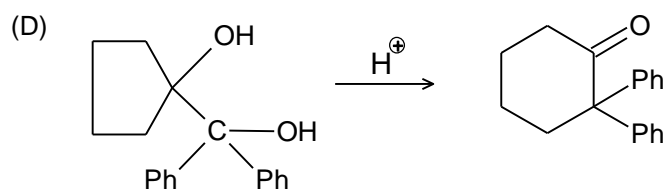
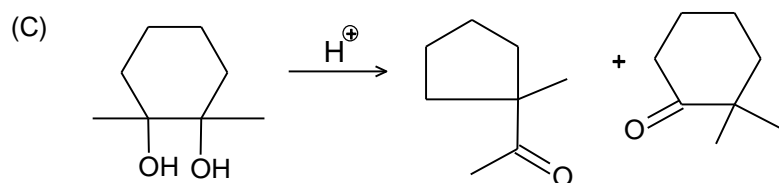
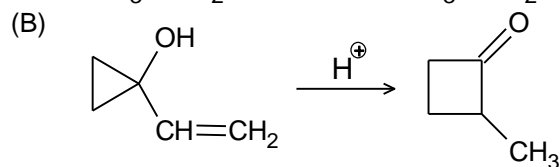
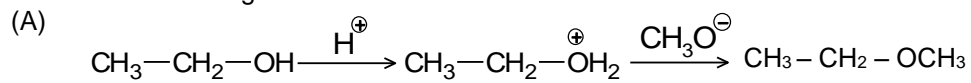
5. The degree of dissociation of HI at a particular temperature is 0.8. The volume of 2 M hypo solution required to neutralize the iodine present in an equilibrium mixture of reaction which is started by 2 mole each of H_2 and I_2 in a vessel of two litre capacity is
 (A) 0.4 litre (B) 0.8 litre
 (C) 1.6 litre (D) 3.2 litre
6. For a reaction $A \rightarrow B$, E_a for the forward reaction (E_a)_f and backward reaction (E_a)_b is 19 kJ/mole and 9 kJ/mole respectively. Potential energy of A is 12 kJ/mole. Find out which of the following options are correct?
 (A) Heat of reaction is 10 kJ/mol
 (B) It is an exothermic reaction
 (C) The threshold energy of reaction is 31 kJ/mol
 (D) The potential energy of product is 22 kJ/mol

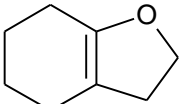
7. Which of the following product(s) is/are formed in the following reaction?



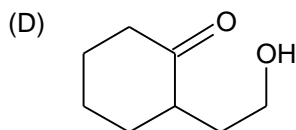
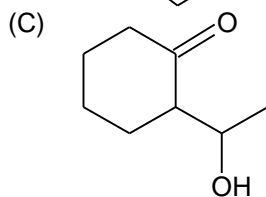
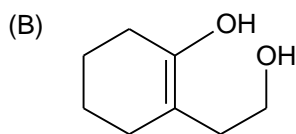
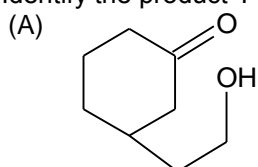
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8. Which of the following reaction is not correct?



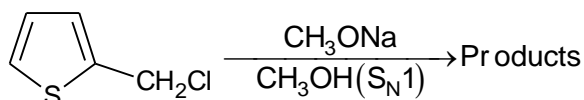
9.  $\xrightarrow[\text{H}_2\text{O}]{\text{H}^+}$ 'P' (major),

Identify the product 'P'

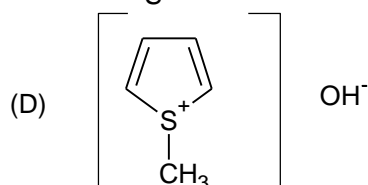
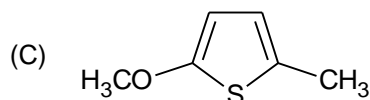
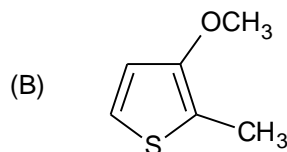
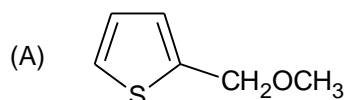


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10.

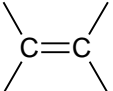


The product(s) formed in the above reaction is/are



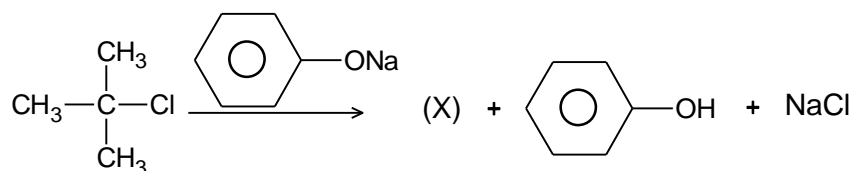
PART – C (Integer Type)

This section contains 10 **questions**. The answer to each question is a **single-digit integer**, ranging from 0 to 9. The correct digit below the question number in the ORS is to be bubbled.

- The molecular formula of an alcohol is $\text{C}_4\text{H}_9\text{OH}$. How many CH_3 group(s) is/are present in its least acidic isomer?
- The formula of a carboxylic acid is $\text{C}_6\text{H}_{12}\text{O}_2$. How many isomer(s) of it contains a 4° -carbon atom (quaternary carbon atom)?
- If it is assumed that enthalpy of polymerisation of ethylene as represented by the reaction, $n(\text{CH}_2 = \text{CH}_2) \longrightarrow (\text{CH}_2 - \text{CH}_2)_n$ is -1 energy unit/mol of ethylene. Given bond enthalpy of  bond is 7 energy unit/mol, then enthalpy of C – C bond in kJ/mol would be
- The boiling point of a solution of 5 gm sulphur in 100 gm CS_2 is 0.5°C above pure solvent. If the K_b of CS_2 is $2.56 \text{ K molality}^{-1}$, then the atomicity of sulphur in this solvent is?
- For a second order reaction
 $t_{75\%} = X t_{50\%}$
 Find the value of X
- The molecular mass of a polyhydric alcohol increases by 252 units when it forms product with CH_3COCl in presence of pyridine. How many OH groups are present in the alcohol?

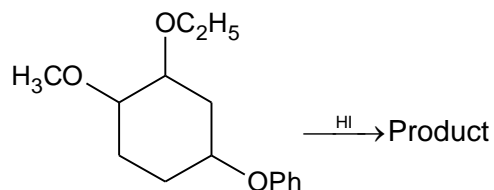
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7.



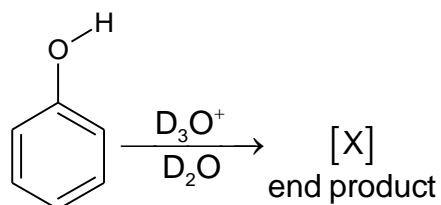
How many hydrogen atom(s) is/are present in product(X)?

8.



How many maximum number of moles of HI can be absorbed by one mole of the above reagent?

9.



What are the number in the end deuterium atoms product [X]?

10. 124 g of ethylene glycol (mol.mass = 62) was added to 935 g of water. The solution was cooled upto -4°C. How many gram of ice would be separated in the process?
 [K_f of H₂O = 1.86 K kg mol⁻¹]

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SECTION-3 : MATHEMATICS

PART – A

(Multi Correct Choice Type)

This section contains 10 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

1. Which of the following are **CORRECT**?

(A) If A and B are symmetric matrices of order 3 then $|AB - BA| = 0$

(B) If A and B are square matrices of order 'n' such that $AB = I_n$, then $BA = I_n$.

(C) The matrix $A = \begin{bmatrix} 9017 & 5148 & 7220 \\ 1234 & 2117 & 4848 \\ 4320 & 3648 & 1179 \end{bmatrix}$ is non-invertible.

(D) If two square matrices A and B of same order commute, then all positive integral powers of A and B commute.

2. If $T(3,2)$ is the foot of perpendicular drawn from focus $S(2,-1)$ on a tangent to the parabola, and the directrix of parabola passes through $P(0,9)$, then

(A) Length of latus rectum of parabola is $8\sqrt{2}$

(B) Equation of tangent at vertex is $x + y - 5 = 0$

(C) Equation of axis of the parabola is $x - y - 3 = 0$

(D) Directrix is at a distance $2\sqrt{2}$ from focus

3. In a triangle ABC, if $4\sin A = 4\sin B = 3\sin C$ and perimeter of the triangle is 10, then

(A) Greatest angle of triangle is $\cos^{-1}\left(\frac{1}{9}\right)$ (B) in-radius of the triangle is $\frac{2}{\sqrt{5}}$

(C) Circumradius of triangle is $\frac{2\sqrt{5}}{9}$ (D) Length of smallest altitude is $\sqrt{5}$

4. Let $f : \left[0, \frac{\pi}{2}\right] \rightarrow [0, 1]$ be a differentiable function such that $f(0) = 0$, $f\left(\frac{\pi}{2}\right) = 1$, then

(A) $f'(\alpha) = \sqrt{1 - (f(\alpha))^2}$ for all $\alpha \in \left(0, \frac{\pi}{2}\right)$

(B) $f'(\alpha) = \frac{2}{\pi}$ for all $\alpha \in \left(0, \frac{\pi}{2}\right)$

(C) $f(\alpha) \cdot f'(\alpha) = \frac{1}{\pi}$ for at least one $\alpha \in \left(0, \frac{\pi}{2}\right)$

(D) $f'(\alpha) = \frac{8\alpha}{\pi^2}$ for at least one $\alpha \in \left(0, \frac{\pi}{2}\right)$

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5. Consider a curve passing through $(1, 1)$ such that perpendicular distance of the normal drawn at any point P from origin is equal to the ordinate of point P. Which of the following statements are **CORRECT**?
- (A) The curve passes through origin
 (B) The equation of tangent at $(2, 0)$ is $x = 2$
- (C) The differential equation of the curve is $\frac{dy}{dx} = \frac{y^2 - x^2}{2xy}$
- (D) The differential equation of the curve is $\frac{dy}{dx} = \frac{x^2 - y^2}{2xy}$
6. Let $S_1 : x^2 + y^2 - 6x = 0$ and $S_2 : x^2 + y^2 + 4x = 0$ be two circles and L_1, L_2, L_3 be their common tangents. Which of the following statements are **CORRECT**?
- (A) Area of triangle formed by the lines L_1, L_2 and L_3 is $12\sqrt{6}$ square units.
 (B) Equation of transverse common tangent is $x = 0$
 (C) Equation of a direct common tangent is $x - 2\sqrt{6}y + 12 = 0$
 (D) Equation of the circumcircle of the triangle formed by direct common tangents and their chord of contact w.r.t. S_2 is $x^2 + y^2 + 14x + 24 = 0$
7. If a, b, c are rational and no two of them are equal then the equations $(b - c)x^2 + (c - a)x + a - b = 0$ and $a(b - c)x^2 + b(c - a)x + c(a - b) = 0$
- (A) have rational roots
 (B) will be such that at least one has rational roots
 (C) have exactly one root common
 (D) have at least one root common
8. The equation $\frac{x^2}{16 - \lambda} + \frac{y^2}{8 - \lambda} = 1, (\lambda \neq 8, 16)$ represents
- (A) an ellipse if $0 < \lambda < 8$
 (B) a hyperbola if $8 < \lambda < 16$
 (C) a rectangular hyperbola if $\lambda = 12$
 (D) no real curve if $\lambda > 16$
9. The coefficient of t^7 in $(1 + t)^6 (1 + t^2) (1 + t^4) (1 + t^8)$ is divisible by
- (A) 4
 (B) 6
 (C) 8
 (D) 16
10. The first two terms of a GP add up to 12. The sum of third and fourth terms is 48. If the terms are alternately positive and negative, then
- (A) common ratio of GP is 2
 (B) common ratio of GP is -2
 (C) sixth term of GP is 128
 (D) sixth term of GP is 384

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PART – C
(Integer Type)

This section contains 10 **questions**. The answer to each question is a **single-digit integer**, ranging from 0 to 9. The correct digit below the question number in the ORS is to be bubbled.

1. Let $A = \{3, 4, 5, 6\}$ and $B = \{1, 2, 3, \dots, 10\}$ be two sets. Let a function f be defined from set A to set B , such that $f(i) - f(j) \geq 2 \forall i > j$, where $i, j \in A$. If the number of such functions is N , then the value of $\frac{N}{5}$ is
2. If $x = 2, 4$ are the solutions of the equation $|mx + \alpha| + |mx + \beta| = c$ where $m > 0$, and α, β, c are non-zero real constants, then $\left| \frac{\alpha + \beta}{m} \right|$ is equal to
3. Let $f(x) = \frac{ax^2 + bx + c}{x + 1}$ such that $\lim_{x \rightarrow 0} f(x) = 2$ and $\lim_{x \rightarrow \infty} f(x) = 1$. Find the value of $(a + b + c)$.
4. Let z be a complex number satisfying $\left(z + \frac{1}{z}\right)\left(z + \frac{1}{z} + 1\right) = 1$. The value of $\frac{1}{6}\left(3z^{100} + \frac{2}{z^{100}} + 1\right)\left(z^{100} + \frac{2}{z^{100}} + 3\right)$ is equal to
5. If the locus of point of intersection of tangents to $x^2 + y^2 = a^2$ at points whose parametric angles differ by $\frac{\pi}{3}$ is $k(x^2 + y^2) = 4a^2$, then the value of k is
6. The number of values of a for which cubic equation $x^3 + 3x^2 + 3 - a = 0$ has all the roots as integers is
7. A parabola $y = x^2 + bx + 9$, $b \in (6, \infty)$ crosses the x -axis at $A(\alpha, 0)$ and $B(\beta, 0)$ both to the right of the origin. A circle also passes through points A and B . The length of the tangent from the origin to this circle is
8. The shortest distance between the lines given by $\vec{r} = 3\hat{i} + 8\hat{j} + 3\hat{k} + \lambda(3\hat{i} - \hat{j} + \hat{k})$ and $\vec{r} = -3\hat{i} - 7\hat{j} + 6\hat{k} + \mu(-3\hat{i} + 2\hat{j} + 4\hat{k})$ is $k\sqrt{30}$, then the value of k is
9. Let $P(x, y)$ is a variable point such that $\left| \sqrt{(x-1)^2 + (y-2)^2} - \sqrt{(x-5)^2 + (y-5)^2} \right| = 3$. If origin is shifted to point $\left(3, \frac{7}{2}\right)$ and the axes are rotated through an angle θ in clockwise sense so that equation of given hyperbola changes to standard form $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$, then $\tan \theta = \frac{3}{\lambda}$ where λ is
10. A positive integer n is randomly guessed. Let the probability that $x^{n+1} - x^n + 1$ is divisible by $x^2 - x + 1$ be P . The value of $12P$ is

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