FIITJEE

BATCH – AII 1820

PHYSICS, CHEMISTRY & MATHEMATICS

CPT2	CODE:	PAPER - 1

Time Allotted: 3 Hours **Maximum Marks: 300**

- 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 three parts: **Part-A, B & 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 ***Blue/Black Ball Point Pen*** 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 Three Parts.

(i) **Part-A (01 – 04)** contains 4 multiple choice questions which have only one correct answer. Each question carries **+5 marks** for correct answer and **– 2 mark** for wrong answer.

(ii) **Part-A (05 – 10)** contains 6 multiple choice questions which have one or more than one correct answer.
Full Marks: +4If only the bubble(s) corresponding to all the correct options(s) is (are) darkened.
Partial Marks: +1For 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: −1In 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 +4marks; darkening only (A) and (D)will result in +2marks; and darkening (A) and (B)will result in −1marks,as a wrong option is also darkene

(iii) **Part-B (01 - 04)** contains 4 Matrix Match Type question containing statements given in 2 columns. Statements in the first column have to be matched with statements in the second column. Each question carries **+8 marks** for all correct answer. For each correct row **+2 mark** will be awarded. There may be one or more than one correct choice. No marks will be given for any wrong match in any question. There is no negative marking

(iv) **Part-C (01 – 06)** contains 6 Numerical based questions with single digit integer as answer, ranging from 0 to 9 and each question carries **+4 marks** for correct answer and **– 1 mark** for wrong answer.

Name of the Candidate :_____

Batch :_____ **Date of Examination :**_____

Enrolment Number :_____

SECTION-I: PHYSICS

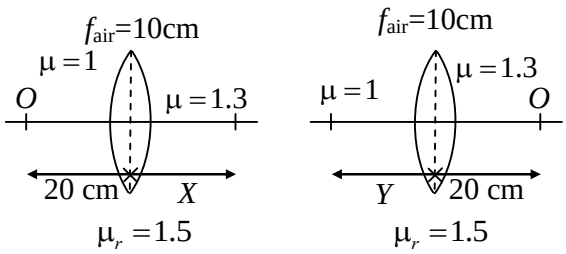
Part-A: Only One Option Correct Type

This section contains **4 Multiple Choice Questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **Only One Option is correct.**

1. A diatomic molecule having atoms of masses m_1 and m_2 has its potential energy function about the equilibrium position r_0 as given by $U(r) = -A + B(r - r_0)^2$ where A and B are constants. When the atom vibrate at high temperature condition, the square of angular frequency of vibration will be

(A) $\frac{2B}{m_1}$ (B) $\frac{2B}{m_2}$ (C) $\frac{2B(m_1+m_2)}{m_1m_2}$ (D) $\frac{B(m_1+m_2)}{2m_1m_2}$

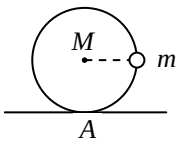
2. An equiconvex lens made up of a material of refractive index 1.5 has focal length of 10 cm when placed in air as shown in the figure. One side of the medium is replaced by another medium of refractive index 1.3. If X and Y are the image distances when the object is placed at a distance of 20cm from optical centre in the medium with refractive index 1 and 1.3 respectively, then



(A) $X > 1.3Y$ (B) $X < 1.3Y$

(C) $X = 1.3Y$ (D) cannot be determined

3. A uniform body of mass M of radius R has a small mass m attached at edge as shown in the figure. The system is placed on a perfectly rough horizontal surface such that mass m is at the same horizontal level as the centre of body. It is assumed that there is no slipping at point A. If I_A is the moment of the inertia of combined system about point of contact A then the normal reaction at point A just after the system is released from rest is (M = 6 kg, m = 2 kg, I_A = 4kg m^2, R = 1m, g = 10m/s^2)



(A) 60N (B) 80 N (C) 75 N (D) 70 N

4. A circuit consists of a capacitor and a resistor having resistance R = 220 Ω connected in series. When an alternating e.m.f. of peak voltage V_0 = 220 $\sqrt{2}$ V is applied to the circuit, the peak current in steady state is observed to be I_0 = 1A. The phase difference between the current and the voltage is

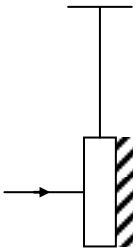
(A) 30° (B) 45° (C) 60° (D) 90°

space for rough work

Part-A: One or More Than One Options Correct Type

This section contains **6 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONE** or **MORE THAN ONE is correct.**

5. A small mirror is suspended by a thread as shown in figure. A short pulse of monochromatic light rays is incident normally on the mirror and gets reflected. Which of the following statements are correct?



(A) mirror will starts oscillating
(B) wavelength of reflected rays will be greater than that of incident rays
(C) wavelength of reflected rays may be less than that of incident rays
(D) mirror will be at rest after some time

6. A particle of mass m is moving in a field where the potential energy is given by $U(x) = U_0(1-\cos ax)$, where U_0 and a are constants and x is the displacement from mean position . Then (for small oscillations)

(A) the time period is $T = 2\pi\sqrt{\frac{m}{aU_0}}$ (B) the speed of particle is maximum at $x = 0$

(C) the amplitude of oscillations is $\frac{\pi}{a}$ (D) the time period is $T = 2\pi\sqrt{\frac{m}{a^2U_0}}$

7. Two different coils have self inductances L_1 = 8 mH and L_2 = 2 mH. The current in one coil is increased at a constant rate. The current in the second coil is also increased at the same constant rate. At a certain instant of time, the power given to the two coils is the same. At this time the current, the induced voltage and the energy stored in the first coil are i_1, V_1 and U_1 respectively. Corresponding values for the second coil at the same instant are i_2, V_2 and U_2 respectively. Then

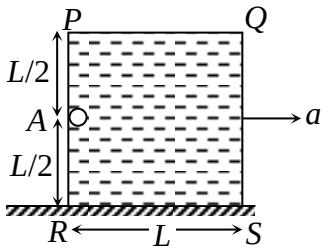
(A) $\frac{i_1}{i_2} = \frac{1}{4}$ (B) $\frac{i_1}{i_2} = 4$ (C) $\frac{U_2}{U_1} = 4$ (D) $\frac{V_2}{V_1} = \frac{1}{4}$

8. The magnetic field perpendicular to the plane of conducting ring of radius r changes at the rate $\frac{dB}{dt} = \alpha$. Then

(A) Emf induced in the ring is $\pi r^2\alpha$
(B) Emf induced in the ring is $2\pi r\alpha$
(C) the potential difference between diametrically opposite points on the ring is half of induced emf
(D) all points on the ring are at same potential

space for rough work

9. A small solid ball of density ρ is held inside at point *A* a cubical container of side *L*, filled with an ideal liquid of density 4ρ as shown in the figure. Now, if the container starts moving with constant acceleration *a* horizontally and the ball is released from point *A* simultaneously, then



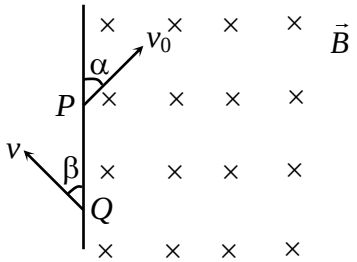
(A) For ball to hit the top of container at end *Q*, $a = 3g$

(B) For ball to hit the top of container at end *Q*, $a = 2g$

(C) Ball hits the top of container at end *Q* after a time $t = \sqrt{\frac{L}{3g}}$

(D) Ball hits the top of container at end *Q* after a time $t = \sqrt{\frac{2L}{3g}}$

10. A particle of charge $-q$ and mass *m* enters a uniform magnetic field $\vec{B}$ (perpendicular to paper inwards) at *P* with a velocity v_0 at an angle α and leaves the field at *Q* with velocity *v* at angle β as shown in the figure. Then



(A) $\alpha = \beta$

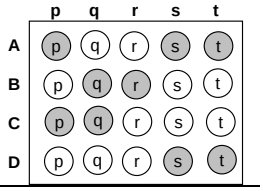
(B) $v = v_0$

(C) $PQ = \frac{2mv_0 \sin\alpha}{Bq}$

(D) particle remains in the field for time $t = \frac{2m(\pi - \alpha)}{Bq}$

Part-B : Matrix-Match Type Questions

This Section contains **4 Matrix Match Type Questions.** Each question has **four statements** (A, B, C and D) given in **Column I** and **five statements** (p, q, r, s and t) in **Column II.** Any given statement in Column I can have correct matching with **ONE** or **MORE** statement(s) given in Column II. For example, if for a given question, statement B matches with the statements given in q and r, then for the particular question, against statement B, darken the bubbles corresponding to q and r in the ORS.

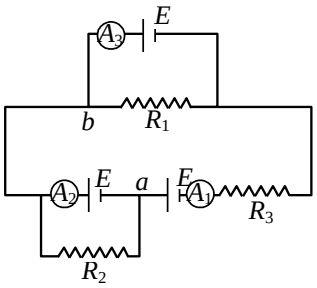


1. Let h_o be the initial height of ball with respect to the earth. The coefficient of restitution is e.

Column I		Column II	
(A)	Total distance travelled by the ball before coming to rest.	(P)	$e^{2n}h_o$
(B)	Height attained after n impacts	(Q)	$h_0\left(\frac{1+e^2}{1-e^2}\right)$
(C)	Average force exerted by ball	(R)	$P\left(\frac{1+e}{1-e}\right)$
(D)	Total momentum transferred to the earth	(S)	mg

space for rough work

2. In the circuit shown in figure, $R_1 = R_2 = R_3 = 3\Omega$ and e.m.f. of each cell is $E = 4V$ and negligible internal resistance. All ammeters are ideal. Match the following:



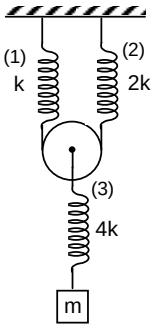
Column-I		Column-II	
(A)	Reading of ammeter A_1 in ampere is	(P)	4/3
(B)	Reading of ammeter A_2 in ampere is	(Q)	8/3
(C)	Reading of ammeter A_3 in ampere is	(R)	4
(D)	Potential difference between point *a* and point *b* in volt is	(S)	zero

3. Column shows O_1 object and O_2 image. The optical system responsible can be a spherical mirror, plane mirror or a thin lens. In the case of the lens and spherical mirror, straight line shows the principal axis. Match column-I and column-II.

Column-I		Column-II	
(A)	O_2 ● O_1 ● ———	(P)	Concave mirror between O_1 and O_2
(B)	O_1 ● O_2 ● ———	(Q)	Diverging lens between O_1 and O_2
(C)	O_2 ● ——— O_1 ●	(R)	Convex mirror between O_1 and O_2
(D)	O_1 ● ——— O_2 ●	(S)	Converging lens between O_1 and O_2
		(T)	Inclined plane mirror somewhere between O_1 and O_2

space for rough work

4. A spring block system is arranged as shown in figure Spring is idle & pulley is light. When block is in equilibrium then match the following.



Column-I		Column-II	
(A)	Extension in spring (1)	(P)	$\frac{mg}{6k}$
(B)	Extension in spring (2)	(Q)	$\frac{mg}{2k}$
(C)	Extension in spring (3)	(R)	$\frac{5mg}{8k}$
(D)	Initially the springs were at their natural length then displacement of block to reach equilibrium position.	(S)	$\frac{mg}{4k}$

Part –C: Single digit integer

This section contains **6 questions.** The answer to each question is a single digit integer ranging from 0 to 9 (both inclusive).

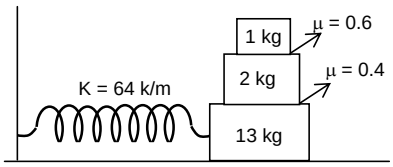
1. 2 kg of ice at -22.5^0C is mixed with 2.5 kg of water at 25^0C in an insulating container. If the specific heat of ice and water are 0.5 cal/gm°C and 1 cal/gm°C respectively. Latent heat of fusion of ice = 80 cal/gm. Find the amount of water present in the container (In kg).

2. The maximum acceleration and maximum velocity of simple harmonically oscillating system are 8 m/sec^2 and 8 m/s respectively. What is the angular frequency.

3. A plane progressive wave of frequency 25 Hz, amplitude 2.5×10^{-5}m, and initial phase zero moves along the negative x axis with a velocity of 300 m/s. A and B are two points at a separation of 6m in the line of propagation the phase difference is $\frac{x\pi}{2}$. Find x.

4. Two satellites with mass ratio $m_1 : m_2 = 1:1$ are moving in orbits of radii ratio $r_1 : r_2 = 4:1$ around a planet. Find the ratio of their time periods.

5. What can be the maximum amplitude (in m) of the system so that there is no slipping between any of the blocks



6. A satellite is moving in a circular orbit around earth at a height R above earth surface (R being radius of earth) It's velocity should be increased to $\sqrt{k}$ times its initial orbital speed value, so as to make it escape from earth gravitational pull and reach infinity. Find k

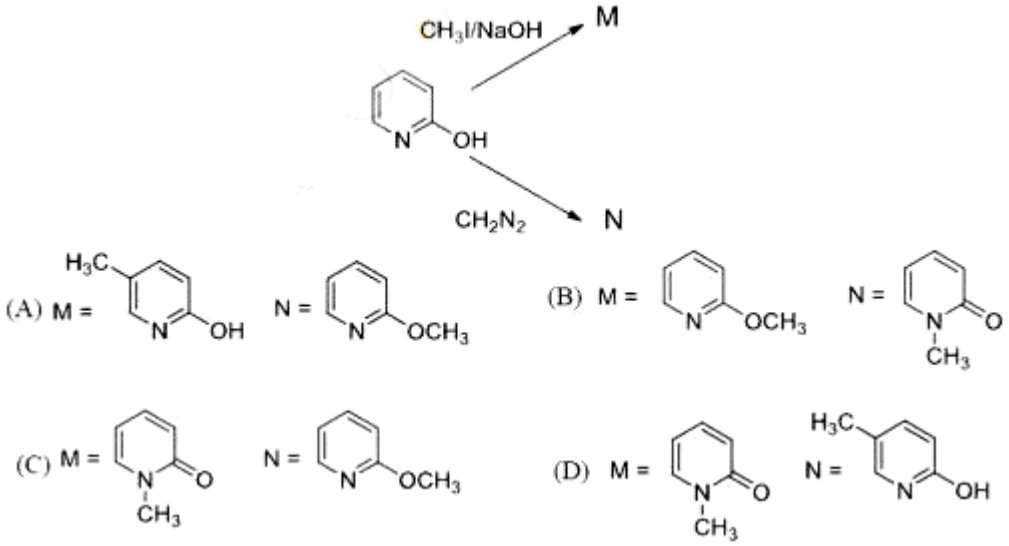
space for rough work

SECTION-II: CHEMISTRY

Part-A: Only One Option Correct Type

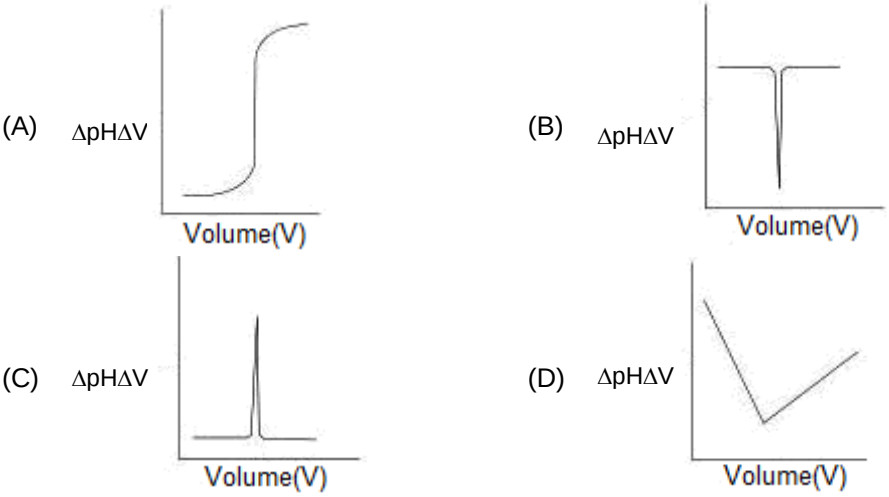
This section contains **4 Multiple Choice Questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **Only One Option is correct.**

1. The major products M and N formed in the following reactions are:–



2. The highest occupied MO in N_2 and O_2^+ respectively are (take x-axis as inter nuclear axis)
(A) $\sigma 2p_x$, $\pi^* 2p_y$ (B) $\pi 2p_y$, $\pi 2p_z$ (C) $\sigma^* 2p_x$, $\sigma 2p_x$ (D) $\pi^* 2p_y$, $\pi^* 2p_z$

3. The titration of a strong acid with a strong base is represented by the plot:–



4. With increasing pressure, the temperature range, over which the liquid state is stable:–
(A) Decreases
(B) Remains constant
(C) Increases
(D) Decreases till the critical pressure and then increases

space for rough work

Part-A: One or More Than One Options Correct Type

This section contains **6 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONE** or **MORE THAN ONE is correct.**

5. For the reaction $A \longrightarrow B$, the rate law expression is $-\frac{d[A]}{dt} = k[A]^{1/2}$. If initial concentration of A is A_0, which of the following statements is/are true regarding this reaction?
(A) The plot of $\sqrt{A}$ against 't' will be linear
(B) The half life period is $t_{1/2} = \frac{\sqrt{2}\left(\sqrt{2}-1\right)}{K}\sqrt{A_0}$
(C) The rate of reaction decreases linearly with time
(D) The integrated form of rate expression is $\sqrt{A} = -\frac{K}{2}t + \sqrt{A_0}$

6. Which of the following statement(s) are correct?
(A) $CH_3 - Cl > CH_3 - F > CH_3 - Br > CH_3 - I$ (Order of dipole moment)
(B) $Cl_2 > F_2 > Br_2 > I_2$ (Order of bond energy)
(C) $S_2O_3^{2-}, S_2O_4^{2-}, S_2O_5^{2-}$ (All have S – S linkage)
(D) $PCl_5 > SiCl_4 > AlCl_3 > MgCl_2$ (Order of hydrolysis)

7. Choose the correct statements:–
(A) Maximum number of atoms lying in one plane of $C(CN)_4$ molecule is 5
(B) Only oxyacid of fluorine which can be isolated is HOF.
(C) In P_4S_3 molecules there are a six P–S bonds, three P–P bond and ten lone pair of electrons
(D) $B_3N_3H_6$, $B_3H_3O_3$, $C_3H_3Cl_3$, $C_{12}O_9$ all have structure similar to benzene

8. Which of the following statements is/are true about the transition metal alkene complexes?
K [Pt $Cl_3C_2H_4$]
(A) Back bonding weakens the double bond of the alkene
(B) σ bonding and back-bonding synergistically strengthen metal alkene interaction
(C) Electron withdrawing substituents on alkene reduce back bonding
(D) π–acidic co-ligands on metal strengthen back bonding

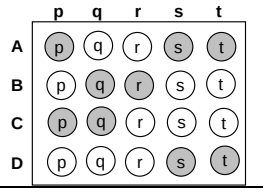
9. On electrolysis, in which of the following, O_2 would be liberated at the anode?
(A) dil H_2SO_4 with Pt electrode (B) aq. $AgNO_3$ with Pt electrode
(C) dil H_2SO_4 with Cu electrode (D) aq. NaOH with Pt electrode

10. Which of the following thermodynamic relation(s) is/are correct?
(A) $\left(\frac{dT}{dV}\right)_S = \left(\frac{dP}{dS}\right)_V$ (B) $\left(\frac{dT}{dP}\right)_S = \left(\frac{dV}{dS}\right)_P$
(C) $\left(\frac{dS}{dV}\right)_T = \left(\frac{dP}{dT}\right)_V$ (D) $\left(\frac{dS}{dP}\right)_T = \left(\frac{dV}{dT}\right)_P$

space for rough work

Part-B : Matrix-Match Type Questions

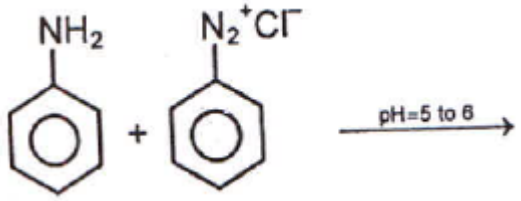
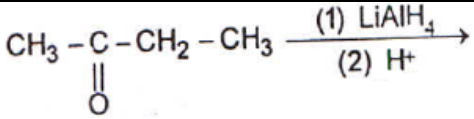
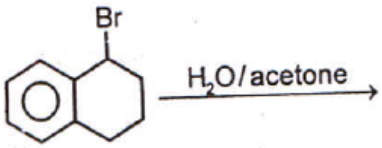
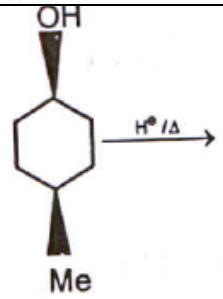
This Section contains **4 Matrix Match Type Questions.** Each question has **four statements** (A, B, C and D) given in **Column I** and **five statements** (p, q, r, s and t) in **Column II.** Any given statement in Column I can have correct matching with **ONE** or **MORE** statement(s) given in Column II. For example, if for a given question, statement B matches with the statements given in q and r, then for the particular question, against statement B, darken the bubbles corresponding to q and r in the ORS.



1. Contents of test tube Y are added drop by drop in test tube W.

Column – I			Column – II	
	W	**Y**		
(A)	CH_3COONa	HCl	(P)	Precipitate is formed in the reaction
(B)	CH_3COOH	NaOH	(Q)	Phenolphthalein becomes colourless when added to the solution at end point
(C)	$BaCl_2$	H_2SO_4	(R)	pH of the solution at the end point of titration is greater than 7
(D)	$PbCl_2$	$NH_3(aq)$	(S)	Molar conductance of solution increases after the end point
			(T)	Molar conductance become nearly constant after end point

2. Match the reactions in column – I with appropriate option in column – II.

Column – I		Column – II	
(A)		(P)	Carbocation
(B)		(Q)	Racemic mixture
(C)		(R)	Coupling reaction
(D)		(S)	Addition reaction
		(T)	Substitution reaction

space for rough work

3. Match the polymer mentioned on the left with the Catalyst used for its manufacture given on the right:–

Polymer		Manufacture	
(A)	Low density polythene	(P)	Ziegler Na^{++a} catalyst
(B)	Low density polythene	(Q)	Traces of oxygen
(C)	Polythene terephthalate	(R)	Butyl Lithium
(D)	P.V.C	(S)	Antimony

4. Match the column.

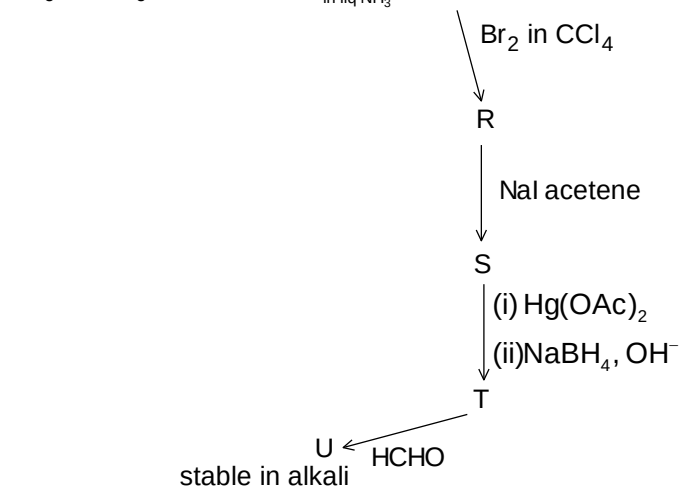
Column-I		Column-II	
(A)	In isothermal reversible expansion	(P)	$^{\Delta}S_{sys} = 0$
(B)	In isothermal irreversible expansion	(Q)	$^{\Delta}S_{sys} \neq 0$
(C)	In adiabatic reversible expansion	(R)	$^{\Delta}S_{surr} = 0$
(D)	In adiabatic irreversible expansion	(S)	$^{\Delta}S_{surr} \neq 0$
		(T)	$^{\Delta}S_{Total} = 0$

Part –C: Single digit integer

This section contains **6 questions.** The answer to each question is a single digit integer ranging from 0 to 9 (both inclusive).

1. How many of the following compound will give positive test with ammonical silver nitrate.
(i) Ethyne (ii) Formic acid (iii) Formaldehyde
(iv) Benzaldehyde (v) Fructose (vi) Acetal
(vii) Glucose (viii) Maltose (ix) Sucrose

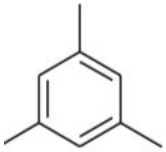
2. $CH_3 - CCl_3 \xrightarrow{6\ Ag} P \xrightarrow[\text{in liq } NH_3]{Na} Q$

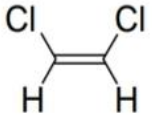


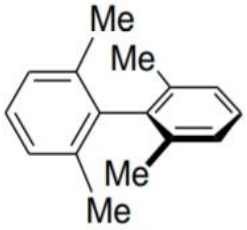
Possible stereoisomers of U is:

space for rough work

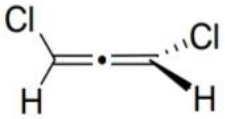
3. Among the following, the number of molecules heat posses C_2 axis of symmetry is:





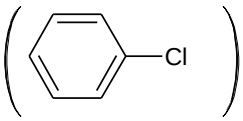


BF_3 $CHCl_3$ 2,5-dimethylthiophene

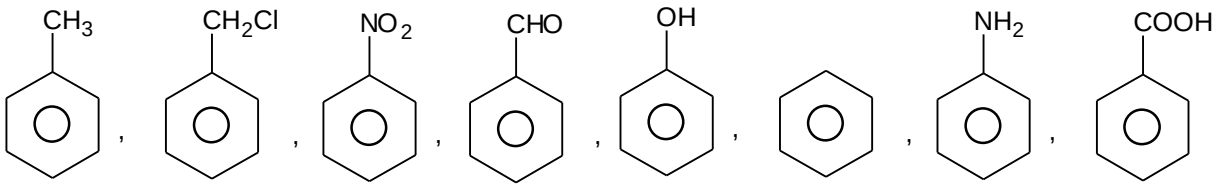


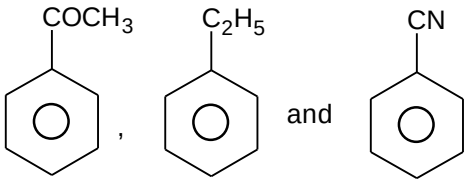
4. How many hydroxide ppt. are soluble in excess NH_4OH?
$Zn(OH)_2$ $Cd(OH)_2$, $Mn(OH)_2$, $Ni(OH)_2$ $Co(OH)_2$, $Pb(OH)_2$, $Fe(OH)_3$, $Cu(OH)_2$

5. What is the double bond equivalent of churchane?

6 How many of the following compound(s) is/are more reactive than chlorobenzene 

towards NO_2BF_4 (Electrophilic substitution reaction)?





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SECTION-III: MATHEMATICS

Part-A: Only One Option Correct Type

This section contains **4 Multiple Choice Questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **Only One Option is correct.**

1. If $f(x)$ is a differentiable function for all $x \in R$ such that

   (i) $f(x)$ has fundamental period '2'

   (ii) $f(x) = 0$ has exactly two solutions in [0, 2] and

   (iii) $f(0) \neq 0$

   Also consider $h(x) = f'(x).\cos x - f(x).\sin x$ and g(x)=f(x).cosx

   then which of the following is correct in the interval (0,99) ?

   (A) Min. no.of distinct roots of h(x) & g(x) are resp. 129 & 130
   (B) Min. no.of distinct roots of h(x) & g(x) are resp. 127 & 128
   (C) Min. no.of distinct roots of h(x) & g(x) are resp. 129 & 129
   (D) Min. no.of distinct roots of h(x) & g(x) are resp. 129 & 128

2. The minimum value of $(\sin\alpha - \cot\beta)^2 + (\tan\beta - \cos\alpha)^2$ for all admissible real Values of α and β is

   (A) $3 - 2\sqrt{2}$ (B) 0 (C) $3 + 2\sqrt{2}$ (D) $2 - 3\sqrt{3}$

3. If $f(x)$ is continuous function and satisfying $f(x) + f(1+x) = |2^x - 1| + |x - 1|$ in $0 \le x \le 2$, then the value of $\int_0^2 f(x)dx$ is equal to

   (A) $\frac{1}{\ln 2} - \frac{1}{2}$ (B) $\frac{1}{\ln 2} - 1$ (C) $\frac{2}{\ln 2} - 1$ (D) none of these

4. If $7\log(t_r(A)) \le 4\log 7$ where A is a diagonal matrix of order 7 with positive entries & $|A| = 7^{-3}$ then $t_r(A^2)$ is

   (A) $\sqrt[3]{7}$ (B) $\sqrt[4]{7}$ (C) $\sqrt[7]{7}$ (D) 7

   ($t_r(A)$ = sum of elements of matrix A along its principal diagonal)

Part-A: One or More Than One Options Correct Type

This section contains **6 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONE** or **MORE THAN ONE is correct.**

5. Let $S_n = \left(\frac{2}{1\times 2}\right) + \left(\frac{5}{2\times 3}\times 2\right) + \left(\frac{10}{3\times 4}\times 2^2\right) + \ldots\ldots$ upto *n* terms. Then, S_n is an integer for *n* equal to

   (A) 27 (B) 31 (C) 61 (D) 63

space for rough work

6. If $\int_0^1 \left(4x^3 - f(x)\right) f(x)\,dx = \frac{4}{7}$, then which of the following is/are true

(A) $f(x)$ has a point of inflexion

(B) $\left|f(x) - \frac{1}{4}\right|$ has exactly one point of non-differentiability

(C) area bounded by $y = f(x)$, x – axis, x = 1 and x =2 is $\frac{15}{2}$

(D) The function $f(x)$ is concave upward for $\forall x \in R$

7. Let A and B be two square matrices such that AB = A + B then which of the following must be true

(A) A and B are both invertible (B) A – 1 is invertible

(C) $A^2B^2 = AB$ (D) AB = BA

8. If $P \equiv \left(1,5,\sqrt{2}\right)$ be a point and $L \equiv \frac{x-1}{\sqrt{2}} = \frac{y-2}{1} = \frac{z-3}{1} = r$ be a line if PQ is the distance of plane $\sqrt{2}x + y - z - 1 = 0$ from point P measured along a line inclined at an angle of 60^o with line L and is minimum, then PQ is equal to.

(A) 1unit (B) $2\sqrt{3}$ units

(C) 2units (D) 4 units

9. Consider the equation $z^6 + 6z + 20 = 0$, Then which of following can be true?

(A) The number of the roots in the first quadrant can be 1or 2

(B) The number of the roots in the second quadrant can be 1or 2

(C) The number of the roots in the third quadrant can be 1or 2

(D) The number of the roots in the fourth quadrant can be 1or 2

10. Let $f(x) = \int_1^x \frac{3^t}{1+t^2}\,dt, x > 0$ then:

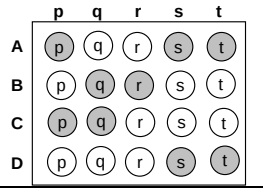
(A) for $0 < \alpha < \beta$, $f(\alpha) < f(\beta)$ (B) for $0 < \alpha < \beta$, $f(\alpha) > f(\beta)$

(C) for all $x > 0$, $f(x) + \frac{\pi}{4} < \tan^{-1} x$ (D) for all $x > 0$, $f(x) + \frac{\pi}{4} > \tan^{-1} x$

space for rough work

Part-B : Matrix-Match Type Questions

This Section contains **4 Matrix Match Type Questions.** Each question has **four statements** (A, B, C and D) given in **Column I** and **five statements** (p, q, r, s and t) in **Column II.** Any given statement in Column I can have correct matching with **ONE** or **MORE** statement(s) given in Column II. For example, if for a given question, statement B matches with the statements given in q and r, then for the particular question, against statement B, darken the bubbles corresponding to q and r in the ORS.



1. If $f(x)=x^3+ax^2+bx+c=0$ has three distinct integral roots and $f(x^2+2x+2)=0$ has no real roots then

Column – I		Column – II	
(A)	min value of a is	(P)	0
(B)	min value of b is	(Q)	2
(C)	min value of c is	(R)	3
(D)	for min values of a, b, c if roots of $f^1(x)=K$ are equal then $K=$	(S)	-1

2. Match the following

Column-I		Column-II	
(A)	If $\lvert A\rvert = 2$ then $\lvert 2A^{-1}\rvert$ is _____ (Where A is a square matrix of order 3)	(P)	24
(B)	If $\lvert A\rvert=\frac{1}{8}$ then $\lvert adj\left(adj\left(2A\right)\right)\rvert-1$ (Where A is a square matrix of order 3)	(Q)	4
(C)	If $\left(A+B\right)^2=A^2+B^2$, and $\lvert A\rvert=2$ then $\lvert B\rvert=$ ___ (Where A and B are of a odd order)	(R)	0
(D)	If $\lvert A_{2\times2}\rvert=2, \lvert B_{3\times3}\rvert=3$ and $\lvert C_{4\times4}\rvert=4$ then $\lvert ABC\rvert$ is equal to	(S)	Can not be determined

3. Match the following

List-I		List -II	
(A)	If $\vec{a}+\vec{b}+\vec{c}=\alpha\vec{d}, \vec{b}+\vec{c}+\vec{d}=\beta\vec{a}$ and $\vec{a},\vec{b},\vec{c}$ are non-coplanar then $\lvert\vec{a}+\vec{b}+\vec{c}+\vec{d}\rvert=$	(P)	$\frac{2\pi}{3}$
(B)	If $\vec{a}$ and $\vec{b}$ are unit vectors inclined at an angle θ to each other and $\lvert\vec{a}+\vec{b}\rvert<1$, then θ can be equal to	(Q)	$\frac{3\pi}{4}$
(C)	If $\vec{a}$ is a unit vector perpendicular to another unit vector $\vec{b}$ then $\lvert\vec{a}\times[\vec{a}\times\{\vec{a}\times(\vec{a}\times\vec{b})\}]\rvert=$	(R)	1
(D)	Let $\vec{a}, \vec{b}, \vec{c}$ be three unit vectors such that $\vec{a}+\vec{b}+\vec{c}=\vec{0}$, then the angle between $\vec{a}$ and $\vec{b}$ is equal to	(S)	0

space for rough work

4. Given a circle S with radius r and two points P and Q in the plane of S. A right angled triangle is inscribed in the circle such that one of its sides passes through P and other through Q. it is also given that d is the distance between the centre O of S to the mid point of the segment PQ. Colum-A says about the number of such inscribed right angled triangle(s) is/are possible and column-B is the corresponding condition

Column A		Column B	
(A)	0	(P)	Not possible
(B)	1	(Q)	$2(r-d) > PQ$
(C)	2	(R)	$2(r-d) < PQ$
(D)	3	(S)	$2(r-d) = PQ$

Part –C: Single digit integer

This section contains **6 questions.** The answer to each question is a single digit integer ranging from 0 to 9 (both inclusive).

1. Z is not a purely real number such that $\frac{1+z+z^2}{1-z+z^2}$ is purely real then $|z| =$ _____

2. Consider the plane $E: \vec{r} = \begin{bmatrix}-1\\1\\1\end{bmatrix} + \lambda\begin{bmatrix}1\\2\\0\end{bmatrix} + \mu\begin{bmatrix}1\\0\\1\end{bmatrix}$

   Let F be plane containing the point A (-4, 2, 2) and parallel to E. Suppose the point B is on the plane E such that B has a minimum distance from the point A, if C (-3, 0, 4)lies in the plane F & area of Δ ABC is A_o then the value of $2A_o$ is.

3. If M is 3×3 matrix where $M^TM = I$ and det(M) = 1 then det$(M-I)$ is_____

4. Let $\vec{a} = (2+\sin\theta)\hat{i} + \cos(\theta)\hat{j} + \sin(2\theta)\hat{k}$

   $\vec{b} = \sin\left(\theta+\frac{2\pi}{3}\right)\hat{i} + \cos\left(\theta+\frac{2\pi}{3}\right)\hat{j} + \sin\left(2\theta+\frac{4\pi}{3}\right)\hat{k}$

   $\vec{c} = \sin\left(\theta-\frac{2\pi}{3}\right)\hat{i} + \cos\left(\theta-\frac{2\pi}{3}\right)\hat{j} + \sin\left(2\theta-\frac{4\pi}{3}\right)\hat{k}$

   be three vectors where $\theta \in \left(0, \frac{\pi}{2}\right)$. Let V is the maximum volume of tetrahedron whose coterminous edges are represented by the vector $2\vec{b}\times\vec{c}, 3\vec{c}\times\vec{a}$ and $\vec{a}\times4\vec{b}$ then $\frac{V}{6} =$

5. If the area bounded by $f(x) = \sqrt{1+x^2}, x > 0$ the line y = x, x=0 & y = –x + a,a>1 is α and the area bounded by the graph of $f^{-1}(x)$, the line y = x between the lines y = –x + 1 and y = –x + a is β , then $\frac{1}{|\alpha-\beta|} =$

6. Consider the polynomial $x^n + a_1x^{n-1} + a_2x^{n-2} + \ldots\ldots\ldots + a_n = 0$ having real roots with coefficients $a_1, a_2 \ldots\ldots\ldots\ldots a_n$ belongs to $\{1,-1\}$ then maximum value of n is _____

space for rough work