FIITJEE
ALL INDIA TEST SERIES
JEE (Advanced)-2025
FULL TEST – IV
PAPER –1
TEST DATE: 18-02-2025

Time Allotted: 3 Hours **Maximum Marks: 180**

General Instructions:

- The test consists of total 51 questions.
- Each subject (PCM) has 17 questions.
- This question paper contains **Three Parts.**
- **Part-I** is Physics, **Part-II** is Chemistry and **Part-III** is Mathematics.
- Each **Part** is further divided into **Two Sections**: **Section-A & Section-B**.

Section – A (01 – 04, 18 – 21, 35 – 38): *This section contains **TWELVE (12)** questions. Each question has **FOUR** options. **ONLY ONE** of these four options is the correct answer.*

Section – A (05 –07, 22 – 24, 39 – 41): *This section contains **NINE (9)** questions. Each question has **FOUR** options. **ONE OR MORE THAN ONE** of these four option(s) is(are) correct answer(s).*

Section – A (08 – 11, 25 – 28, 42 – 45): *This section contains **TWELVE (12)** Matching List Type Questions. Each question has **FOUR** statements in **List-I** entries (P), (Q), (R) and (S) and **FIVE** statements in **List-II** entries (1), (2), (3), (4) and (5). The codes for lists have choices (A), (B), (C), (D) out of which, **ONLY ONE** of these four options is correct answer.*

Section – B (12 – 17, 29 – 34, 46 – 51): *This section contains **EIGHTEEN (18)** numerical based questions. The answer to each question is a **NON-NEGATIVE INTEGER VALUE**.*

MARKING SCHEME

Section – A (Single Correct): Answer to each question will be evaluated according to the following marking scheme:

Full Marks	:	+3	If ONLY the correct option is chosen.
Zero Marks	:	0	If none of the options is chosen (i.e. the question is unanswered);
Negative Marks	:	–1	In all other cases.

Section – A (One or More than One Correct): Answer to each question will be evaluated according to the following marking scheme:

Full Marks	:	+4	If only (all) the correct option(s) is (are) chosen;
Partial Marks	:	+3	If all the four options are correct but ONLY three options are chosen;
Partial marks	:	+2	If three or more options are correct but ONLY two options are chosen and both of which are correct;
Partial Marks	:	+1	If two or more options are correct but ONLY one option is chosen and it is a correct option;
Zero Marks	:	0	If none of the options is chosen (i.e. the question is unanswered);
Negative Marks	:	–2	In all other cases.

Section – B: Answer to each question will be evaluated according to the following marking scheme:

Full Marks	:	+4	If ONLY the correct numerical value is entered at the designated place;
Zero Marks	:	0	In all other cases.

Physics

PART – I

SECTION – A
(One Options Correct Type)

*This section contains **FOUR (04)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.*

1. A steel tube of length ℓ with inner and outer radii R and 2R respectively is fixed at one end. The modulus of rigidity of the tube is η. The torque required in twisting the steel tube through an angle 'θ' about its axis is

(A) $\frac{3\pi\eta R^4\theta}{2\ell}$ (B) $\frac{7\pi\eta R^4\theta}{2\ell}$

(C) $\frac{11\pi\eta R^4\theta}{2\ell}$ (D) $\frac{15\pi\eta R^4\theta}{2\ell}$

2. Current I flowing along edges of one face of a cube as shown in figure-I, produces magnetic field $\vec{B} = B_0\hat{k}$ at the centre of the cube. Consider another identical cube, where current I flows along the path as shown in the figure-II. What magnetic field is produced at the centre of the second cube?

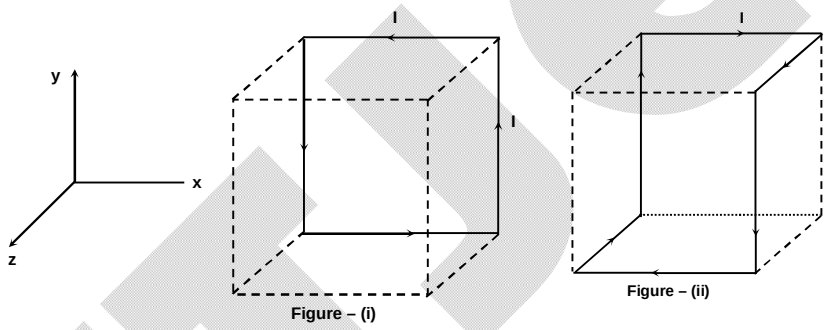
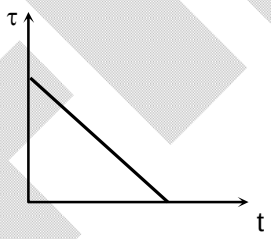


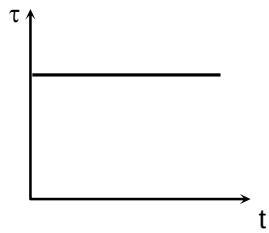
Figure – (i) Figure – (ii)

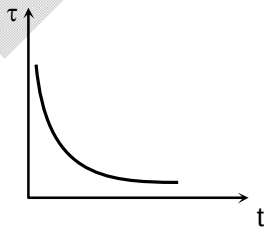
(A) Zero (B) $B_0\left(-\hat{j}+\hat{k}+\hat{i}\right)$

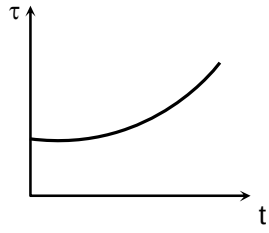
(C) $B_0\left(-\hat{j}-\hat{k}+\hat{i}\right)$ (D) $B_0\left(\hat{j}+\hat{k}-\hat{i}\right)$

3. A steel ball bearing bounces vertically on a steel plate. If the speed of the ball just before a bounce is v_i, the speed of the ball immediately afterwards is $v_f = \alpha v_i$ with $\alpha < 1$. Which one of the following graphs best shows the time between successive bounces (τ) as a function of time (t)?

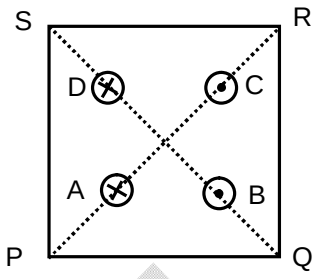
(A)


(B)


(C)


(D)


4. PQRS is a square of side ℓ_0. A, B, C and D are four long current carrying wires kept perpendicular to the plane of paper as shown in the figure. PA = QB = RC = SD = $\frac{\ell_0}{\sqrt{5}}$. The magnitude of current in the wires A, B, C and D are i_0, $2i_0$, $8i_0$ and $4i_0$ respectively, the direction of current are shown. It is given that $\int_P^Q \vec{B}_A \cdot d\vec{\ell} = -9\mu_0$ Tesla meter and $\int_R^S \vec{B}_B \cdot d\vec{\ell} = 5\mu_0$ Tesla meter, where $\vec{B}_A$ and $\vec{B}_B$ are the magnetic fields due to the wires A and B respectively. The magnitude of i_0 is



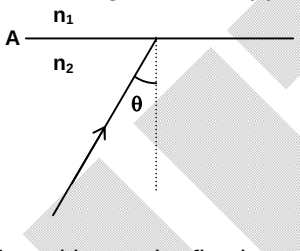
(A) $\frac{23}{2}$ amp (B) 46 amp

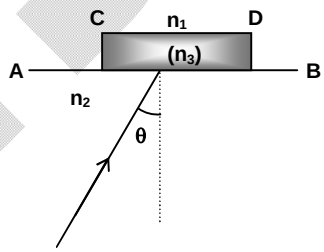
(C) 23 amp (D) $\frac{23}{4}$ amp

SECTION – A
(One or More than one correct type)

*This section contains **THREE (03)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).*

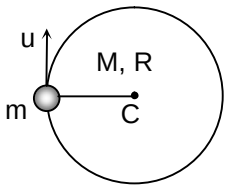
5. An interface AB divides two media of refractive indices n_1 and $n_2(>n_1)$ respectively. A ray of light is incident on this interface from medium of refractive index n_2 at an angle θ which is slightly greater than the critical angle for the pair of two media. Now keeping the direction of incident ray fixed, a parallel long slab of refractive index n_3 is placed on the surface AB as shown, which of the following statement(s) is/are correct.





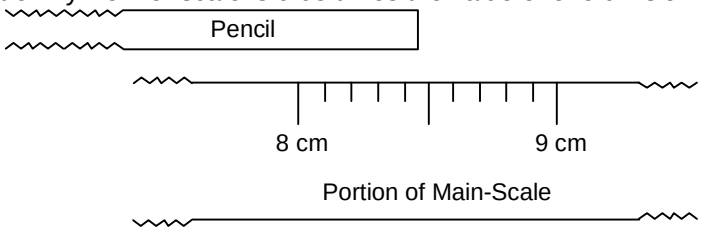
(A) total internal reflection occurs at AB for $n_3 < n_1$.
(B) total internal reflection occurs at AB for $n_3 > n_1$.
(C) total internal reflection occurs at CD for $n_3 > n_1$.
(D) the ray will return back to medium of refractive index n_2 for all values of n_3.

6. A small bead of mass m = 4kg is threaded on a smooth uniform ring of mass M = 6 kg and radius R = 0.5 m. Initially the system rests in a gravity free space and the bead is struck to impart it a velocity u = 5 m/s along the tangent to the ring as shown in the figure. Choose the correct option(s).



(A) The magnitude of the force of interaction between the bead and the ring is 120 N.
(B) The magnitude of the force of interaction between the bead and the ring is 60 N
(C) The minimum kinetic energy of the bead in subsequent motion is 26 J.
(D) The minimum kinetic energy of the bead in subsequent motion is 2 J.

7. I am a Vernier Calliper. I have a task to measure the length of a pencil as shown in the figure. The least count of my Vernier scale is 0.05 times the value of one division of main-scale.



My Vernier Scale has n-divisions and coincides with (n – 4) divisions of main scale. While measuring the length of pencil, the $\frac{n}{5}$th division of Vernier-Scale exactly coincide the main-scale.

Now choose the correct option(s)

(A) The value of n is 40
(B) The least count of Vernier scale is 0.005 cm
(C) The length of Pencil is 8.44 cm
(D) The length of Pencil is 8.48 cm

SECTION – A
(Matching List Type)

*This section contains **FOUR (04)** Matching List Type Questions. Each question has FOUR statements in **List-I** entries (P), (Q), (R) and (S) and FIVE statements in **List-II** entries (1), (2), (3), (4) and (5). The codes for lists have choices (A), (B), (C), (D) out of which **ONLY ONE** of these four options is correct answer.*

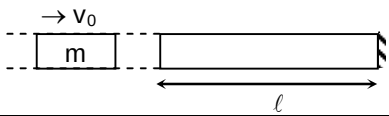
8. List –I describes physical quantities and List-II gives their dimensions.

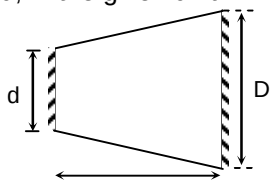
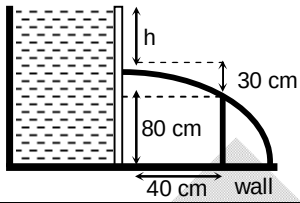
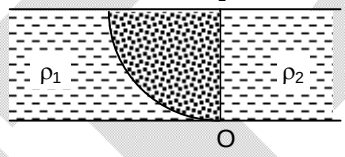
List –I		List -II	
(P)	Magnetic flux	(1)	$MLT^{-3}A^{-1}$
(Q)	Electrical conductivity	(2)	$M^{-1}L^{-3}T^{3}A^{2}$
(R)	Electric field	(3)	$M^{-1}L^{-2}T^{4}A^{2}$
(S)	Capacitance	(4)	$ML^{2}T^{-2}A^{-1}$
		(5)	$M^{2}L^{2}T^{-2}A^{-1}$

The correct option is:

(A) (P) → (3) (Q) → (2) (R) → (2) (S) → (4)
(B) (P) → (4) (Q) → (2) (R) → (1) (S) → (3)
(C) (P) → (1) (Q) → (3) (R) → (4) (S) → (2)
(D) (P) → (2) (Q) → (5) (R) → (1) (S) → (3)

9. Match the following.

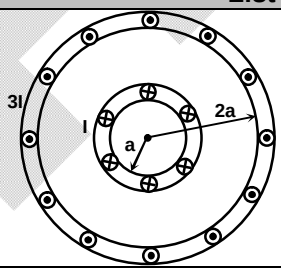
List – I		List - II	
(P)	A heavy mass m, moving horizontally with speed v_0 strikes the end of a fixed bar of length ℓ, cross-sectional area A and modulus of rigidity E. If $\frac{Emv^2}{A\ell}$ is 4 unit, then stress due to impact in the given unit will be…….. 	(1)	4

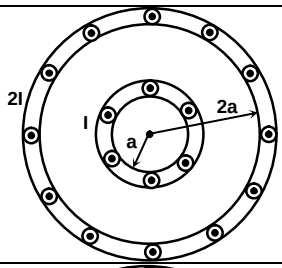
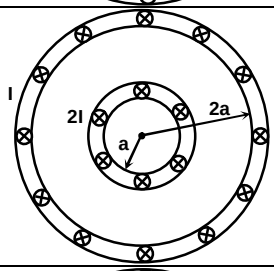
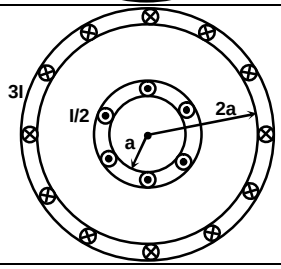
(Q)	A tapered circular bar of length ℓ is rigidly fixed at both the ends. Diameter of bar at one end is D and other end is d. The temperature of the bar is raised by ΔT. The modulus of elasticity and linear expansion coefficient of material are E and α respectively. If $\frac{DE\alpha\Delta T}{d}$ is 3 unit, then the maximum thermal stress induced in the bar when its temperature is raised, in the given unit will be …….. 	(2)	3
(R)	The exit hole is horizontal. If losses are negligible. The water level h for free jet to just clear the wall is $\frac{40n}{3}$cm . The value of n will be…. 	(3)	2
(S)	A weightless gate having cross-section of a quarter cylinder (radius R, and length l) is pivoted at point O at the bottom and is in static equilibrium when subjected to two different fluids of density ρ_1 and ρ_2 as shown in the figure. The value of $\frac{\rho_2}{\rho_1}$ is ……. 	(4)	1

The correct option is:

(A) (P) → (3) (Q) → (2) (R) → (2) (S) → (4)
(B) (P) → (3) (Q) → (1) (R) → (4) (S) → (2)
(C) (P) → (1) (Q) → (3) (R) → (4) (S) → (2)
(D) (P) → (2) (Q) → (5) (R) → (1) (S) → (3)

10. List-I contains four different systems of two thin walled long current carrying coaxial cylinders. List-II contains the magnitude of magnetic pressure exerted on the wall of the outer cylinder.

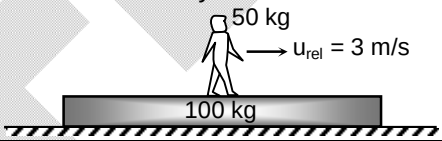
List –I		List –II	
(P)		(1)	$\frac{5\mu_0 I^2}{32\pi^2 a^2}$

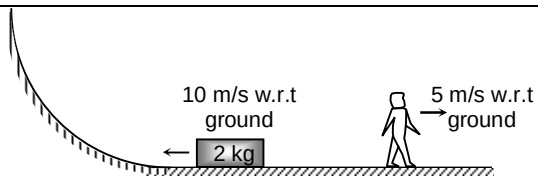
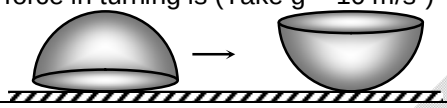
(Q)		(2)	$\frac{5\mu_0 I^2}{16\pi^2 a^2}$
(R)		(3)	$\frac{3\mu_0 I^2}{32\pi^2 a^2}$
(S)		(4)	$\frac{3\mu_0 I^2}{16\pi^2 a^2}$
		(5)	$\frac{\mu_0 I^2}{4\pi^2 a^2}$

The correct option is:

(A) (P) → (3) (Q) → (2) (R) → (2) (S) → (4)
(B) (P) → (3) (Q) → (1) (R) → (4) (S) → (2)
(C) (P) → (1) (Q) → (3) (R) → (4) (S) → (2)
(D) (P) → (3) (Q) → (5) (R) → (1) (S) → (4)

11. List –I describes for systems and List-II gives possible value of work done in Joules.

List –I		List -II	
(P)	A plank of mass 100 kg is placed on a smooth horizontal surface at rest along with a man. Now man starts moving on the plank with relative velocity of 3 m/s with respect to plank. The work done by man is 	(1)	+100J
(Q)	A block of mass 2 kg is placed on a smooth track and imparted a velocity of 10 m/s to the left and observed by an observer moving with 5 m/s as shown in the figure. Work done by the normal force applied by the track on the block upto the instant when the block reaches the highest point on the track in the frame of observer. Assume that block never loose contact with the track. (take g = 10 m/s^2)	(2)	–100J

			
(R)	A particle of mass 1 kg is projected from an unstable equilibrium point N towards a stable equilibrium point S with negligible velocity in a conservative force field having potential energy function $U=-\left(\frac{1}{100}\,J/m^4\right)\left[x-10\right]^2\left[x-30\right]^2$, where x is in meters. Then work done by conservative force during the displacement from N to S is	(3)	+150J
(S)	A solid hemisphere of mass 4 kg and radius 10 m is slowly turned as shown in the figure. Then work done by external force in turning is (Take g = 10 m/s^2) 	(4)	–150J
		(5)	Zero

The correct option is:

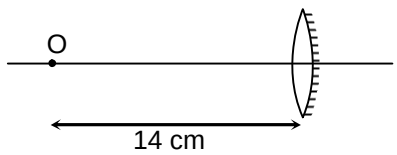
(A) (P) → (3) (Q) → (2) (R) → (2) (S) → (1)
(B) (P) → (3) (Q) → (2) (R) → (5) (S) → (4)
(C) (P) → (1) (Q) → (3) (R) → (4) (S) → (2)
(D) (P) → (2) (Q) → (5) (R) → (1) (S) → (3)

SECTION – B

(Numerical Answer Type)

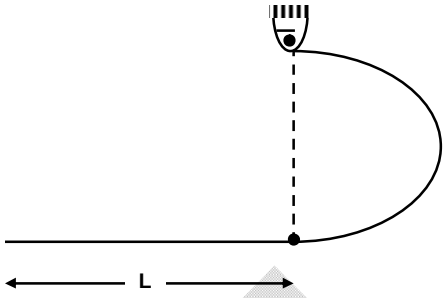
*This section contains **SIX (06)** Numerical based questions. The answer to each question is a **NON-NEGATIVE INTEGER VALUE**.*

12. Object O is placed at a distance of 14 cm from an equi-convex lens of refractive index $\mu=\frac{3}{2}$ and radius of curvature of lens surface is 32 cm. One of its surface is silvered another convex lens of focal length 24 cm is placed between object and silvered lens such that the final image coincides with the object. The distance between object and the lens in cm is ……..

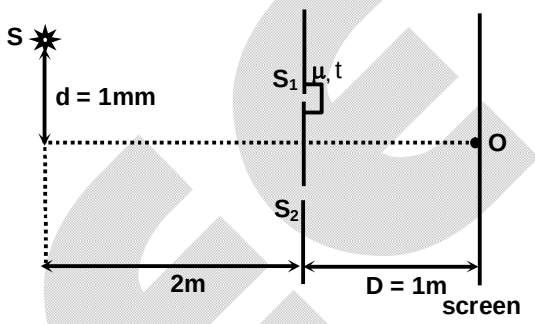


13. A thin string is held at one end and oscillate vertically such that
y (x = 0, t) = (8 sin 4t) cm
Neglect the weight of the string. The string's linear density is 0.2 kg/m and its tension is 1 N. The string passes through a bath filled with 1 kg water. Due to friction heat is transferred to the bath. The heat transfer efficiency is 50%. If the time elapsed till the temperature of the bath rises by 2.5°C is n × 10^5 s, the value of n is (to the nearest integer)

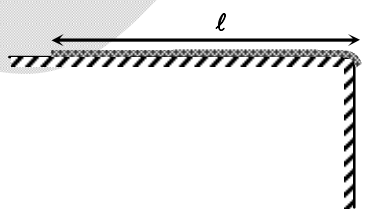
14. A uniform rod of length L is rigidly attached with a uniform semi-circular ring of same density as of rod to form a rigid body in a plane. The system is hanged in vertical plane in equilibrium with the help of hinge as shown such that rod is in horizontal position. Then the distance of centre of mass of the system from hinge is $\frac{L}{2}\left[\frac{\pi+\alpha}{\pi+\beta}\right]$. Find the value of $\alpha\beta$.



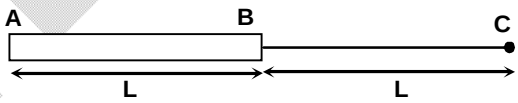
15. In YDSE, a monochromatic source 'S' of wavelength 4000 Å is placed at a distance d = 1mm from the central axis as shown in the figure. Where d = 1 mm is the separation between the two slits S_1 and S_2. The minimum thickness (in μm) of the thin film of refractive index μ = 1.5 is t which is placed in front of S_1 so that the intensity at point 'O' becomes maximum. Find the value of 5t.



16. If you hang vertically some length of a long uniform inextensible rope, the longest hanging length is ℓ_0 = 1.40 m that does not break due to its own weight. Now you cut a length of the same rope and place it straight on a smooth horizontal table with a little length hanging over the edge so that it begins to slide down when released. What maximum length (in cm) can this piece have so that it does not break during sliding.



17. A rod AB of mass M and length L is fixed. A point mass is released from point C as shown in the figure. Point mass starts moving towards rod when set free. The speed of the point mass was found to be $v=\sqrt{\frac{xGM}{L}\ell\left(\frac{y}{2}\right)}$, when point mass is at a distance of $\frac{L}{2}$ from end B. Find x + y.

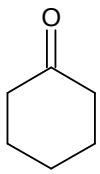


Chemistry

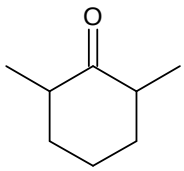
PART – II

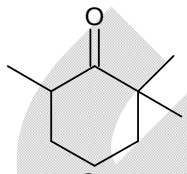
SECTION – A
(One Options Correct Type)

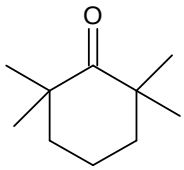
*This section contains **FOUR (04)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.*

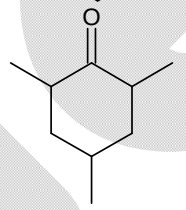
18. 

$\xrightarrow[KH-excess]{MeI\ excess}$ 81% yield, product of the reaction is

(A) 

(B) 

(C) 

(D) 

19. A particular 100-octane aviation gasoline used 1.00 cm^3 of tetraethyl lead $(C_2H_5)_4Pb$ of density 1.66g/cc, per litre of product. This compound is made as follows.
$4C_2H_5Cl + 4NaPb \longrightarrow (C_2H_5)_4Pb + 4NaCl + 3Pb$. How many gram of ethyl chloride is needed to make enough tetraethyl lead for 1 L of gasoline.
(A) 1.33g (B) 2.66 g
(C) 9.2g (D) 0.33g

20. Boron cannot form which of the following anions:
(A) BF_6^{3-} (B) BH_4^-
(C) $B(OH)_4^-$ (D) BO_2^-

21. Black Jack is an ore of:
(A) Cr (B) Sn
(C) Zn (D) Ni

SECTION – A
(One or More than one correct type)

*This section contains **THREE (03)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).*

22. If P° and P_S are the V.P. of solvent and its solution respectively and N_1 and N_2 are the moles of solute and solvent then
(A) $(P° - P_S)/P° = N_1/(N_1 + N_2)$ (B) $(P° - P_S)/P_S = N_1/N_2$
(C) $(P° - P_S)/P° = N_1/N_2$ (D) None of these

23. Select the correct statements :

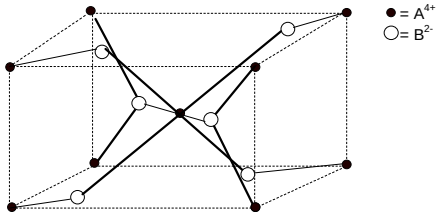
(A) For the reaction $H_{2(g)} + I_{2(g)} \underset{K_b}{\overset{K_f}{\rightleftharpoons}} 2HI\,(g)$; $\frac{d[H_2]}{dt} = K_b[HI]^2$ (Assuming the reactions to be elementary)

(B) At equilibrium net rate of change in conc. of H_2 is zero for $H_2 + I_2 \rightleftharpoons 2HI$

(C) The equilibrium constant for the reaction $H_{2(g)} + I_{2(g)} \underset{K_b}{\overset{K_f}{\rightleftharpoons}} 2HI$; is independent of temperature

(D) (A) is correct and (B) is wrong

24. Consider the following solid:



(distarted cubic structure)

Identify the correct statements regarding the above crystalline solid:

(A) The coordination number of A^{4+} is 8
(B) The coordination number of B^{2-} is 3
(C) The formula of the solid is AB_2
(D) Effective number of A^{2+} ions per unit cell is 2

SECTION – A
(Matching List Type)

*This section contains **FOUR (04)** Matching List Type Questions. Each question has FOUR statements in **List-I** entries (P), (Q), (R) and (S) and FIVE statements in **List-II** entries (1), (2), (3), (4) and (5). The codes for lists have choices (A), (B), (C), (D) out of which **ONLY ONE** of these four options is correct answer.*

25. Match the following:

List – I		List – II	
(P)	Chalcopyrite → copper (pure)	(1)	Froth floatation
(Q)	Zinc blende → zinc (pure)	(2)	Hall process
(R)	Bauxite → aluminium (pure)	(3)	Roasting
(S)	Galena → lead (pure)	(4)	Self reduction
		(5)	Basemerisation

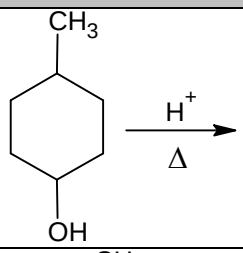
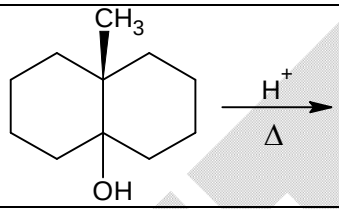
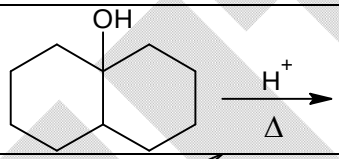
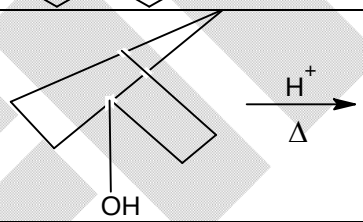
(A) P → 1, 3, 4, 5; Q → 1, 3; R → 2; S → 1, 3, 4
(B) P → 1, 2, 4, 5; Q → 1, 2; R → 4; S → 1, 2, 4
(C) P → 1, 3, 4, 5; Q → 1, 5; R → 4; S → 1, 2, 4
(D) P → 1, 3, 4, 5; Q → 2, 3; R → 3; S → 1, 4, 5

26. Match the following:

List – I		List – II	
(P)	$K_P > Q_p$	(1)	Non-spontaneous
(Q)	$\Delta G^\circ < RT \log_e Q_p$	(2)	Equilibrium
(R)	$K_P = Q_p$	(3)	Spontaneous and endothermic
(S)	$T > \frac{\Delta H}{\Delta S}$	(4)	Spontaneous
		(5)	Spontaneous and exothermic

(A) P → 3; Q → 2; R → 1; S → 4
(B) P → 2; Q → 3; R → 4; S → 5
(C) P → 4; Q → 1; R → 2; S → 2
(D) P → 2; Q → 1; R → 4; S → 5

27. Match the List – I with List – II:

List – I		List – II	
(P)		(1)	Racemic mixture
(Q)		(2)	Major product consist of even number of α-hydrogen
(R)		(3)	Will not undergo dehydration
(S)		(4)	Major product consist of odd number of α-hydrogen
		(5)	Bridged carbocation is an intermediate

(A) P → 1, 3; Q → 1, 4; R → 3; S → 4, 5
(B) P → 1, 2; Q → 1, 2; R → 2; S → 4, 5
(C) P → 1, 4; Q → 1, 3; R → 2; S → 2, 5
(D) P → 1, 3; Q → 1, 4; R → 4; S → 3, 5

28. Match the List – I with List – II:

List – I(Reaction)		List – II(Products)	
(P)	$[Co(NH_3)_4 (H_2O)_2] Cl_2$	(1)	Geometrical isomers
(Q)	$[Pt (NH_3)_2 Cl_2]$	(2)	Paramagnetic
(R)	$[Co(H_2O)_5 Cl] Cl$	(3)	Diamagnetic
(S)	$[Ni(H_2O)_6] Cl_2$	(4)	Metal ion with +2 oxidation state
		(5)	On reaction with $AgNO_3$ forms 2 equivalents of AgCl

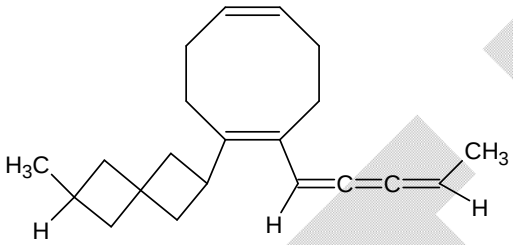
(A) P → 1, 2, 4, 5; Q → 1, 3, 4; R → 2, 4; S → 2, 4, 5
(B) P → 1, 2, 3, 5; Q → 1, 3, 4; R → 3, 4; S → 2, 4, 5
(C) P → 1, 2, 4, 5; Q → 1, 2, 3; R → 2, 4; S → 1, 4, 5
(D) P → 1, 2, 3, 5; Q → 1, 3, 4; R → 1, 4; S → 3, 4, 5

SECTION – B

(Numerical Answer Type)

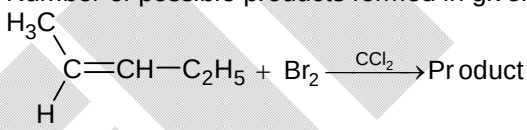
*This section contains **SIX (06)** Numerical based questions. The answer to each question is a **NON-NEGATIVE INTEGER VALUE**.*

29. Number of stereo centres in a given molecule?



30. The conductivity of 0.001 M Na_2SO_4 solution is 2.6×10^{-4} S cm^{-1} and increases to 7.0×10^{-4} S cm^{-1} and increases to 7×10^{-4} S cm^{-1}, when the solution is saturated with $CaSO_4$. The molar conductivity of Na^+ and Ca^{2+} are 50 and 120 S cm^2 mol^{-1}, respectively. Neglect conductivity of used water the solubility product of $CaSO_4$ is $y \times 10^{-x}$ M^2. What is the value of x.

31. Number of possible products formed in given reaction



32. The half life of two samples of a substance is 50 sec and 200 sec at 0.4 M and 0.1M concentrations, respectively the order of reaction is _____.

33. The total number of pi-bonds in pyrene responsible for its aromatic behaviour are:

34. The total number of cyclic, structural isomers for a compound with molecular formula C_5H_{10} is_____.

Mathematics

PART – III

SECTION – A
(One Options Correct Type)

*This section contains **FOUR (04)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.*

35. Number of six digit numbers whose sum of the digits is 49 are
(A) $^{12}C_5$ (B) 6
(C) $^{10}C_5$ (D) 1200

36. A square matrix A satisfies the relation $A^2 = 2I - A$, where I is the identity matrix, $A^5 = KI + PA$, then P + K is equal to (where P, K $\in$ R)
(A) 6 (B) –6
(C) –1 (D) 1

37. For continuous function f: [0, 1] $\to$ R; $A = \int_0^1 \left(x^2 \cdot f(x)\right) dx$; $B = \int_0^1 x \cdot \left(f(x)\right)^2 dx$ then, maximum value of A – B is λ where $\left[\frac{1}{4\lambda}\right]$ is
(A) 1 (B) 2
(C) 3 (D) 4

38. Let A be an n $\times$ n matrix such that $A + A' = O_{n \times n}$, then $|I + \lambda A^2| \geq M$ where 3M + 1 is
(A) 1 (B) 2
(C) 3 (D) 4

SECTION – A
(One or More than one correct type)

*This section contains **THREE (03)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).*

39. Let (x, y) be the ordered pair satisfying the inequalities $\sin\frac{\pi x}{2} + \cos \pi y \geq 2$ and x > 1, where x, y $\in$ **N**. Choose the **correct** statement(s).
(A) if $x^y - y^x$ is divisible by 8 remainder can be 1.
(B) if $x^y + y^x$ is divided by 8 remainder can be 1.
(C) if $x^y + y^x$ is divided by 8 remainder can be 3.
(D) if $x^y - y^x$ is divided by 8 remainder can be 5.

40. f : **R** $\to$ **R**, be a twice differentiable function such that $f(x)f''(x) \neq 0$, $\forall$ x $\in$ **R**. Choose the **correct** option(s).
(A) y = f(x)f′(x) is a strictly increasing function.
(B) if f′(x) = 0 for some x $\in$ **R**, then it is always point of inflection.
(C) $f(x)f''(x) > 0$ $\forall$ x $\in$ **R**
(D) if $f'(x_0) = 0$ and $f(x_0) < 0$ then it is point of local maxima.

41. The roots of the equation $az^4 + bz^2 + cz + d = 0$ are vertices of a convex quadrilateral in argand plane ($a, b, c, d \in C$). Choose the **correct** option(s).
(A) The intersection point of diagonals is necessarily origin.
(B) If the quadrilateral is a parallelogram then point of intersection of diagonals is origin.
(C) If the quadrilateral is a rhombus then it is necessarily a square.
(D) If the quadrilateral is rhombus then its area is $2\sqrt{\left|\frac{d}{a}\right|}$.

SECTION – A
(Matching List Type)

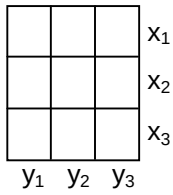
*This section contains **FOUR (04)** Matching List Type Questions. Each question has FOUR statements in **List-I** entries (P), (Q), (R) and (S) and FIVE statements in **List-II** entries (1), (2), (3), (4) and (5). The codes for lists have choices (A), (B), (C), (D) out of which **ONLY ONE** of these four options is correct answer.*

42. Let A and B are points on the line L_1, L_2 respectively such that d = OA + OB + AB is minimum (O being the origin), match the following List-I with List-II

List - I		List - II	
(P)	$L_1 : x-1=y-1=\frac{z+1}{0}$, $L_2 : x+2=4-y=\frac{z+1}{0}$	(1)	$d=4\sqrt{2}$
(Q)	$L_1 : \frac{x-1}{2}=1-y=1-z$, $L_2 : x-2=y-2=\frac{2-z}{2}$	(2)	$d=2\sqrt{3}$
(R)	$L_1 : x=y=z-\sqrt{2}$, $L_2 : x=y=z+\sqrt{2}$	(3)	$d=6\sqrt{2}$
(S)	$L_1 : 2x-3=6-y=\frac{z}{0}$, $L_2 : x+3=2y=\frac{z}{0}$	(4)	$d=4\sqrt{3}$
		(5)	∞

The correct option is:
(A) P – 1; Q – 4; R – 2; S – 3
(B) P – 2; Q – 4; R – 1; S – 3
(C) P – 2; Q – 4; R – 3; S – 1
(D) P – 4; Q – 1; R – 2; S – 3

43. Let every cell of adjoining 3×3 array is filled by natural number such that $x_1x_2x_3 = y_1y_2y_3 = 2^3 3^4 5^7$ where x_i, y_j are product of numbers filled in three cells of i^{th} row and j^{th} column respectively $i, j \in \{1, 2, 3\}$, match the following List-I with List-II



List – I (Condition on x_i, y_i)		List – II (Number of filling the array)	
(P)	If x_i as well as y_j are divisible by 2 for every $i, j \in \{1, 2, 3\}$	(1)	$3\cdot{}^{11}C_3({}^9C_2\cdot{}^9C_5 + {}^{12}C_5\cdot{}^6C_2 - 2\cdot{}^9C_2\cdot{}^6C_2)$
(Q)	If none of y_i (i = 1, 2, 3) is divisible by 27	(2)	$(3! \cdot {}^{12}C_4 \cdot {}^{15}C_8)$
(R)	If none of x_i (i = 1, 2, 3) is divisible by 15	(3)	$2\cdot 3^5\cdot{}^{11}C_3 \cdot {}^{15}C_7$
(S)	If exactly two cells are assigned the value 1 and all other cells have number divisible by 5	(4)	$({}^9C_6 \cdot {}^{10}C_6){}^9C_2$
		(5)	∞

The correct option is:
(A) P – 2; Q – 1; R – 3; S – 4
(B) P – 4; Q – 3; R – 1; S – 2
(C) P – 3; Q – 1; R – 4; S – 2
(D) P – 2; Q – 3; R – 1; S – 4

44. The equation $x^2 - a = \sqrt{x+a}$ has real or imaginary roots depending on values of a. List-I represents the nature of root and List-II represents the corresponding exhaustive values of a, match the following List-I with List-II

List–I		List–II	
(P)	No real root	(1)	$(0,1)\cup\left\{-\frac{1}{4}\right\}$
(Q)	One real root	(2)	$\left(-\infty,-\frac{1}{4}\right)$
(R)	Exactly two real roots	(3)	$\left(-\frac{1}{4},0\right]\cup[1,\infty)$
(S)	Atleast two real roots	(4)	$\left(0,\frac{3}{4}\right)\cup\left\{-\frac{1}{4}\right\}$
		(5)	$\left(-\frac{1}{4},0\right]\cup\left[\frac{3}{4},\infty\right)$

The correct option is:
(A) P – 2; Q – 1; R – 3; S – 3
(B) P – 2; Q – 1; R – 5; S – 4
(C) P – 1; Q – 4; R – 5; S – 5
(D) P – 2; Q – 4; R – 5; S – 5

45. For a given n sided regular polygon, its r vertices are chosen randomly. In List-I: the value of n and r as well as event E is defined. In List-II: P(E), probability of event (E), is given. Match the following List-I with List-II

List–I		List–II	
(P)	n = 10; r = 3, circumcentre lies on the side of triangle itself	(1)	P(E) = 1
(Q)	n = 9; r = 3, orthocentre of triangle so formed lies inside it	(2)	$P(E)=\frac{5}{14}$
(R)	n = 10; r = 4, quadrilateral thus formed is regular	(3)	P(E) = 0
(S)	n = 9; r = 4, out of four selected points, feet of perpendiculars from one of the point to sides of triangle formed by remaining three points is collinear	(4)	$P(E)=\frac{1}{3}$
		(5)	∞

The correct option is:
(A) P – 4; Q – 2; R – 3; S – 1
(B) P – 2; Q – 4; R – 3; S – 3
(C) P – 4; Q – 2; R – 3; S – 3
(D) P – 2; Q – 4; R – 1; S – 3

SECTION – B

(Numerical Answer Type)

*This section contains **SIX (06)** Numerical based questions. The answer to each question is a **NON-NEGATIVE INTEGER VALUE**.*

46. ABCD is a regular tetrahedron with side length $\left(\sqrt{2}+1\right)$ units. A point P is taken on the edge AB such that $\frac{AP}{BP}=\sqrt{2}-1$. Q is the point in the plane of triangle BCD such that PQ $\perp$ AB. If d is perpendicular distance of P from plane BCD and d_1 is minimum distance between P and Q, then find the value of $\left(\frac{d_1}{d}\right)^4$.

47. y = f(x) is a parabola having $\left(0,\frac{3}{2}\right)$ and (0, 0) as vertex and focus respectively, find the number of roots of the equation $\frac{1}{2f(x)-3}-\frac{1}{2f(x)+3}+\frac{6}{x^2}=0$.

48. A point $P\left(\frac{e^t+e^{-t}}{2},\frac{e^t-e^{-t}}{2}\right)$ traces a locus S = 0 in X–Y plane (t being a non negative parameter). A fixed point P_0, having parameter t_0, lies on the curve S = 0. The area bounded by the curve, line OP_0 and x-axis in 240 sq. units (O being the origin), find the value of t_0.

49. Given that $\cos\alpha\cos\beta+\sin^2\alpha\sin\beta-\cos^2\gamma\sin\alpha=1$, $0<\alpha,\beta,\gamma<\pi$.
Find the value of $\sin(\alpha+\beta-\gamma)+\sin(\beta+\gamma-\alpha)+\sin(\alpha+\gamma-\beta)$.

50. Ten points are given in a plane such that no three points are collinear and no four of them form a trapezium. From every point, all the possible lines are drawn which are parallel to lines formed by taking any two points out of remaining points. Find the total number of points of intersection of these lines. (excluding the given ten points)

51. Given that $\begin{vmatrix} a & d & 1 \\ b & e & 1 \\ c & f & 1 \end{vmatrix}=-5$, $\begin{vmatrix} a & b & c \\ 1 & 2 & 3 \\ d & e & f \end{vmatrix}=-3$ find the value of $\begin{vmatrix} c & 3 & f \\ b & 1 & e \\ a & -1 & d \end{vmatrix}$.