FIITJEE

ALL INDIA TEST SERIES

JEE (Advanced)-2025

FULL TEST – IX

PAPER –1

TEST DATE: 04-05-2025

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.

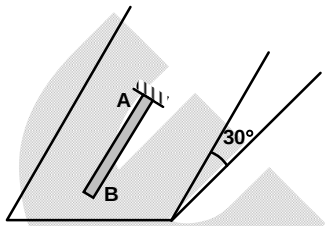
Physics

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. In the shown figure, A thin rod AB of length ℓ is placed on smooth inclined plane having angle 30° with horizontal. It is hinged at end A such that it is free to move parallel to the plane. Its linear mass density increases linearly as $\frac{dm}{dx} \propto x$, where x is distance from end A. It is slightly displaced from its equilibrium position then it oscillates about an axis passing through A and perpendicular to inclined plane. The time period of oscillations is



(A) $2\pi\sqrt{\frac{3\ell}{2g}}$ (B) $2\pi\sqrt{\frac{3\ell}{4g}}$

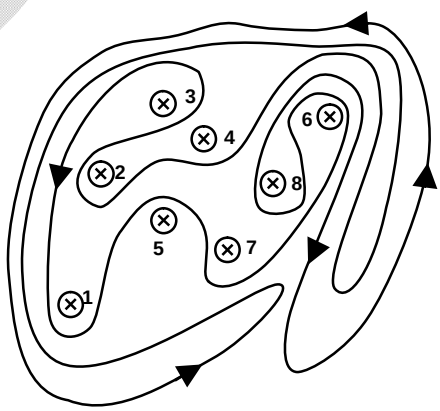
(C) $2\pi\sqrt{\frac{2\ell}{3g}}$ (D) $2\pi\sqrt{\frac{\ell}{2g}}$

2. The length of a wire is measured with a metre scale having least count 1 mm. Its diameter is measured with a vernier callipers of least count 0.1 mm. Given that length and diameter of the wire is measured as 5 cm and 4 mm, the percentage error in the calculated value of volume of the wire will be

(A) 3% (B) 5%

(C) 7% (D) 2%

3. Eight wires are placed perpendicularly at points as shown in figure. The wires are labelled with integer 1, 2, 3, …….8. The magnitude of current in wires 1, 2, 3, 4 and 5 is i_0 while in wires 6, 7, and 8 is $2i_0$. Find $\int \vec{B}\cdot d\vec{\ell}$ along the closed loop in the direction shown.



(A) $+6\mu_0 i_0$

(B) $-6\mu_0 i_0$

(C) $+2\mu_0 i_0$

(D) $-2\mu_0 i_0$

4. A bead is connected with a fixed disc of radius R by an inextensible massless string of length $\ell = \frac{\pi R}{2}$ in a smooth horizontal plane. If the bead is pushed with a velocity v_0 perpendicular to the string, the bead moves in a horizontal curve, and consequently collapses on the disc after a time t. Then

(A) work done by the string on the bead is mv_0^2.

(B) The average speed of the bead is v_0 and its average velocity for time t is $\frac{4v_0}{\pi}$

(C) Tension in the string will increase continuously.

(D) Kinetic energy of the bead increases gradually.

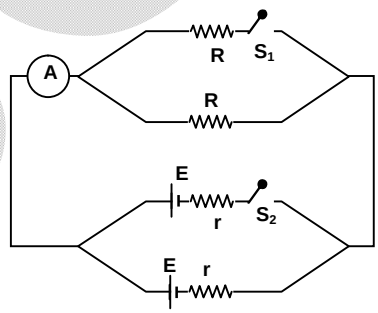
SECTION – A
(One or More than one correct type)

*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. Hydrogen gas absorbs radiation of wavelength λ_0 and consequently emit radiations of 6 different wavelengths of which three wavelengths are shorter than λ_0. Then,
(A) The final excited state of the atom is n = 4.
(B) The initial state of the atom is n = 2.
(C) The initial state of the atom is n = 3.
(D) There are three transitions belonging to Lyman series.

6. A car moves towards a hill with speed V_C. It blows a horn of frequency f which is heard by an observer following the car with speed V_0. The speed of sound in air is V.
(A) The wavelength of sound reaching the hill is V/f
(B) The wavelength of sound reaching the hill is $\frac{V - V_C}{f}$
(C) The wavelength of sound of horn directly reaching the observer is $\frac{V + V_C}{f}$
(D) The beat frequency observed by the observer is $\frac{2V_C(V + V_0)f}{V^2 - V_C^2}$

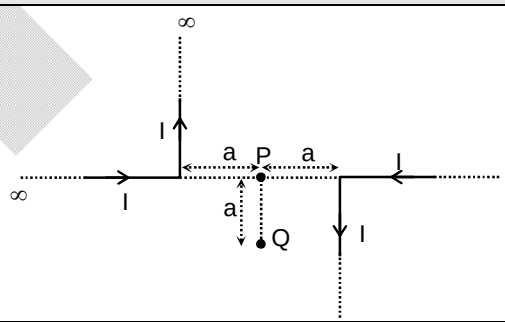
7. In the circuit shown in figure, reading of ammeter will
(A) Increase if S_1 is closed
(B) decrease if S_1 is closed
(C) increase if S_2 is closed
(D) decrease if S_2 is closed.

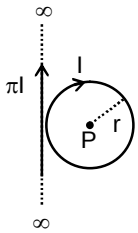
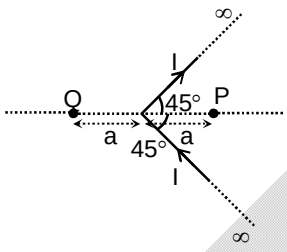
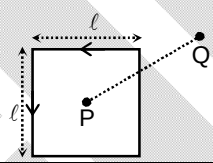


SECTION – A
(Matching List Type)

*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. In List-I certain current carrying wires/loops are given and in List-II ratio of magnitudes of magnetic field at two points P and Q are given. Match the List-I with List-II.

List –I		List –II	
(P)		(1)	$\frac{4}{\sqrt{5+2\sqrt{2}}}$

(Q)	A circular current carrying loop of radius r and carrying current I and another infinitely long straight current carrying wire carrying current πI are placed very close to each other end that they lie in same plane. The point P is the centre of the circular loop and point Q lies on the normal to the plane of circular loop and passing through the centre of loop at a distance r from it 	(2)	$\sqrt{6}$
(R)	Two infinitely long straight current carrying wires are placed so that their one of the ends coincide. Two points P and Q lie on the angle bisector of the two wire at same distance from their common end O. 	(3)	1
(S)	There is a square shaped current carrying loop of side length ℓ and carrying current I. Point P is the centre of the loop and Q lies on the normal to the plane of the loop passing through its centre and a distance $\ell/2$ from centre of loop. 	(4)	$\frac{4\sqrt{2}}{\sqrt{5+2\sqrt{2}}}$
		(5)	$3+2\sqrt{2}$

The correct option is:

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

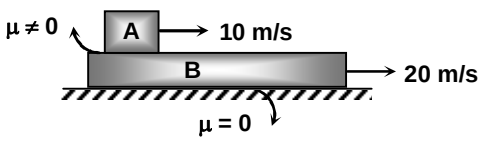
9. Match the statements in List-I with the values in List-II.

List –I		List –II	
(P)	A stationary source emits sound of frequency 660 Hz. The sound is reflected by a reflector moving away from the source with a velocity 33 m/s. The frequency (in Hz) of the sound reflected by the reflector is (speed of sound in air is 330 m/s)	(1)	600
(Q)	A bus is moving towards a hill with speed 16.5 m/s. The driver of the bus sounds a horn of frequency of 627 Hz. The frequency (in Hz) of the echo heard by a passenger in the bus will be (speed of sound in air is 330 m/s)	(2)	500
(R)	A fighter plane is travelling in a horizontal direction at a certain height from the ground with a speed equal to half the speed of sound in air. The frequency of the sound produced by the plane is 450 Hz. What is the frequency (in Hz) of the sound heard by a stationary observer on the ground when the plane is directly above the observer.	(3)	540
(S)	A star emits a electromagnetic wave of frequency $500\sqrt{3}$ GHz. It moves away from a observer with a relative speed equal to half of the speed of light in vacuum. The frequency of the wave (in GHz) observed by the observer is	(4)	620
		(5)	693

The correct option is:

(A) (P) → (3) (Q) → (5) (R) → (1) (S) → (2)
(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)

10. Block A of mass 8 kg is placed on the rough surface of a long block B of mass 12 kg. Block B is placed on smooth horizontal surface. Block A and B are given velocities 10 m/s and 20 m/s respectively as shown in the figure.



List –I		List –II	
(P)	Common velocity (in m/s) of blocks when sliding between block A and B stops	(1)	624
(Q)	Magnitude of work done (in joule) by the friction on the block A, when both block A and B starts moving with same velocity	(2)	$(16-6\sqrt{2})$
(R)	Magnitude of work done (in joule) by the friction on the block B, when both block A and B starts moving with same velocity	(3)	16
(S)	Velocity of block A when the loss of energy becomes half of its maximum value	(4)	864
		(5)	$\left(16-3\sqrt{2}\right)$

The correct option is:

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

11. List –I gives different physical phenomena while List-II gives physical process involved in List-I.

List –I		List –II	
(P)	Blue colour of earth as seen from space	(1)	Refraction
(Q)	Blue iris in eye	(2)	Reflection
(R)	Twinkling of star	(3)	Dispersion
(S)	Sun set 2 minutes later than actual setting time	(4)	Scattering of light
		(5)	Tyndall effect

The correct option is:

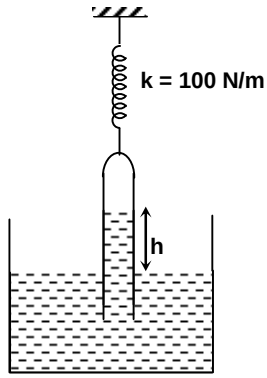
(A) (P) → (4) (Q) → (5) (R) → (1) (S) → (1)
(B) (P) → (3) (Q) → (2) (R) → (5) (S) → (4)
(C) (P) → (1) (Q) → (3) (R) → (4) (S) → (2)
(D) (P) → (2) (Q) → (5) (R) → (1) (S) → (3)

SECTION – B

(Numerical Answer Type)

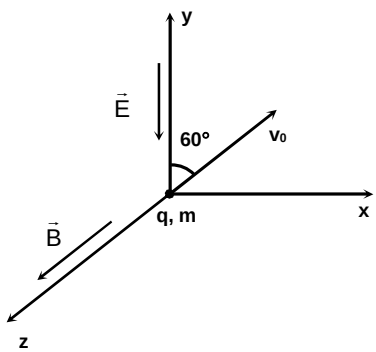
*This section contains **SIX (06)** Numerical based questions. The answer to each question is a **NON-NEGATIVE INTEGER VALUE**.*

12. The tube of ideal barometer having negligible mass is suspended by spring as shown in the figure. Height of mercury in tube is h and area of cross-section of tube is A = 1 cm^2. The reading of spring balance is x newton. Find the value of x (in mm) (Atmospheric pressure is P_0). Ignore surface tension and thickness of tube. (Given density of mercury is 13.6×10^3 kg/m^3 and atmospheric pressure = 10^5 N/m^2)

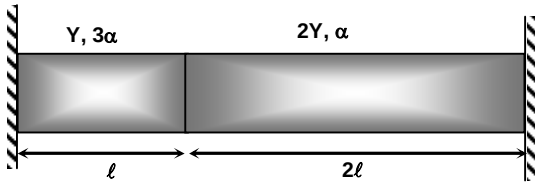


13. Two rods each of length L_1 and one rod of length L_2 form isosceles triangle having base of length L_2. Co-efficient of linear expansion of base is 1×10^{-6} /°C while for rod of length L_1 is 4×10^{-6} /°C. Find the ratio $\left(\frac{L_2}{L_1}\right)$, if the length of latitude remains same when the temperature of the system is increased by 10°C.

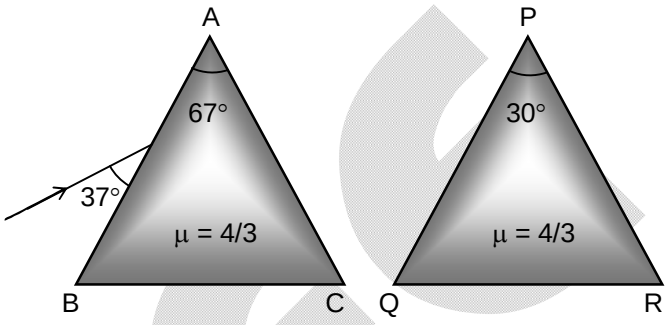
14. A positively charged particle is given an initial velocity v_0 in XY plane as shown in diagram. Initially the particle was at origin and the region contains uniform, mutually perpendicular electric and magnetic field. Let $\vec{E} = -E\hat{j}$ and $\vec{B} = B\hat{k}$. The minimum magnitude of the magnetic field so that the charge particle crosses the origin again during its subsequent motion is $B_{min} = \frac{n\pi E}{v_0}$, find the integer value n.



15. Figure shows two solid rods with equal cross section area fitted between two rigid ends without any stress at temperature T_0. The system's temperature is now increased by ΔT. The junction between the rods gets displaced, as a result, by an amount $\frac{\alpha \ell \Delta T}{n}$. Find n.



16. A light ray is incident on the edge face AB of a prism ABC as shown in the figure. The second prism is kept in such a manner that emergent ray from prism ABC is falling normally on face PQ of prism PQR. Find the net deviation (in degree) produced in the light ray by the optical system of two prisms. (Take $\sin^{-1}\left(\frac{3}{5}\right) = 37°$ and $\sin^{-1}\left(\frac{2}{3}\right) = 42°$)



17. Bob of mass m of simple pendulum is given a velocity from the lower most position in horizontal direction in uniform vertical gravitational field (g) such that $\frac{T_{max}}{T_{min}} = 2$ during the subsequent motion. Then the tension in the string when it becomes horizontal is K mg. Find the value of K. (T represents tension in the string)

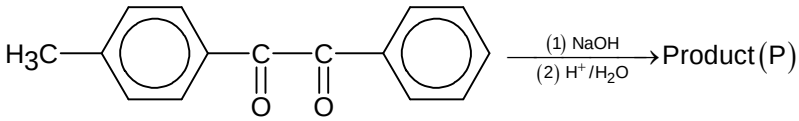
Chemistry

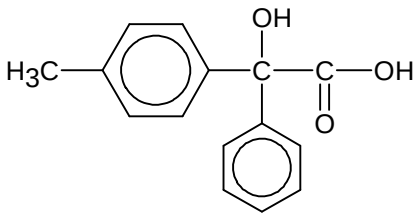
PART – II

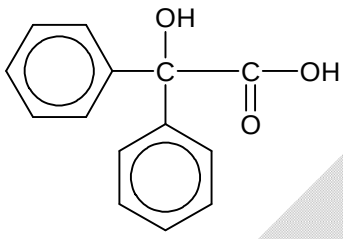
SECTION – A
(One Options Correct Type)

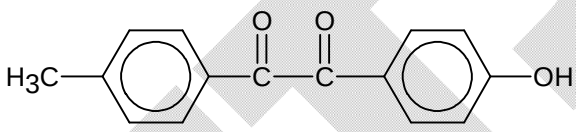
*This section contains **FOUR (04)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.*

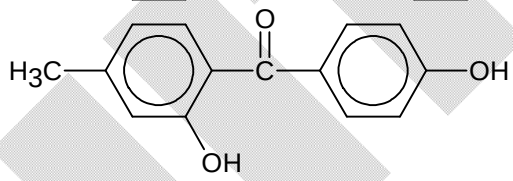
18. The major product of the reaction is



(A)


(B)


(C)


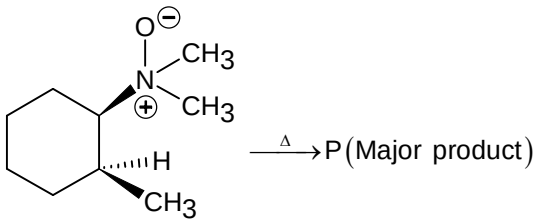
(D)


19. Beryl $(Be_3Al_2Si_6O_{18})$ is a silicate. The number of oxygen atom of structural unit of SiO_4^{4-} shared with neighbouring unit in Beryl are:

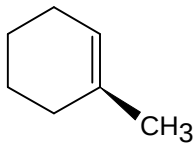
(A) 1 (B) 2
(C) 3 (D) 4

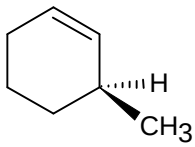
20. Which of the following statements is incorrect?

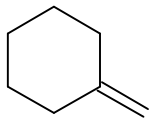
(A) Glycerol (1 mole) on reaction with periodic acid (2 moles) yields formaldehyde and formic acid
(B) Glycerol on dehydration in presence of conc. H_2SO_4 yields unpleasant smelling compound
(C) Oxidation of glycerol with conc. HNO_3 gives mainly glyceric acid
(D) Glycerol on heating with large excess of HI produces allyl iodide

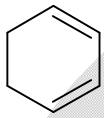
21. 

P is

(A) 

(B) 

(C) 

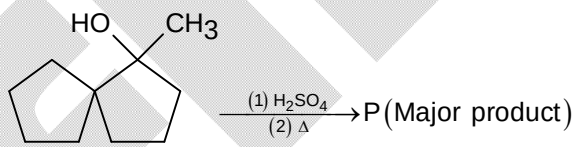
(D) 

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

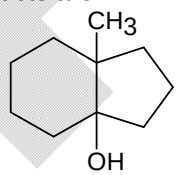
*This section contains **THREE (03)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).*

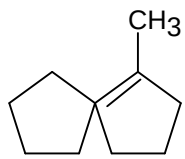
22. Consider the following cell:
$M(s) \mid MX_2(s),\ X^-(0.2\ M) \parallel M^{2+}(0.01\ M) \mid M(s)$
The EMF of the cell at 298 K is 0.236 V
($MX_2(s)$ being the sparingly soluble salt):
Pick out the correct options of the following:
(A) The solubility product of MX_2 is $2.0 \times 10^{-11}\ M^3$
(B) The solubility of MX_2 in 0.2 M X^- is 1.0×10^{-10} M
(C) The solubility product of MX_2 is $4.0 \times 10^{-12}\ M^3$
(D) The solubility of MX_2 in pure water is 1.0×10^{-4} M

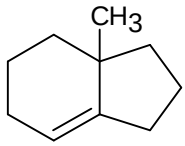
23. Which of the following pairs consists of ore of same metal and both are oxides?
(A) Haematite, Magnetite
(B) Anglesite, Cerrusite
(C) Bauxite, Corundum
(D) Cuprite, Cassiterite

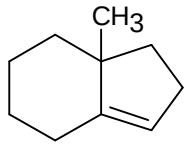
24. 

Products are

(A) 

(B) 

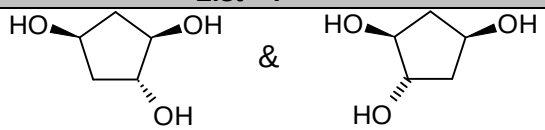
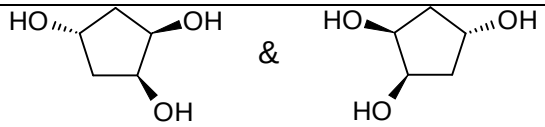
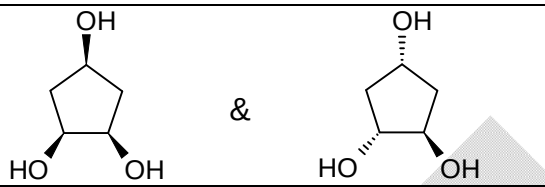
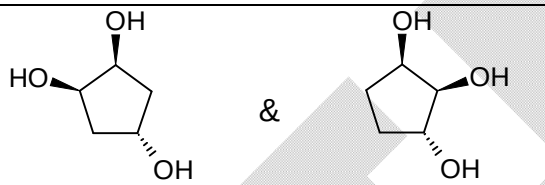
(C) 

(D) 

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)		(1)	Identical
(Q)		(2)	Diasteromers
(R)		(3)	Enantiomers
(S)		(4)	Positional isomer
		(5)	Same magnitude of optical rotation

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

26. Match the following

List – I (Solution)		List – II pH (at 25°C)	
(P)	50 mL of 0.5 M NaOH + 25 mL of 1 M $CH_3COOH(pK_a = 4.74)$	(1)	8.4
(Q)	100 mL of 0.1 M aq. $HCO_3^-\left(pK_{a_1} = 6.4, pK_{a_2} = 10.4\right)$	(2)	9.1
(R)	50 mL of 0.1 M HCl + 50 mL of 0.2 M $NH_4OH(pK_b = 4.74)$	(3)	9.3
(S)	100 mL of 0.1 M $NH_4OH\left(K_b = 2\times10^{-5}\right)$	(4)	7
		(5)	11.2

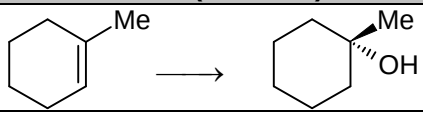
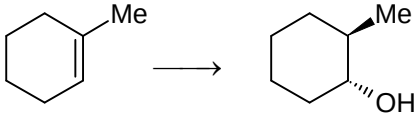
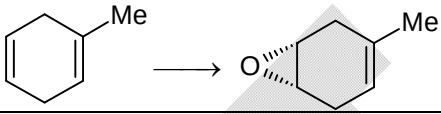
(A) P→4; Q→1; R→3; S→2
(B) P→2; Q→1; R→4; S→5
(C) P→4; Q→3; R→1; S→5
(D) P→2; Q→1; R→3; S→5

27. Match the following

List – I		List – II	
(P)	$Ti(NO_3)_3$	(1)	Lewis base
(Q)	$(SiH_3)_3N$	(2)	Oxidizing agent
(R)	$SnCl_2$	(3)	Reducing agent
(S)	$(CH_3)_3N$	(4)	$p\pi - p\pi$ overlap
		(5)	$p\pi - d\pi$ overlap

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

28. Match the following transformation with suitable reagent.

List – I(Reaction)		List – II(Reagent)	
(P)		(1)	mCPBA
(Q)		(2)	(i) $Hg(OAc)_2$, H_2O (ii) $NaBH_4$ / OH^-
(R)		(3)	H_2O_2 / OH^-
(S)		(4)	(i) B_2H_6, THF (ii) H_2O_2 / OH^-
		(5)	B_2H_6 / CH_3COOH

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

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. What is the total number of correct statements in the following?
(A) Antiseptics are applied to living tissues.
(B) Aspirin is non-narcotic analgesic.
(C) Disinfectants are applied to inanimate.
(D) Aspartame is an artificial sweetener.
(E) Aspirin is acetyl salicylic acid.
(F) Insulin is a co-enzyme.
(G) Aluminium hydroxide is an antacid.
(H) D.D.T. is non-biodegradable pollutant.

30. If P, Q, R, S is the total number of unpaired electrons in t_{2g} or t_2 set of orbitals in $K_3[Fe(CN)_6]$, $[FeCl_4]^{2-}$, $[Fe(H_2O)_6]Cl_3$, $[FeF_6]^{4-}$ respectively, then what is the value of 'P + Q + R + S'?

31. If closed vessel contains 5 g of ice at $-10^{o}C$, then how much heat in kJ must be added to convert it into steam at $205.56^{o}C$

[Given: Specific heat capacity (ice) $= 2.00\ J/g^{o}C$

Specific heat capacity of water $= 4.18\ J/g^{o}C$

Specific heat capacity of steam $= 1.8\ J/g^{o}C$

Enthalpy of fusion of water = 333 J/g

Enthalpy of vaporization of water = 2439 J/g

32. The freezing point 0.08 molal $NaCO_3$ is $-0.372^{o}C$. Calculate the percentage of HCO_3^- ion that transfer H^+ ion to water. Assuming 100% ionization of $NaHCO_3$. K_f of H_2O = 1.86 K mol/lit

33. NaOH and Na_2CO_3 mixture require 15 ml of $\frac{N}{20}H_2SO_4$ solution using phenolphthalein as indicator. But the same amount of solution when titrated with methyl orange as an indicator 20 ml of same acid. Calculate amount of NaOH in milligram.

34. 10 gram mixture of CO and CO_2 reacted with excess of I_2O_5 and liberated I_2 required 100 ml of $\frac{M}{2}Na_2S_2O_3$. Find the % of CO in mixture.

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. In ΔABC, a is the arithmetic mean and b, c are two geometric means of two positive distinct numbers, then the value of $4^4\left(\frac{\sin^{12}B+\sin^{12}C}{(\sin 2A+\sin 2B+\sin 2C)^4}\right)$ can be equal to

(A) $\frac{1}{2}$ (B) $\frac{1}{4}$
(C) 2 (D) 3

36. A parabola having directrix 2x + y = 3 touches a line x + y = 2 at (3, –1). If focus of parabola is (α, β), then $\alpha + 2\beta$ is equal to
(A) 1 (B) 2
(C) 3 (D) 4

37. Let line x + 2y = 3 intersects a circle S = 0 at A and B. Let point of intersection of tangents to circle at A and B meet at P(3, 5). If S = 0 passes through origin then radius of circle S = 0 is

(A) $\frac{\sqrt{83}}{8}$ (B) $\frac{\sqrt{85}}{8}$
(C) $\frac{\sqrt{79}}{8}$ (D) $\frac{\sqrt{87}}{8}$

38. If y is a function of x satisfies $\frac{dy}{dx}=\frac{y}{x}+\int_1^2 y\,dx$ and f(1) = 2 then $\int_1^2 y\,dx$ is equal to

(A) $\frac{12}{7+4\ln 2}$ (B) $\frac{12}{7-8\ln 2}$
(C) $\frac{12}{7+8\ln 2}$ (D) none of these

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. Which of the following is/are correct?

(A) If A is a n × n matrix such that $a_{ij}=\left(i^2+j^2-5ij\right)\cdot(j-i)\ \forall$ i and j then trace (A) = 0

(B) If A is a n × n matrix such that $a_{ij}=\left(i^2+j^2-5ij\right)\cdot(j-i)\ \forall$ i and j then trace (A) $\neq$ 0

(C) If P is a 3 × 3 orthogonal matrix, α, β, γ are the angles made by a straight line with OX, OY, OZ and $A=\begin{bmatrix}\sin^2\alpha & \sin\alpha\cdot\sin\beta & \sin\alpha\cdot\sin\gamma\\ \sin\alpha.\sin\beta & \sin^2\beta & \sin\beta\cdot\sin\gamma\\ \sin\alpha\cdot\sin\gamma & \sin\beta\cdot\sin\gamma & \sin^2\gamma\end{bmatrix}$ and $Q = P^TAP$, then $PQ^6P^T = 32A$

(D) If matrix $A=\left[a_{ij}\right]_{3\times3}$ and matrix $B=\left[b_{ij}\right]_{3\times3}$ where $a_{ij}+a_{ji}=0$ and $b_{ij}-b_{ji}=0\ \forall$ i and j then A^6B^7 is a singular matrix

40. Let $A = \tan^{-1}(\cot 65^\circ + 2\tan 40^\circ)$; $B = \cos^{-1}\left(\sqrt{3}\sin 80^\circ - 2\sin 50^\circ\right)$ then

(A) $\cos(2B - A) > 0$
(B) $\cot(A + B) > -1$
(C) $\sin(2A + 3B) > 0$
(D) $\tan(2A - B) > 1$

41. Let $A_1, A_2 ..... A_7$ be a polygon and $a_1, a_2 ..... a_7$ be the complex numbers representing vertices $A_1, A_2 ..... A_7$. If, $|a_1| = |a_2| = ... |a_7| = R$, then $\sum_{1\le i<j\le 7} |a_i + a_j|^2$

(A) greater than $30R^2$
(B) has minimum value as $35R^2$
(C) has its minimum value in $(25R^2, 45R^2)$
(D) is less than $45R^2$

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.*

42. A variable plane cuts the x, y and z-axes at the points A, B and C respectively, such that the volume of the tetrahedron OABC remains constant equal to 32 cu units and O is the origin of the co-ordinate system, then match the Column-I with Column-II

List – I		List – II	
(P)	The locus of the centroid of the tetrahedron is	(1)	$xyz = 24$
(Q)	The locus of the point equidistant from O, A, B and C is	(2)	$(x^2 + y^2 + z^2)^3 = 192xyz$
(R)	The locus of the foot of perpendicular from origin to the plane is	(3)	$xyz = 3$
(S)	If PA, PB and PC are mutually perpendicular, then the locus of P is	(4)	$(x^2 + y^2 + z^2)^3 = 1536xyz$
		(5)	$x^3 + y^3 + z^3 = 3xyz$

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

43. If $f(x) = \left|\left|1-x^3\right| - \left|x^2-1\right|\right| + \left|1-x^2\right| + \left|x^3-1\right|$; then

List – I		List – II	
(P)	Number of points of non-differentiability of f(x) is	(1)	1
(Q)	x = a is point of local minimum, then a is	(2)	3
(R)	Area bounded by f(x) in first quadrant is A sq. units, then 2A is	(3)	2
(S)	$\lim_{x\to 1} \frac{f(x)}{\left\|1-x^2\right\|}$ is	(4)	4
		(5)	5

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

44. Match the following :

List – I		List – II	
(P)	Let f(x) is cubic polynomial such that f(1) = 1, f(2) = 2, f(3) = 3 and f(0) = 36, then $\lim_{x\to\infty}\frac{f(x)-x}{x^3}$ is	(1)	$\frac{1}{12}$
(Q)	$\int_{-1/2}^{1/2}\left(\cos^{-1}(x+x^3)+\sin^{-1}(x^3)\right)dx$	(2)	–6
(R)	The value of $\int_0^{\pi/4}(\cos 2x)^{9/2}\cos x\,dx$	(3)	$\frac{\pi}{2}$
(S)	$\lim_{x\to\infty}\left(\sqrt[4]{x^4+3x^3}-\sqrt[3]{x^3+2x^2}\right)$	(4)	$\frac{\pi}{4}$
		(5)	$\frac{63\pi}{512\sqrt{2}}$

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

45. Let C_1: $x^2 + y^2 = 9$ and C_2: $x^2 + y^2 + 4x - 10y + 25 = 0$ be two circles. If equation of a fixed chord AB to the circle C_1 be x – 2 = 0 and a variable line PQ where P and Q lie on circles C_1 and C_2 respectively.

List – I		List – II	
(P)	Co-ordinates of a point Q such that area of ΔPAB is maximum is/are	(1)	$\left(-3, 5\pm\sqrt{3}\right)$
(Q)	Co-ordinates of a point Q such that the line PQ is parallel to AB and area of ΔPAB is maximum is/are	(2)	(–2, 7)
(R)	Co-ordinates of a point Q such that line PQ is parallel to AB and ∠BAP = $\frac{\pi}{2}$ is/are	(3)	(0, ±3)
(S)	Co-ordinates of a point P such that the line PQ is parallel to AB and area of ΔQAB is minimum is/are	(4)	(–3, 0)
		(5)	(–4, 5)

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

46. Consider a equation $x^3 - 3x = \sqrt{x+2}$ such that x is a real number then sum of its positive roots is λ where $\left[\frac{\lambda}{2}\right]$ is _____

47. If $\alpha \in (0, 1)$ and f: R $\to$ R and $\lim\limits_{x\to\infty} f(x) = 0$, $\lim\limits_{x\to\infty} \dfrac{f(x) - f(\alpha x)}{x} = 0$, then $\lim\limits_{x\to\infty} \dfrac{f(x)}{x} = \lambda$ where 2λ + 7 is _____

48. Let N be the number of function f: A $\to$ A where A = {1, 2, 3, 4, 5}, such that f({1, 2, 3}) and f(f({1, 2, 3})) are disjoint. Let M be the sum of all the prime factor of N, then the value of $\sqrt{M}$ is equal to _____

49. Let the probability of arranging 8 boys (B_1, B_2, ..., B_8) and 5 girls linearly such that B_1 and B_2 are not together and exactly four girls are together be p, then [99p] is equal to _____ (where [.] denotes the greatest integer function)

50. Let $A = \dfrac{1}{\sqrt{2}} + \dfrac{1}{\sqrt{3}} + ... + \dfrac{1}{\sqrt{10000}}$, then find $\left[\dfrac{[A]}{50}\right]$ _____ (where [.] denotes the greatest integer function)

51. If the quadratic equation $a_1x^2 - a_2x + a_3 = 0$ where $a_1, a_2, a_3 \in N$ has two distinct real roots belonging to the interval (1, 2), then least value of a_1 is _____